1997 Ecosystem Workforce Project Curriculum

A practical learning and resource guide for forest/ecosystem workers

July 1997

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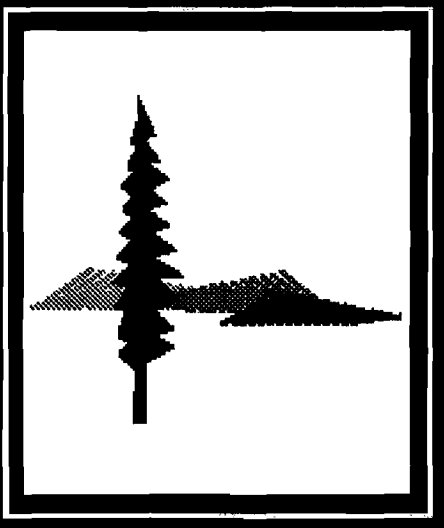

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In late spring of 1995, the Labor Education and Research Center, University of Oregon, in collaboration with OSU Extension Service, Oregon State University, was awarded a three year grant from the Northwest Area Foundation for their innovative project—the Ecosystem Workforce Project (EWP). The Northwest Area Foundation, based in Minnesota, is a private, nonprofit philanthropic organization that awards grants to support projects that advances sustainable development in an eight-state area.

The EWP is an outgrowth of President Clinton's Northwest Economic Adjustment Initiative. The goal of the EWP is to support the creation of a forest/ecosystem industry based on project work design and contracting practices that provide long-term, high-skill, and high-wage jobs for a local workforce.

In late 1995, Flaxen Conway, OSU Extension community outreach specialist, convened an innovative, interdisciplinary team of educators (see page v of the Introduction) from a wide range of educational resources (universities, community colleges, agencies, NGOs, industry, etc.). These educators had expertise in forestry and agricultural sciences, fisheries and wildlife management, watershed management, and forest and stream measurement and survey, worker and equipment safety, and business development and management. This team evaluated existing training materials and used their years of experience and/or research-based information and perspective to develop a new, work-based curriculum revolving around three main sections—Science, Technical and Safety, and Business Management. We consider them the three legs of a stool; all must be sturdy.

Working independently and together, the team created, in four months, the draft 1996 EWP curriculum. It was NOT intended to be the "Sistine Chapel" of curricula. Rather, we have tried to create a product that quickly meets the needs of the transitioning forestry/ecosystem workforce: **a brief, practical, and enjoyable teaching and reference resource.**

The 1996 curriculum was evaluated by worker-trainees and instructors, and revised for 1997. The EWP curriculum will be something that will eventually be used, as is or in conjunction with other efforts, by education providers throughout the region in continuing education or specialized training programs for existing workers, businesses, etc. As such, it is meant to be comprehensive yet remain flexible to accommodate new learning and management techniques, ultimately assisting the learner to comprehend and use new ways to manage ecosystems wisely.

ECOSYSTEM WORKFORCE PROJECT 1997 CURRICULUM

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INTRODUCTION

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Welcome

Welcome to the revised 1997 Ecosystem Workforce Project curriculum— truly a work of cooperation and a work *in progress!*

This curriculum was created with the support of a grant from the Northwest Area Foundation, a private foundation that funds projects to support sustainable development in an eight-state area.

This curriculum, in many ways, is similar to the ever-changing and evolving ecosystem industry. It has been developed through the cooperation of a team of industry, education, agency, and community partners, all working hard to share the latest in science, technology, and business skills (see page v). It is a curriculum that has been born out of the ideas and needs expressed by many of the worker-trainees that participated in previous Ecosystem Workforce Demonstration Projects in 1994 and 1995.

In this 1997 version, we listened to the suggestions of worker-trainees and instructors to improve the 1996 version. In the 1997 version we have tried to capture and share the basic knowledge, skills, and abilities needed to understand and operate successfully in the ecosystem industry. We have tried to create a curriculum that is:

- short and simple, yet thorough,
- easy to read *and* use as a reference,
- practical, flexible, and useful for hands-on learning, and
- provides a balance of background/theoretical information and task specific information that will be helpful for certain tasks.

As such, we encourage the learners and trainers to work as a team, to learn from each other, to communicate with co-workers, and to link classroom learning and field-based learning.

Finally, we must all recognize that as the industry and research evolves, we will continue to listen and learn from each other and make improvements to this curriculum. This is a fun and interesting challenge—remembering that we must continue to learn throughout our lifetimes if we really want to succeed in restoring, enhancing, and managing our ecosystems wisely.

The Goals/Objectives of the EWP

Northwest forests, the forestry workforce, and local forest-based communities are in a period of transition. The emphasis is changing from the harvest of forest products to an "ecosystem management" approach that creates and sustains healthy forests **and** provides economic and social stability for the workforce and local communities. In short, quality jobs and quality ecosystem outcomes.

The Ecosystem Workforce Project (EWP) is an outgrowth of President Clinton's Northwest Economic Adjustment Initiative (NEAI), an initiative that was created to address this transition and provide support to local communities and workers. The goal of the EWP is to train displaced or underemployed forest industry workers for new, higher- and multi-skill jobs in the evolving forest/ecosystem management industry—a holistic approach to forest and natural resource management that invests in rehabilitation and care of the ecosystem in addition to product harvesting.

The objectives of the EWP are to:

- recruit and train former forest workers for high-, multi-skilled, family-wage jobs,
- encourage the design of forest work projects that involves the input and skills of agency/land managers, contractors, and workers in a healthy and productive way,
- introduce new industry practices that emphasize an ecosystem management approach that is good for the environment and for local communities and workers
- and to provide technical assistance and facilitate collaboration among the agency and community partners participating in the NEAI.

This Curriculum

The goal of this curriculum is to create an educational resource that is practical, flexible, and helpful to hard-working, dedicated, lifelong learners in the forest/ecosystem management industry. We recognize that while forest workers have lots of skills to share, they must also be *continually* updating and diversifying their skills to be competitive and competent in this evolving industry. As such, we have created a curriculum that has three core topic areas:

- Science for Ecosystem Restoration and Enhancement
- Technical and Safety Knowledge for Ecosystem Restoration and Enhancement
- Business Development and Management for Ecosystem Restoration and Enhancement

The idea is that in order for forest/ecosystem management professionals to succeed, they must become competent in all three core topic areas. Therefore, in each of the sections in the curriculum there are clear competency measures for that section that each learner would be wise to read and use carefully. This is the best way to make the most of this curriculum, and to learn from and share with each other.

How the Three Topic Areas of This Curriculum Are Innately Connected

Like the evolving forest/ecosystem management industry—a holistic approach to forest and natural resource management that invests in rehabilitation and care of the ecosystem in addition to product harvesting—the three core topic areas of this curriculum are innately connected.

This is true *within* the core topic areas. For example, in the "science" topic area, there is a relationship and interconnectedness to a management activity or practice on the upslope of the forest (i.e., road building) and the function or processes going on in the stream or riparian area (i.e., habitat for salmonid resting and feeding). Another example would be in the "business" topic area, where a business or technical activity or practice (such as keeping good records) is innately connected to a contracting activity or practice (such as knowing the best way to develop and manage a bid on a contract).

This is also true *between* the core topic area. For example, a forest worker/contractor may have a strong grasp of forest ecology and know the latest skills and techniques in wildlife management ("science"), but if this person doesn't know how to run a legal and profitable business ("business"—keep good records, use good communication and employee management skills, and submit and manage realistic bids), they're not likely to be competitive or succeed in the forest/ecosystem industry in the future.

So, like ecosystem management itself, where someone may talk about one component or function (land measurements or surveys, contract requirements, or local stream flow patterns) at a time, it is important to recognize that all parts are interconnected. Keep this in mind as you work your way through this curriculum, an Ecosystem Workforce Demonstration Project, working for a local contractor, or marketing your contracting business to a local land manager.

How to Use This Curriculum

After listening to worker-trainees in former Ecosystem Workforce Demonstration Projects and local industry contractors, this curriculum was created specifically to be a practical, flexible educational tool for hands-on learning. It's hard to be thorough, yet keep it short and simple...but that's what we've tried to do. We believe you'll find the format and the information interesting and helpful, both to read and use during the training and as a reference later.

Industry professionals have said that it's hard to find good, multi-skilled workers who are or soon will be leaders in their field. They say this takes someone who understands the balance of background/theoretical information and task specific information that will be helpful for certain tasks.

As such, we encourage you to work and learn as a team. Learn from each other—everyone is a teacher and a learner! Communicate with co-workers, and link what you've learned in the classroom or field-based training to what you're doing out on a job site.

At the beginning of each part of each section there are clear competency measures for the topic discussed. **So before you read the section or attend the training session on that topic, think about what you need to do in order to, *in your own words,* do the following:**

1) List the five to ten basic core concepts of this topic,
2) Describe their uses in a possible forest/ecosystem restoration project,
3) Demonstrate that you understand and know how to safely use equipment related to performing tasks related to this topic,
4) Say why this topic is important for ecosystem management and stewardship,
5) Say why this topic is important for land owners/managers, and
6) List the sources of support/assistance/reference for this topic.

One last thing: Remember that the only stupid question is the one not asked. So, over the months and years, in order to keep learning and improving, it's important to know who to connect with and where to find more information. Therefore, at the end of each section is a listing of resources for further training and certification as related to the topic.

How to Deliver This Curriculum to Learners

For those of you who are playing the trainer role in an Ecosystem Workforce Demonstration Project, or some other training for forest/ecosystem industry workers, please consider the following:

- Remember what the worker-trainees told us: Keep it practical and simple. Don't talk over our heads or shove too much down our throats!
- Design training sessions that take place in the classroom *and* in the field.
- Provide a balance of theory and task specific information.
- There's no need to start from scratch. Ask learners what they know already and what they want to learn. Build on strengths and help folks eliminate weaknesses.
- Use this curriculum as is, or use it as a springboard to create a longer, more in-depth training for longer programs.
- In each topic of the three main sections there is a short list of suggested field exercises. Please consider these as suggestions to use as is or to stimulate your individual creativity in developing hands-on educational experiences that maximize learning for a myriad of learning styles.

And lastly, don't hesitate to contact any member of the curriculum development team (see the list on the inside cover of this notebook), or other colleagues across the region or nation. There is lots of expertise out there, lots of different perspectives, and networks that can provide support and good ideas. Let's model the behavior and skills we expect from our learners—flexibility, interest, lifelong learning, and communication.

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SCIENCE FOR ECOSYSTEM RESTORATION AND ENHANCEMENT

WATERSHED PROCESSES AND ECOLOGY

Paul Adams

Introduction

Overview

A watershed can be a useful setting for understanding and using scientific concepts in ecosystem restoration and enhancement work. Although a watershed can be smaller or larger than many ecosystems, watershed features and processes often strongly affect the local ecosystems that overlap and also how these ecosystems can be managed. This is especially true in managing water resources like fish and the aquatic ecosystems they are part of.

In this section, we will describe what a watershed is and how different watersheds can be identified. Important watershed features like climate, geology, and soils will be discussed. The hydrologic cycle and other key watershed processes also will be described. Stream channels and riparian areas, which are often the focus of watershed restoration and enhancement projects, will be discussed in some detail. Both physical and ecological characteristics of these unique areas will be highlighted, which will help students better understand why and how watershed and other ecosystem management projects are now being prescribed and conducted.

How this topic fits in

Each major science topic that follows (i.e., forest ecology, forest management, wildlife management, and watershed management) contains some topics where a basic understanding of watershed features and functions (e.g., climate, geology, soils, hydrology, and ecology) can be very useful. This section provides some especially helpful background for the training in watershed management, which emphasizes water resource and aquatic ecosystem restoration and enhancement.

Watersheds also are an ideal way to introduce the important ecosystem concept of "connectivity," which stresses the important (and sometimes overlooked) links between different parts of the environment. An understanding of these links is essential to deal effectively with such current concerns as declining numbers of salmon, which have a very extensive and complex life cycle. Many different locations, people, and practices may need to be involved to improve fish populations, and watersheds can help focus our efforts.

Competency measures

After completing the Watershed Processes and Ecology section, students should be able to:

- Explain in general terms what a watershed is, and identify the approximate location of a watershed on a topographic map
- Generally describe an example of how a difference in climate, geology, landform, and soil can each affect streamflow characteristics
- List and generally explain the major parts of the hydrologic cycle, and how a change or difference in each part can affect streamflow
- Describe in general terms how streamflow can vary seasonally and during extreme events, and generally explain the concept of a return interval
- Generally describe some important physical, chemical, and biological water quality characteristics
- Explain in general terms the processes of surface erosion and mass movement
- Generally describe several major physical stream channel features and processes
- Explain in general terms some of the most important physical characteristics and functions of riparian areas
- Describe the major components of organic matter dynamics, including the major sources and their timing during the year
- Outline the major functional groups of macroinvertebrates and give a general description of their life-histories
- Know the basics of a benthic index to biological integrity, and be able to collect samples for determining the Index of Biological Integrity
- Know the major species of salmonids found in the Pacific Northwest, and describe their basic life histories
- Be able to make knowledgeable predictions of the effects of particular management activities on the aquatic organisms.

The watershed setting

Identifying watersheds

What is a watershed: definition and terminology

A watershed is an area of land that collects rain and snow and discharges much of it to a stream, river, or other water body. The specific water body of concern is what defines the watershed. Other terms with generally the same meaning as watershed that are sometimes used are basin, drainage, or catchment.

Watersheds in the landscape

Big watersheds like the Columbia River basin are made up of lots of smaller watersheds, including the ones that feed the small streams found at higher elevations. A small or intermittent stream near a ridgetop, for example, may have a watershed of less than 40 acres.

In areas where soils are not too deep and the underlying bedrock generally follows the shape of the ground surface, watersheds can be identified by the local surface terrain. This is because rain and snowmelt that moves either over the ground surface or into the soil will generally follow the lay of the land downhill to the water body. USGS topographic maps can be used to identify the ridges and other high points surrounding the lands that shed water to a particular stream or other water body.

Climate, geology, landforms and soils

Precipitation patterns

Forms and amounts. Most people in Oregon know that rain and snow vary widely in the state. However, many would be surprised to learn how much they vary, even over some fairly short distances. Traveling only about 10 miles west from Corvallis, for example, annual precipitation nearly doubles to over 60 inches.

At high elevations and in many parts of eastern Oregon, most precipitation comes in the form of snow. Snowpacks in these areas are often monitored closely because important river levels can be predicted from the snowpacks. Typically, both snowpacks and rainfall increase with elevation, as well as on west-facing slopes.

Averages, distribution, timing, and intensity. Although "average" rain and snow levels are often talked about, average is not necessarily "normal." That is, only one of every several years may be very close to the long term average, and significantly higher or lower than average rain and snow may be the most common situation.

Most precipitation in Oregon falls from mid-fall to mid-spring, often as relatively low intensity (i.e., low amount per hour) events. Summer thunderstorms occasionally occur in eastern Oregon and at higher elevations, and these can sometimes be of fairly high intensity.

Temperature and humidity

Key patterns. Because it is close to the Pacific Ocean, western Oregon has more moderate temperatures and fewer extremes than the more "continental" climate of eastern Oregon. Higher elevations also show greater temperature extremes. For much of the year, humidity is often highest in western Oregon, but in the summer months the absence of clouds and storms from the Pacific allows for much lower humidity levels.

Role in evapotranspiration. Evapotranspiration is the loss of water to the atmosphere by evaporation from ground, water, and plant surfaces, as well as the pore tissues of plants (i.e., transpiration). This is a key environmental process because large amounts of water can be lost this way both just after precipitation (primarily evaporation) and later in the growing season (primarily transpiration). The net effect of evapotranspiration is a reduction in soil moisture that leaves significantly less water for later plant use and flows to wells and streams, especially over extended periods of dry weather.

Evapotranspiration losses are closely linked to weather: the amount and timing of precipitation that supplies the water available for evaporation, as well as temperature, humidity, and wind conditions that control the rate of evaporation. Some of the highest evapotranspiration losses occur when the weather is sunny, hot, low humidity, and windy, yet recent rains or snowmelt have left plants and soils very moist. The lowest evapotranspiration rates occur either during extended periods of cool, wet, cloudy, and low wind conditions, or when the weather has been hot and dry for so long that there is virtually no additional moisture to be lost.

Geology and landforms

Landforms and elevation. The lay of the land can have a lot to do with how watersheds and ecosystems function. Environmental conditions often differ greatly between valley and high mountain locations. For example, at high elevations, a short growing season, high precipitation, and shallow, low fertility soils are common. And at either location, more subtle changes in local terrain can have important effects on soil, vegetation, streams, etc. For example, in a lowland riparian area, just a few feet of elevation may mean the difference between a regularly flooded or a well-drained soil rooting zone. These and other important watershed and ecosystem characteristics often can be generally identified when both major and subtle terrain features are recognized.

Physical and chemical characteristics. Local rock and mineral types strongly influence the physical and chemical characteristics of the land and water. For example, the porous, layered sedimentary rock found the Coast Range often has weaknesses that contribute to slope stability problems. The rocks in much of Oregon also are relatively young, which enriches the streams with dissolved minerals and makes the water "hard."

Soils

Factors of soil formation. Local soil properties reflect 5 major soil-forming factors: climate, terrain, geology, organisms, and time. An understanding of some key ways each factor can affect soils can help us predict some important local soil conditions from a simple assessment of soil-forming factors.

Important properties. There are many soil properties that can be important in watershed function and management. Among the most important is the capacity for rain and snowmelt to move into (infiltration) and through (permeability) the soil. Also significant are soil texture and depth, which can limit water storage, release, and uptake by plants.

Watershed Hydrology

The hydrologic cycle

An understanding of the hydrologic cycle is vital for effectively managing and restoring watersheds. The cycle shows how water moves into, through, and out of a watershed.

Key components/processes of the hydrologic cycle

precipitation: rain, snow, sleet, hail, and condensation
interception: plant surfaces catch precipitation, which may evaporate
surface runoff: precipitation water that moves over the ground surface
subsurface flow: water that moves under the ground surface
transpiration: soil water uptake by roots, and evaporation through leaves
evapotranspiration: water loss to the atmosphere by interception, evaporation, and transpiration
streamflow: runoff water that flows in defined channels

Role of climate and evapotranspiration

Not surprisingly, when there is more precipitation, there is more water available for plant growth and streamflow. However, where the climate is warm and dry for extended periods (e.g., summer in most of Oregon) and heavy vegetation are present, very large amounts of water may be lost through evapotranspiration, leaving considerably less water for plants and streamflow as warm and dry conditions persist.

Local stream flow patterns

Annual and seasonal flows

Like precipitation, we may hear of average annual flows, but streamflows in Oregon vary much over the year. In areas where rain dominates, flows are usually greatest in the winter months and lowest in late summer and early fall. Where snow is the primarily source of water for streamflows, flows are greatest during snowmelt in spring and early summer, with low flows in late summer and fall.

Extreme flows, return periods

Extreme flows are periods of very high or low streamflow that may cause problems for people and natural resources. If we have some idea of the size and chance that an extreme event will happen, we can take steps to help avoid or reduce problems. A "50-year" flow is the flow level for a given stream or river that, on average, is only expected to happen about once every 50 years. Because these return periods are very long-term averages, though, there is always some chance that a major peak or low flow could be repeated within less time than the average return period.

Local stream flow influences

Many local watershed conditions can affect streamflow. Some of these conditions also can be altered by land use or enhancement practices, resulting in desirable or undesirable streamflow changes.

Watershed area and climate. Just as more precipitation leads to more streamflow, having more watershed area to capture precipitation leads to greater flows. Where climate is fairly uniform, measurements of watershed area can be used to provide reasonable estimates of streamflow.

Plant species and cover. Plants can alter streamflow directly through their effects on evapotranspiration, and indirectly through their effects on soil properties that influence surface infiltration. Trees, for example, generally have higher evapotranspiration rates than other types of vegetation (e.g., shrubs or grasses), so lower overall streamflows are expected from a forest watershed than an otherwise similar non-forested watershed.

Soil infiltration and storage, geomorphology. Soil and terrain characteristics can affect how quickly precipitation water moves to streams. Soil infiltration characteristics determine whether rain or snowmelt moves over or into the soil, with surface duff and soil porosity being very important soil features. Soil depth to bedrock limits how much water can be stored for later release to streams. Not surprisingly, watersheds with steep terrain and shallow soils have streams whose flows change very quickly in response to rain or snowmelt periods.

Land use and management effects, changes over time. Land use and management can affect streamflow through changes in soil infiltration and/or changes in plant cover. Duff removal and/or soil compaction can reduce infiltration and increase surface runoff and rapid water delivery to streams. Timber harvest over a significant proportion of a watershed can increase annual streamflows by reducing evapotranspiration water losses, with flows returning to pre-harvest levels at about the time when regrowth produces a closed forest canopy (i.e., about 20-30 years in western Oregon).

Water quality characteristics

High water quality is important both for human uses as well as fish and wildlife habitat. There are many different water quality characteristics, with some characteristics being more important for certain priority uses or values. Watershed hydrology and other characteristics can have some important effects on local water quality and also on how land use and management may alter water quality.

Natural water quality

Even in areas undisturbed by human activity, streams and other water bodies are not pure H_2O. Certain dissolved, particulate, and biological constituents are common to nearly all waters, although their relative amounts may vary considerably with different watershed conditions.

Physical characteristics

Important physical water characteristics include:
Temperature: very high temperatures can be stressful to many fish, and promote algae "blooms" and disease organisms
Sediment: fine sediment can harm fish spawning and cause water treatment problems

Chemical characteristics

Important chemical water quality characteristics include:
Dissolved oxygen: most fish need high oxygen levels, low oxygen in water often tastes bad and may be less safe to drink
Nutrients: some nutrients (e.g., N, P, K) are needed for the food base for fish, but too much may be harmful to fish, wildlife, or people
Manufactured chemicals: excess amounts may harm fish, wildlife, or people
pH: a measure of acidity, the pH level can affect nutrient, chemical, biological reactions and characteristics of water

Biological characteristics

Organic matter: leaves and other similar material is very important for the aquatic food base, but excess amounts can reduce oxygen levels
Organisms: all waters have some organisms (bacteria, insects, etc.) that are normal and often beneficial, but imbalances or harmful pathogens may cause problems for fish, wildlife, or people

Water quality dynamics

In a given watershed, most water quality characteristics vary over time. Streamflow and weather conditions are among the most important factors that can alter water quality seasonally or over shorter periods. Monitoring water quality usually requires that many samples be taken to accurately assess water quality conditions.

Stream Channels and Riparian Areas

Physical patterns and influences

Hillslope processes

In many ways, a stream channel reflects the uplands that feed it with water and other material. Both individual and multiple processes and events on the surrounding hillslopes can have strong effects on stream channel forms and hydrology. These hillslope processes and events can be very obvious or subtle, but each can be very important to stream characteristics both locally and some considerable distance downstream.

Surface erosion. Surface erosion is the movement of individual soil particles, usually by water flowing over exposed soil surfaces. If rainfall or snowmelt rates exceed the local soil infiltration rates, there is a risk of surface erosion, especially on steeper slopes where runoff water can develop more erosive energy. Some soil types are more susceptible to surface erosion than others, usually because they have low infiltration rates and/or the individual soil particles are easily detached and moved. Most forest soils in the Pacific Northwest have fairly low surface erosion rates, especially when the duff layers are maintained and infiltration remains high.

Mass movement. Mass movement refers to landslides and other types of downhill movement of larger masses of soil and related material (e.g., rock, woody debris). Mass movement is a very important process in many areas of the Pacific Northwest, including the steep terrain of the Coast and Cascade Ranges. Mass movements can rapid and dramatic, while others may be very slow and subtle. Debris avalanches or slides are shallow, rapid movements that are more common in steep, upland areas of thin soils over bedrock. If debris avalanches or slides reach a stream channel, they may become very fluid and change to a debris torrent. These torrents can scour extensive lengths of stream channels, but where they stop they may also deposit much sediment and other debris. In areas of deep, fine-textured soils, large and slow mass movements such as slumps and earthflows may occur. These may only move inches per year, and clues of movement may not be very obvious (e.g., leaning trees, soil cracks). Like the other types of mass movements, they may be important sources of sediment and debris to streams.

Stream channel characteristics

There are many different kinds of stream channels, and stream restoration and enhancement needs and practices can vary considerably among channel features and types. Channel processes are another important consideration, because many channels are active and dynamic and thus may be more or less suitable for certain management practices.

Major channel features and types

Floodplains, levees, and terraces. In lower areas with little slope where valleys have formed or broadened, both large and small streams may have floodplains, levees, and terraces that can interact with the stream. These areas also have soil conditions, vegetation, and other important features that can be unique and different from the nearby, steeper uplands.

Constricted, unconstricted, complex channels. The shape and movement of a stream channel may be constricted by resistant bedrock or large boulders. Where streams are found in deep soils and other easily moved fine material, channels may migrate or become braided (e.g., forming secondary or smaller side channels) over time, especially as flows change. Stream migration in unconstrained settings also often results in greater stream sinuosity, which is the winding or snake-like pattern of a stream.

Channel processes

Erosion and deposition. Most stream channels, especially those in soil and other loose material, have areas of active erosion and deposition of sediment. Stream banks are a common place where some erosion can be seen, especially during high flows. Erosion of stream bed materials also may be important, but less obvious. Areas of sediment deposition are common in most streams, and may be found even near eroded areas. The dynamic and interacting processes of channel erosion and deposition can extend over long distances within a watershed, and also be linked to the hillslope processes described earlier. The success of watershed restoration and enhancement projects may depend on an understanding of these processes and linkages.

Levee, terrace, and delta formation. These features often form near larger streams and rivers in wide, level areas where water has deposited sediment during high flows. Their location and landform often lead to unique soil and vegetation conditions that may be important to consider in restoration and enhancement projects.

Role of channel slope and shape and sediment size. Fast moving water in steeper streams can promote channel erosion, while slow moving water in more level areas can allow for eroded sediments to be deposited. Faster water also allows coarser channel materials to erode and move some distance. When fine sediments (e.g., clays) erode, even slow moving water can carry them over long distances. Eroded sediments can be deposited in the stream channel wherever flows become slower, such as the inside of channel bends or where a stream becomes significantly wider (e.g., unconstrained by surrounding terrain) or less steep.

Riparian characteristics and functions

The many unique features and functions of riparian areas, which are sites of land and water interaction directly adjacent to streams and other water bodies, can be very important to both land and water resources. Some key physical relationships are highlighted and discussed here.

Role of trees: large woody debris

Stream velocity. In small to medium forest streams, trees that fall over into the stream can add substantial roughness or steps to the channel that reduce the speed and erosive energy of the flowing water. This can be especially important in streams that lack boulders or bedrock to absorb energy.

Channel morphology. Where significant amounts of large woody debris exist in stream channels, there is often a wide diversity of channel features such as pools, glides, riffles, and cascades. The physical barriers and velocity changes from woody debris dams often result in sediment and organic matter storage as well as downstream scour pools. A wider diversity of fish species, as well as higher overall fish production is often found where there is abundant channel diversity, food storage, and cover from woody debris.

Role of vegetation: canopy

Shade and water temperature. Trees and other riparian vegetation almost completely shade many small to medium forest streams. Because direct sunlight can rapidly warm stream water, such shade can help maintain the cool water temperatures that are desirable for most fish and other water resource values.

Transpiration and water quantity. Riparian trees and shrubs like willow and alder can have very high transpiration water losses because of their heavy water uptake from moist, riparian soils during periods of warm weather. In some smaller streams, this may result in reduced low flows in summer.

Role of vegetation: duff and roots

Infiltration. Most forest soils have some duff (dead and decomposing leaves, twigs, etc.) on their surface, and productive riparian areas may have substantial accumulations. Duff can be very important in enhancing the infiltration of rain and snowmelt into the soil, thereby reducing erosion problems.

Bank stability. The root systems of riparian trees and other vegetation can be strong and extensive. Along stream banks of loose soil, these roots may be very important for soil stability and erosion resistance. They may also help create overhanging banks that provide valuable fish habitat.

Soil characteristics and site stability

Infiltration and permeability. Riparian soils are often rich in organic matter, which contributes to porosity and infiltration. On the other hand, some riparian soils have high levels of clay or residual moisture that can limit their capacity to accept additional water during rain or snowmelt.

Water table depth. Riparian soils are often quite moist, and in relatively level terrain the water table (i.e., zone of saturated soil) may be near the surface, especially during wet weather. Only certain tree and other plant species may grow well where there is a high water table, and this condition also may pose some limitations for machine or vehicle traffic as well as the use of management chemicals.

Surface erodibility and slope stability. Because of their proximity to waters that may be readily affected by sediment losses, the erodibility and stability of riparian soils may be an important concern. As mentioned, riparian areas may have wet, fine textured soils, which can be especially susceptible to erosion. These same conditions may lead to slope instability and especially slump failures, sometimes in relation to cutting of streambanks during high flows.

Management relationships

Some management considerations for riparian areas have been mentioned, and the topic will be covered in much greater detail in the upcoming section on "Watershed Management and Enhancement." However, a few major points are emphasized here.

Large woody debris. Historical riparian timber harvesting, agricultural, and stream cleanup (i.e., intentional removal of large woody debris) practices have reduced current and expected future woody debris levels in some streams. Because of reduced fish habitat and other concerns, restoration and enhancement practices are being used to improve habitat with woody debris additions to streams and also to establish desirable riparian tree species for future debris supplies.

Canopy, duff, and roots. The resource benefits of a well-developed riparian canopy, duff layer, and root system have been reduced in some areas of past timber harvest or agricultural land use. Tree planting, livestock fencing, and other practices are being used to re-establish or improve these features.

Soil erosion and stability. In situations of more extreme erosion or stability problems, efforts solely to establish or enhance riparian vegetation may be unsuccessful or provide limited benefits. Supplementary or alternative practices for physical protection such as mulches, riprap (e.g., boulders that absorb erosive energy of flowing water), or rock buttresses (e.g., large rocks placed at the base of slumping soil or streambank) thus may be used in some projects.

Aquatic Biology and Ecology

Streams and rivers are a product of the watersheds that they flow through. We have previously seen that rivers are shaped by the climate, geology, soils, and riparian vegetation. This section focuses on the ecology of aquatic organisms. Emphasis will be

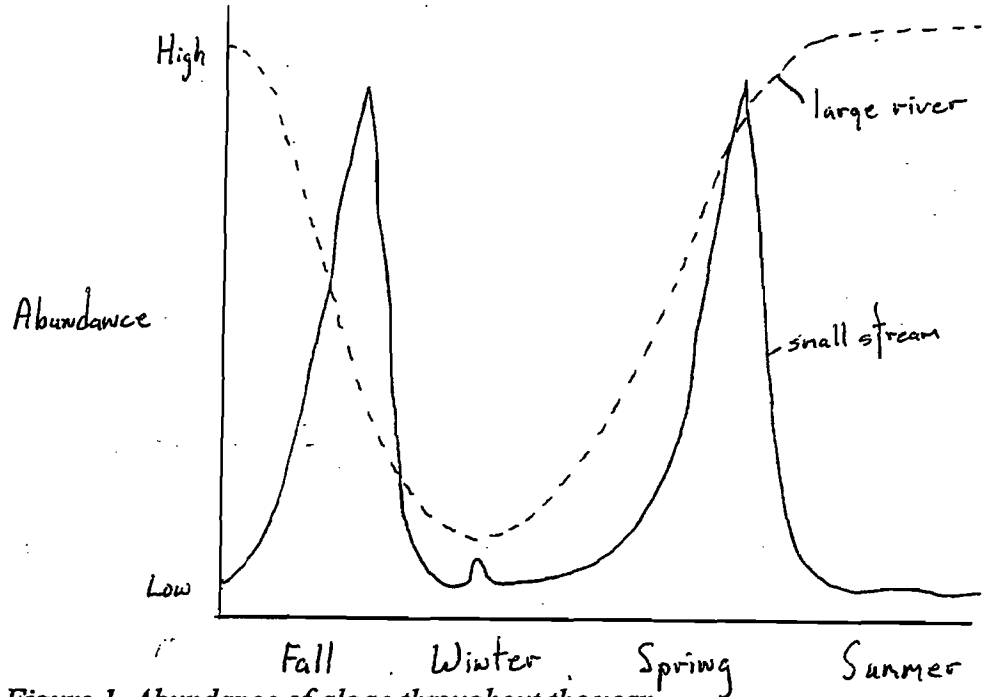


Figure 1. Abundance of algae throughout the year.

placed on the organic matter dynamics within the watershed. Much of the emphasis of restoration in this region has been on the physical aspects such as physical habitat, however, attention must be equally placed on the food relationships or we will have no increase in fish production in many streams. If we do not understand how the food resources ought to work in the watershed, it is unlikely that our restoration efforts will be successful. If we only focus on putting large wood in pools, it is unlikely that we will restore the organic matter dynamics within the river system.

Organic matter dynamics

(**Note:** Organic matter dynamics refers to the movement of living material through the ecosystem. For the purposes of this chapter, it is closely related to the aquatic food chain. The food chain focuses on the relationships among the organisms, while the organic matter dynamics focuses on the movement of material through the organisms.)

Organic matter dynamics is one of the basic components of the ecosystem. The great majority of organisms depend directly or indirectly on green plants for their sustenance. For example, salmon and trout in the Pacific Northwest rivers are indirectly dependent on the green plants. The fish feed on aquatic insects which feed on the plants. The amounts and kinds of food annually available determine how productive a stream system can be. However, as we will see in a later section, the retention of this material in the stream section is crucial. If it is not held long enough to be utilized by the organisms, it is not of benefit. Not only is the amount of food resources important but the timing is equally important.

Sources of organic matter. In streams and rivers there are three sources of food which drive the aquatic portion of the ecosystem: algae, organic matter from the watershed, and salmon carcasses. These three sources provide the material and energy

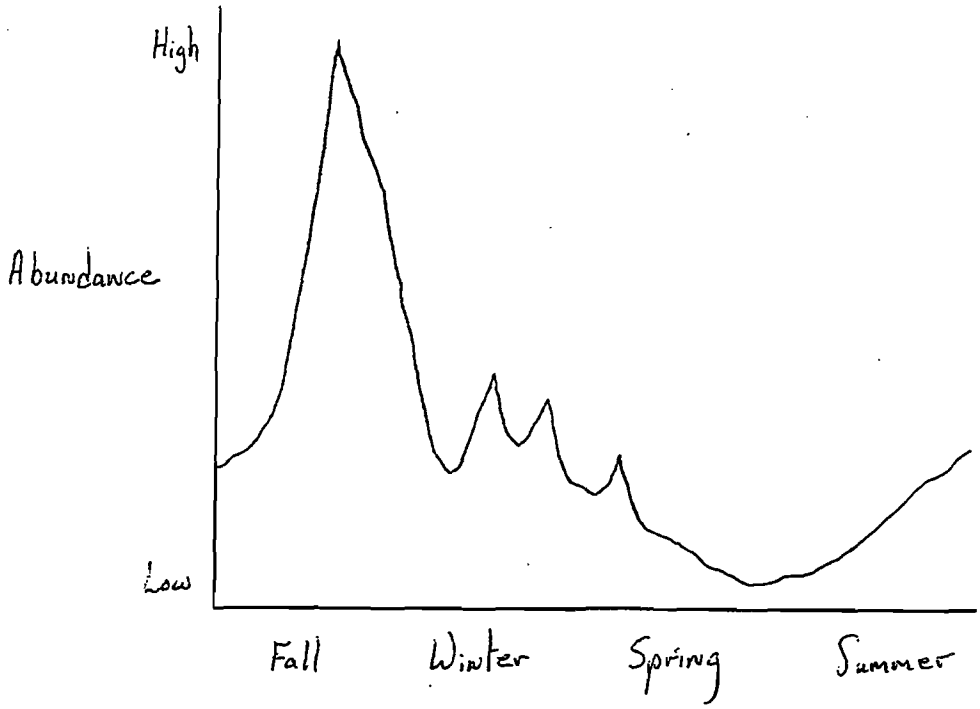


Figure 2. Abundance of leaves throughout a year.

which will support the organisms through their next generation. Each source of food has its own unique characteristics and timing, so they are not interchangeable. We cannot simply replace one source with another.

Freshwater algae. Algae is one of the major sources of food within stream systems. In streams, it usually appears as a thin brown film on the bedrock, rocks, gravel, and logs within the system (Diatoms). It is algae which makes rocks slippery to walk on. Sometimes the algae appears as long green threads.

Algae is high quality food when it is available. However, it is not abundant throughout the year. In fact, in the stream system of the size we are most interested in, algae is most abundant during two short periods during the spring and fall. It is abundant prior to leaf out of the riparian vegetation, especially alders, and it is abundant after leaf fall in the fall. Algal production is low during the summer in streams which have closed canopies. This is particularly true of our second growth streams which are dominated by alders. In larger stream systems with a more open canopy, algal production is highest during the summer. In the Pacific Northwest, production is also low during the winter. Stream temperatures and light levels are low, and the storms scour the algae off the rocks.

Organic matter from the watershed. The second major category of food resources within the stream system is the food obtained from the watershed. This includes leaves, needles, twigs, logs etc. In the tributary streams that we are primarily interested in, this source of food may represent over 90% of the total food resources available for the stream during the year. The quality of this food varies from high to low, and it enters the stream systems at varying times throughout the year.

Leaves are probably the most important single source of food within this category. Most leaf litter is high quality. While most of it enters the streams during the fall, there

is considerable leaf fall during the summer. In old-growth riparian zones, big-leaf and vine maple predominates, while in second growth riparian zones, alder predominates. The maples are high quality leaves which are rapidly colonized by fungus and available for organisms. Alder are high quality food; however, alder has a thick cuticle on the leaves which must decompose before the leaves can be colonized by the fungus. Consequently, alder is not available to organisms as quickly as the maple leaves are.

Most leaf litter comes from the riparian zone along streams, but some of it also comes in during debris flows and torrents. Also, with large winter storms, new sources of leaf litter in ephemeral channels (which only flow during large storms) and intermittent channels (which flow for about 6 months of the year) and in other areas of riparian zone are tapped as the water levels rise. With each larger storm, a new supply of leaves from the watershed is brought into the stream system. This storm has the capacity to flush the leaf litter out of the stream system. The retentive capacity of the stream channels determines how much of the leaf litter can be kept within the stream system. The timing of this storm determines how long this food source is available to the organisms in the stream.

Needles from conifer trees are also an important source of food for the stream systems. Needles from Douglas-fir come in throughout the year, but needle fall during summer is important for the stream system, as other sources of food are scarce. Large quantities of needles enter streams during major wind storms. Needles are medium quality food.

Wood, ranging in size from twigs to logs, is also a food source in the stream system. Most wood comes in during fall/winter storms with high wind. The larger pieces come in largely from root-throw. Wood is generally abundant but a poor source of food. There are a few aquatic organisms which feed on wood.

Salmon carcasses. Most of the growth of the salmon occurs in the ocean, so their return and subsequent dying brings nutrients and food from the ocean back into the stream systems. This is high quality food. Historically, this may have been the dominant food source for many of our streams. Some macroinvertebrates (aquatic insects and other invertebrates that are visible to the eye) eat salmon directly while much of the salmon flesh enters the food web by other means.

Retention of organic matter. The amount of organic material which enters stream systems is only one of the important ecosystem measures. The other major factor is the retention capability of the ecosystem. If a lot of organic material enters a stream system but it is not retained, then little food resources are left for the production of the biological community.

The retention capability of the stream channel is largely dependent on how many "sticky wickets" are in the channel. Some of the most important retention features in the channel include: log jams, branches, which are held in place by large wood or boulders, and willows.

A major feature of retention in streams is its dynamic nature. For example, jams may come apart in a storm and move a short distance and set up again. This pulses material a short distance downstream. In many Pacific Northwest streams this is the major way material is retained within the stream channel.

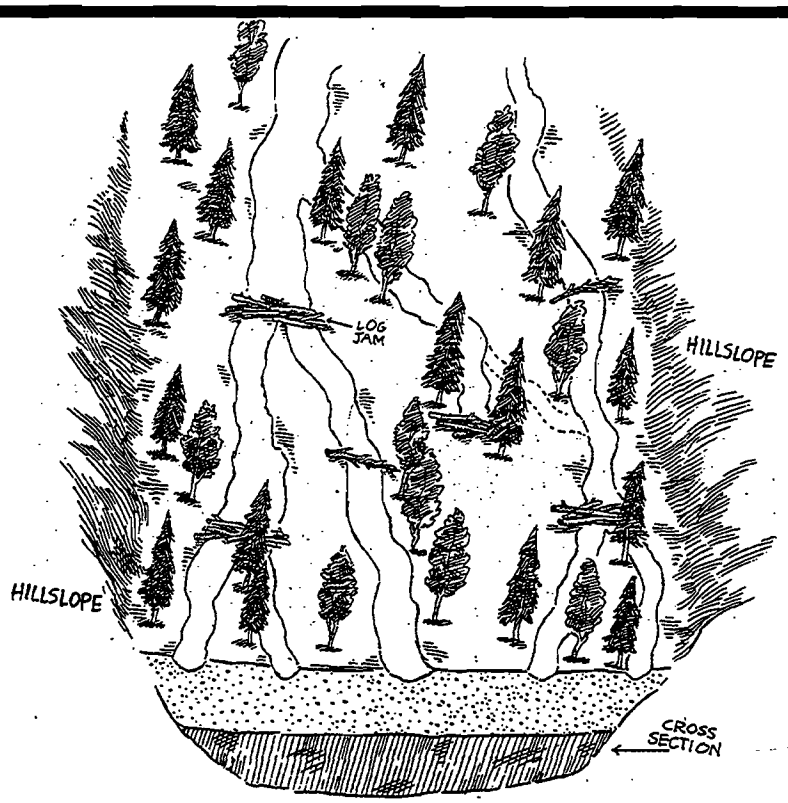


Figure 3. Stream channel "connected" to valley floor.

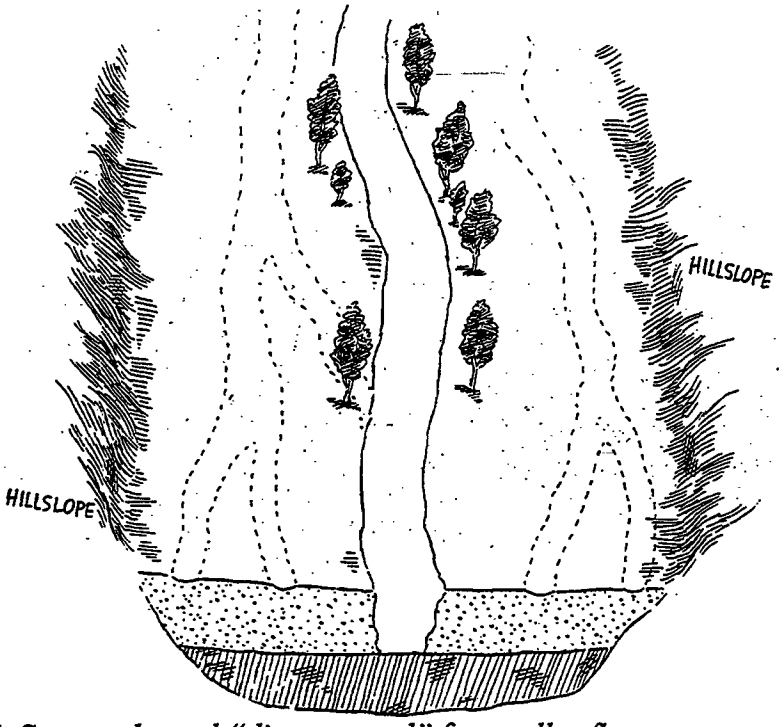


Figure 4. Stream channel "disconnected" from valley floor.

A large part of the retentive capacity of the watershed is on the valley floor. Stream channels which are highly "connected" to their valley floors are highly retentive. This is especially true of valley floors which themselves have a lot of "sticky wickets."

Streams which are largely disconnected from their valley floors have little retention capability.

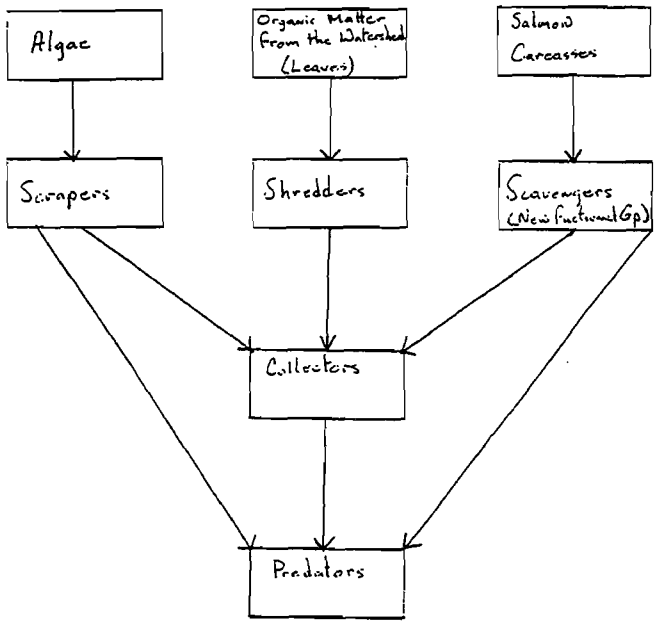


Figure 5. Function groups of aquatic macroinvertebrates. (Adapted from published work by K.W. Cummins.)

The aquatic food chain: a functional view. Stream ecologists have devised a functional classification scheme for the macroinvertebrates which identifies how the organisms obtain their food. This scheme aids in the understanding of how invertebrate communities are structured and how they function.

Shredders make their living by shredding leaves.

Scrapers make their living by scraping algae off the rocks.

Collectors make their living by collecting small particles of organic matter. Some collectors "fish" the stream currents for food, while others gather it from the bottom of the stream.

Scavengers have only recently been identified as a functional group. The macroinvertebrates in this group have not been identified adequately.

Predators eat members of all the other functional groups.

The life histories of the macroinvertebrates are predictable from the physical setting of the watershed and from the dynamics of their particular source of food. For instance, shredders begin their life history in the fall. They do most of their growing in fall and winter. Scrapers do most of their growing during the spring and fall. Some scrapers have two generations per year.

"Digestion": the movement of food resources through the stream system. The abundance and movement of organic matter follows a predictable pattern from the headwaters to the mouth of a stream system (Vannote et al. 1980). This pattern is analogous to digestion. The organic matter must enter at the right time and the right place. The movement and changes in these resources must also follow the pattern or the whole system is disrupted below where the disruption occurs. In general, there is a decline in food size from the headwaters to the mouth of rivers. Food quality also generally declines from the headwaters to the mouth of rivers, as the food is repeatedly

gested by macroinvertebrates. Therefore, the further downstream you head the greater the amount of food that becomes small, low-quality food.

The retention capability of each reach determines a great deal of the organic matter dynamics.

There are also predictable changes in the functional group of the macroinvertebrates from the headwaters to the mouth. For instance, the proportion of shredders is high in the headwaters and declines downstream. Scrapers are relatively rare in the headwaters, and they generally increase in abundance as the streams get wider and there is more algal production. The proportion of scrapers also decreases as the rivers get larger and deeper, which greatly decreases the amount of algal production.

Collectors generally increase in proportion from the headwaters to the mouth of rivers. In large rivers, the organic matter in transport is small size and generally low-quality food.

Narrative of the annual cycle of organic matter dynamics (optional). A major part of the focus will be on the macroinvertebrates which are the food source of the salmonids. The year begins October 1st. The streams are at low-flow and the amount of organic matter in the stream is low but increasing. The fall brings an increase in stream flow and an increase in leaf inputs to the stream. Many aquatic insects begin their life cycle at this time to utilize the food which is increasingly abundant (for instance, Shredders).

By mid-November, streamflows have greatly increased, and leaf fall is in full swing. As the leaves fall, algal production greatly increases, as the sunlight hitting the stream increases. The adult salmon begin to return to the rivers to spawn and die. This is the time during the year of maximum food availability. The first major storm of the year usually occurs in the Pacific Northwest around Thanksgiving. During this storm, food resources crash. Most of the leaf litter is transported downstream and much of it is deposited far downstream out of the stream channel or buried in the sediments. Salmon carcasses also suffer the same fate. Algal abundance drops as the high flows sand-blast the algae off the rocks and gravels.

The key to maintaining the productivity of the stream is retaining the organic matter within the stream system. Without the retention capability of the system, the food resources are moved rapidly into the estuary. The most retentive stream reaches are those which are connected to their flood plains. These reaches are characterized as being intimately connected to their valley floors. There are no steep banks. If the water comes up a few inches or a foot, water begins to flow in other channels throughout the valley floor.

Organic material is also retained on the valley floors. In a connected reach, the water quickly begins to flow all across the valley floor. Jams, downed wood, and trees all help retain material from being swept downstream. During later storms, the stream can move some of the material stored on the valley floor into the stream channels.

Sometimes during the winter, there are periods without major storms. During this time, algal production can get quite high even though the stream temperatures are near freezing.

With the coming of spring, the floods decrease and algal production greatly increases until the alders begin to leaf out. This is a very productive period of the year. Many of the macroinvertebrates complete their growing during this time and hatch. This is also a time of rapid growth for the salmonids as they feed on the macroinvertebrates.

The approach of summer brings a halt to high productivity. The stream flows drop rapidly. Food resources are low as algal production is low, and organic matter and salmon carcasses have been "digested" or transported downstream. The juvenile salmonids rely heavily on insects from the riparian zone to make it through the summer.

Major points in the annual cycle

- The fall-winter period is the most active ecologically, and the annual organic matter dynamics are usually determined during this period.
- The timing and size of winter storms greatly affects the annual organic matter dynamics.
- Very little is happening in streams during the summer. Most aquatic organisms are not very active in the summer.

The Life History of Common Salmonids in the Pacific Northwest

The salmonids share a common life history. The adults spawn in streams by burying their eggs in nests called redds. The sites selected depend on the species. They generally spawn in "tail outs" at the end of pools. These are the areas where a pool becomes shallow as it begins to enter a downstream riffle. The eggs remain in the gravels for a month or more. The young fry then make their way up into the stream channel. This is a crucial stage for salmonids. Most of the fry die in the first month. Food abundance plays a crucial role at this stage. Predation by fish and birds is also high. The young then grow to adults. Some salmonids have an ocean stage. Sometimes young from the same parents have different life-history strategies. For instance, from the same redd some young may go to the ocean, while others do not.

In general, where all species are found, they tend to separate themselves as follows: (see Figures 6 and 7) Chum salmon spawn the lowest within the river system. Chinook spawn in the mainstems and lower portions of tributaries. Coho and Steelhead spawn in the tributaries. And Cutthroat tend to spawn in the highest reaches within the stream system.

Chinook salmon *(Oncorhynchus tshawytscha)*

Chinook or King Salmon are the largest and longest lived of the Pacific Salmon. They often average 20-25 lb. as adults and individuals up to 100 lb. have been reported. They generally live 3-5 years. There are two basic life-histories of Chinook in our area. The first is fall Chinook, which return from the ocean in late-August through early November. They spawn in mainstems and lower reaches of tributaries. The pre-

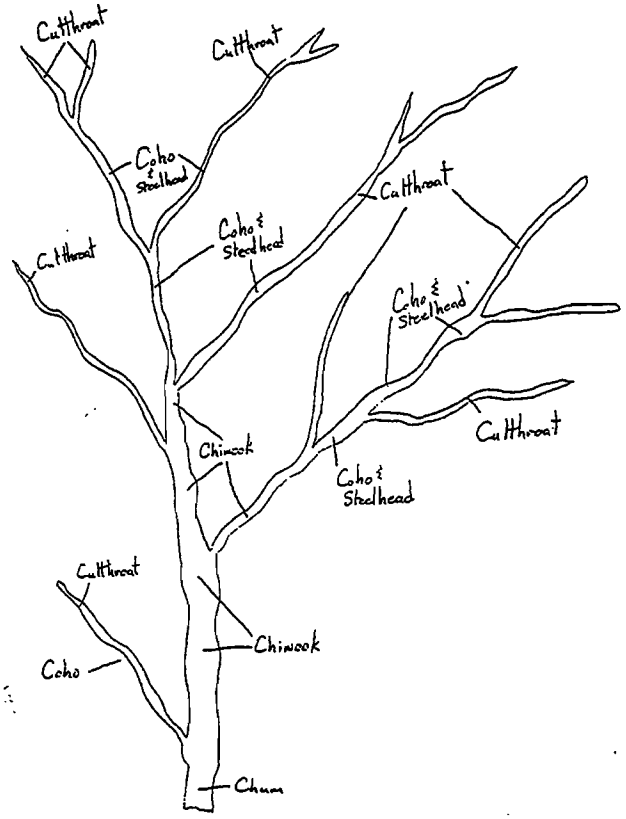


Figure 6. Distribution of salmonid spawning in a generalized basin in the Pacific Northwest.

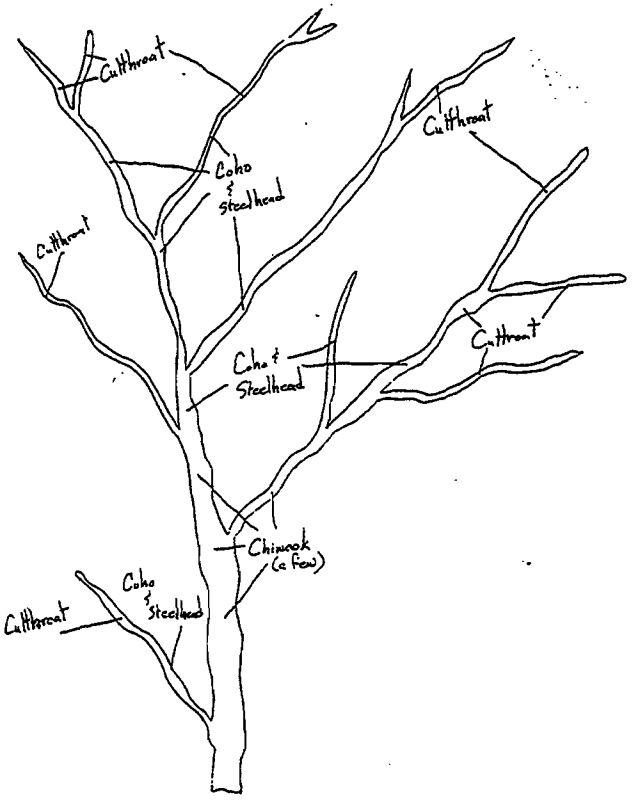


Figure 7. Distribution of salmonid rearing in a generalized basin in the Pacific Northwest.

ferred size of material to spawn in include gravels or rubble up to softball size. Because of their large size, they can bury their eggs deep in the gravels. The eggs are buried deeper than the river channel will scour during many winter storms. However, Chinook are susceptible to having their redds scoured out in a large storm. If a large storms scours most of them out, the lost year class will be replaced in successive generations because chinook spawn from 3-5 years of age. The young of fall chinook emerge from the gravels beginning in February or March. They stay in the streams for only a short period of time. Most of them move into the estuary or lower mainstem river by April or May of their first year. They generally spend the rest of their first year in the estuary and then go to the ocean for a number of years. Spring Chinook return to their rivers in the spring and over-summer as adults. They spawn from summer into fall. The life-histories of the juveniles is quite variable.

Coho salmon *(O. kisutch)*

Coho salmon or silver salmon were probably historically the most abundant salmon on the Oregon Coast. They weigh between 6-12 lb. as adults and they generally have a three year life cycle. Because coho generally spawn at the same age, they are susceptible to catastrophic events. Once a year class becomes rare, it is likely to remain rare for a considerable period of time. Coho generally recolonize areas from source areas of high productivity (flats). They can be rapidly exterminated from a river basin or area of a coast by losing these source areas (flats) which produce high numbers of fish year in and year out.

Coho generally spawn from November to March. There are two tendencies driving their life-history strategy. One is that it is best to spawn early. So, many coho come in on the first major storm of the year, usually in mid-November. When these fish spawn, if they are successful, they have the advantage of getting first shot at the food resources. They also would be the largest individuals, giving them additional survival advantage. However, coho are not as large as chinook, they spawn in smaller gravels, and their redds are not as deep as those of the Chinook. Therefore, they are more likely to be scoured out during the winter storms. Therefore, many coho delay spawning until it is likely that the major winter storms have passed. This may be as late as March or April.

Coho juveniles emerge from the gravels from February through April. Their preferred habitat is pools with slow flow through them or beaver ponds. The juveniles remain in the stream until the following April to June, when the go to the ocean. The adults return a year-and-a-half later.

Chum salmon *(Oncorhynchus keta)*

These are the third most common species of salmon in the Pacific Northwest. They are generally of less interest than coho and chinook, because they spend so little time in fresh water. Most of the adults in our area spawn in the fall. They are usually 3-4 years old and weigh about 11 lbs. Chum spawn in lower river systems just above tidewater. The fry come out of the gravels in the spring and immediately migrate downstream.

Steelhead trout *(O. mykiss)*

Steelhead are seagoing rainbow trout. Adults average about 8 lbs. and are 3-4 years old. The adults return from the ocean in late December through March. Many come in on the largest storm of the year. This allows them to move far up into the headwaters of the streams. Like the salmon, the eggs are deposited in gravels, however, not all steelhead die after spawning. About 50 % survive to spawn again. Most of the young emerge by June. During the first year they live in riffles and along the margins of stream channels. They are territorial, and they defend an area against intruders. During the first summer, droughts can severely impact them. They spend two years in the streams before going to the ocean.

Cutthroat trout *(O. clarkii)*

Cutthroat trout have a variable life history pattern. Some individuals go to the oceans, while others remain in freshwater for their entire lives. Some remain in one portion of stream for their entire lives, others move throughout the river systems. Generally they spawn in spring, and juveniles emerge by June or July. Cutthroat trout are usually the salmonid distributed furthest upstream.

Bull trout *(Salvelinus malma)*

Bull trout are the native char in the Pacific Northwest. Like other chars, they spawn in fall, and the juveniles emerge in late-winter or spring. There life history is quite variable. Few populations of Bull trout are healthy. If they occur in a watershed you are working in, you need to keep their needs in mind. They are very dependent on cold water seeps and springs. They are also very intolerant of fine sediment.

Questions for discussion

- What ecological changes in the stream system would you expect if the riparian timber was removed?
- What changes in organic matter dynamics would you expect with an increase in mass erosion due to poor road construction and timber harvest techniques?
- What effects would an increase in mass erosion due to poor road construction or timber harvest techniques have on each fish species?

Suggested Field Exercises

The watershed setting

Exercise 1. Site assessment

An introduction to some basic references and a checklist of field clues for a preliminary assessment of general watershed conditions, including climate, geology, and soils. Published precipitation maps, soil surveys, and geologic maps will first be used to identify expected watershed conditions. A field checklist will identify vegetation, soil, and

other features that verify expectations from published information, as well as highlight important local conditions that may not show up in maps and other published references.

Exercise 2. Hydrologic measurements

An introduction to methods for estimating streamflow, including the use of floats, stream flow meters, and/or stream-crossing culverts. Basic methods of evaluating soil infiltration, such as ring infiltrometers, may also be introduced as time permits.

Stream channels and riparian areas

Exercise 3. Stream channel survey

An introduction to some procedures for evaluating stream channel conditions that affect or interact with streamflow and channel stability. Channel roughness and other features will be examined and relationships with peak flows assessed. As time permits, a pebble count procedure for evaluating stream bed conditions and potential land use effects also will be performed.

Exercise 4. Riparian area survey

An introduction to survey procedures for evaluating important riparian conditions, including shade/cover, tree type, size and number, snags and down wood, and soils. Procedures used will be consistent with or similar to those used by agencies and industry.

Exercise 5. Aquatic invertebrate survey

In the field, learn the major sampling and sorting techniques for aquatic macroinvertebrates. Also use functional group key provided to identify organisms into their functional groups. (See R.W. Merritt and K.W. Cummins, 1984, *An Introduction to the Aquatic Insects of North America.* (2nd ed). Kendall/ Hunt, Dubuque, Iowa.

Also, collect samples for analysis for J.R. Karrs' *Index of Biological Integrity.* Understand the basic components of the index. See L.S. Fore and J.R. Karr. 1996, *A benthic index of biotic integrity for streams in the Pacific Northwest* (submitted to Journal of the North American Benthological Society).

Exercise 6. Fish counts

Learn the various techniques fisheries biologist use for estimating the numbers of fish at various stages in their life-histories. (Integrate with fish habitat sampling.)

Additional Resources

Principles of Forest Hydrology. J.D. Hewlett. 1982.

(soft cover textbook, ISBN 0-8203-0608-8) Very good introduction to basic hydrology terminology and concepts. Includes excellent line drawings that clarify concepts and are useful for overheads, etc.

Wildland Watershed Management. D.R. Satterlund and P.W. Adams. 1992.

(hard cover textbook, ISBN 0-471-81154-8) Provides a detailed summary of watershed science principles, as well as considerable data, discussion and references related to management concerns. Includes information on land uses other than forest management, such as grazing, recreation, and mining.

Forestry and Water Quality. G.W. Brown. 1980.

(soft cover textbook, ISBN 0-88246-007-2) Addresses specific topics related to water quality, including water temperature, nutrients, chemicals, dissolved oxygen and pathogenic organisms. Emphasizes data and references from the Pacific Northwest.

County Soil Surveys. (various publication dates) USDA Soil Conservation Service (now NRCS). (soft cover books) These provide both general and detailed maps and descriptions of local soil characteristics. They also include management concerns and recommendations for each soil type, as well as climate and geology information.

Forest Soils of the Douglas-fir Region. P.E. Heilman and others, ed. 1979.

(soft cover book available from Washington State University Extension Service) Chapter summaries that not only describe forest soils in the Pacific Northwest, but also climate, geology, vegetation, and forest and watershed management considerations. Includes many summary tables, graphs, maps and photos.

The ecology of running waters. Hynes, H.B.N. University of Toronto Press, Toronto, 1970. 555pp

Streamside Management: Forestry and Fishery Interactions. E.O. Salo and T.W. Cundy. 1987.

(soft cover book published by the University of Washington, Institute of Forest Resources—currently out-of-print, but may be found in libraries, etc.) Includes many excellent chapters that summarize research and other information on diverse aspects of streamside management on forest lands. Includes many graphs, tables, and diagrams that illustrate key concepts.

Freshwater Fishes of Canada. Scott,W.B. and E.J. Crossman. 1973. Fisheries Research Board of Canada, Ottawa, Bulletin 184.

Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. W.R. Meehan, ed. 1991.

(hard cover textbook, ISBN 0-913235-68-7) Many detailed chapters with diverse topics ranging from the life histories of individual salmonid species, to habitat rehabilitation, and economic considerations in habitat management. Includes many tables, graphs, and maps.

Cummins, K.W. 1973. "Trophic relations of aquatic insects." *Annual Review of Entomology* 18:183-206.

Cummins, K.W. 1974. "Structure and function of stream ecosystems." *BioScience* 24:631-641.

Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell, and C.E. Cushing. 1980. "The river continuum concept." *Can. J. Fish. Aquat. Sci.* 37: 130-137.

KEY TO FUNCTIONAL GROUPS
(for use in western Oregon by T.C. Dewberry)

1. Does animal have a shell or house?

Yes:

1. Snail (SCRAPER) 

2. Caddisflies 

A. If caddisfly has a stone or pebble case (SCRAPER)

B. If caddisfly has a leaf or twig case (SHREDDER)

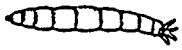
C. If caddisfly spins a net-retreat (FILTER-GATHERER)

NO:

Go to #2

2. Does the animal have legs?

NO:

1) If it looks like this  it is a(SHREDDER).

2) If it looks like this  it is a(COLLECTOR-GATHERER).

3) If it looks like this  it is a (FILTERING-COLLECTO

Yes:

If the animal has 2 tails and no abdominal gills. it is a stonefly. 

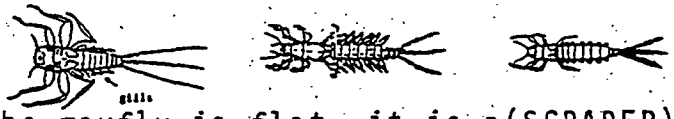
1) If the stonefly is brightly colored (especially has some yellow) and very active. it is a(PREDATOR).

2) If the stonefly is dull brown or black and sluggish. it is a(SHREDDER).

(Continue next page)

(Adapted From published work by K.W. Cummins and others see R.W. Merritt & K.W. Cummins, 1984. An Introduction to the Aquatic Insects of North America (2nd Edition). Kendall/Hunt.

2.(Continued)

If the animal has 2-3 tails and abdominal gills, it is a mayfly. 

If the mayfly is flat, it is a(SCRAPER).

If the mayfly is round, it is a (GATHERER_COLLECTOR).

If it is not a stonefly or mayfly, it is a(PREDATOR).

FOREST ECOLOGY

Stephen Fitzgerald

Introduction

Overview

This section provides the ecosystem worker information and background on forest ecosystems and ecology. An ecosystem is "the total assemblage of living organism together with their non-living environment in a particular area (Kimmins 1992). "A forest ecosystem is a community of plants, animals, and microorganisms and the physical environment they inhabit, in which trees are the dominant life form (Hunter 1990). The study of forest ecology refers to the interrelationships between trees and other plants and other organisms in a given environment (Spurr and Barnes 1973).

Forest ecosystems are dynamic and constantly changing. Change can occur a every level — from the death of single tree to a large-scale stand replacement fire. In fact, in forest ecosystems change is the norm rather than the exception.

Forest ecosystems are complex and we do not fully understand their complexity. Most aspects of ecosystem dynamics occur in cycles. Some cycles include the water cycle (described in the watershed section), nutrient cycle and plant growth and decay cycles. None of these cycles exist by themselves; outputs from one cycle are used as inputs for another. Thus, each cycle is dependent on the other in order to keep the system fully functioning.

I will not be able to discuss each of these cycles in detail. What I intend to do is provide enough information and background so you have a basic understanding of how forest ecosystems work. Specifically, I will address how trees grow and how forest ecosystems are shaped by the disturbance, competition, and succession.

How this topic fits in

Understanding how forests grow and develop provides an important foundation for ecosystem management. Many projects you encounter in the forest will be aimed at restoring or enhancing ecological functions of forest and streams, whether it's placing logs in a stream to improve stream habitat or planting or thinning trees to enhance tree and forest growth.

As you read and learn about watershed, forest, and wildlife management in other sections, you will find that management activities are based upon applied forest ecology concepts. Understanding ecological concepts, therefore, provides a blueprint for manipulating or managing forests for timber, wildlife, recreation, water, and other amenities.

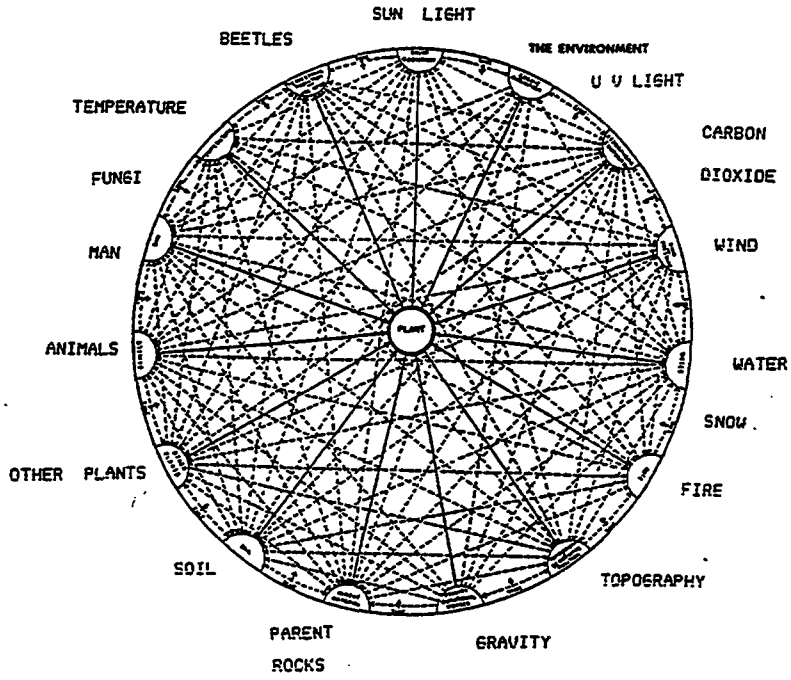


Figure 1. A plant and its environment

Competency measures

At the end of this session, each student will be able to:

- Define forest ecology;
- Describe the process of photosynthesis;
- Understand the differences between shade-tolerant and shade-intolerant trees;
- Describe components of forest structure;
- Describe 3 types of forest disturbance and their effect on forest ecosystems;
- Understand and describe the process of plant succession;

Forest ecosystems are complex

Forest ecosystems are comprised of plants, animals, micoorganisms in a physical landscape. As scientists study forest ecosystems, they continue to find that "all things are connected to something else." Some connections or associations between two species — whether it be plant to plant, plant to insect, animal to animal — are relatively straight forward and easily observed. Other associations are more subtle and there are still many other connections yet to be discovered.

It is often hard to imagine all aspects of tree or plant growth and the effect of outside influences on a single organisms growth, health, and longevity. However, consider for a moment one plant and its environment. A simple diagram (Figure 1) showing how some of the factors that influence the plant are interconnected should convince you that a forest ecosystem with thousands of plants and literally millions of microorganisms per acre is indeed a COMPLEX system.

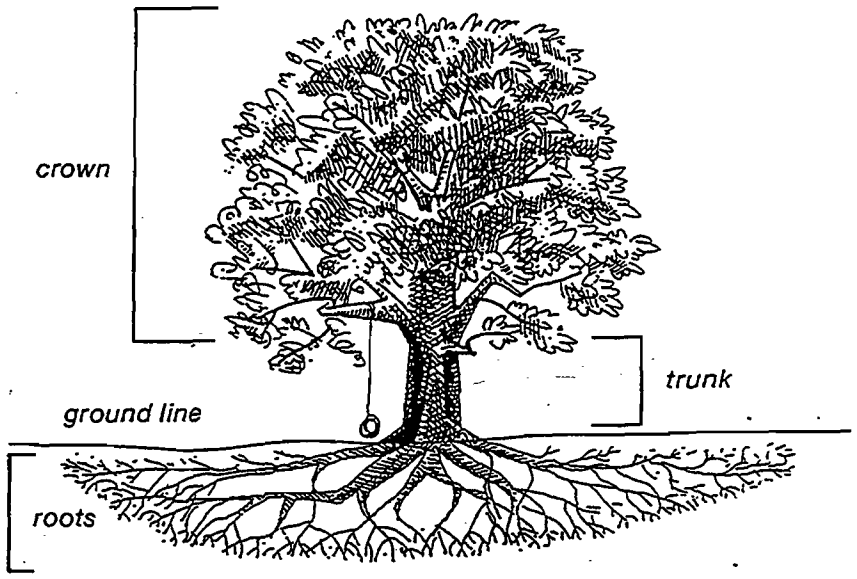


Figure 2. Growing regions of a tree.

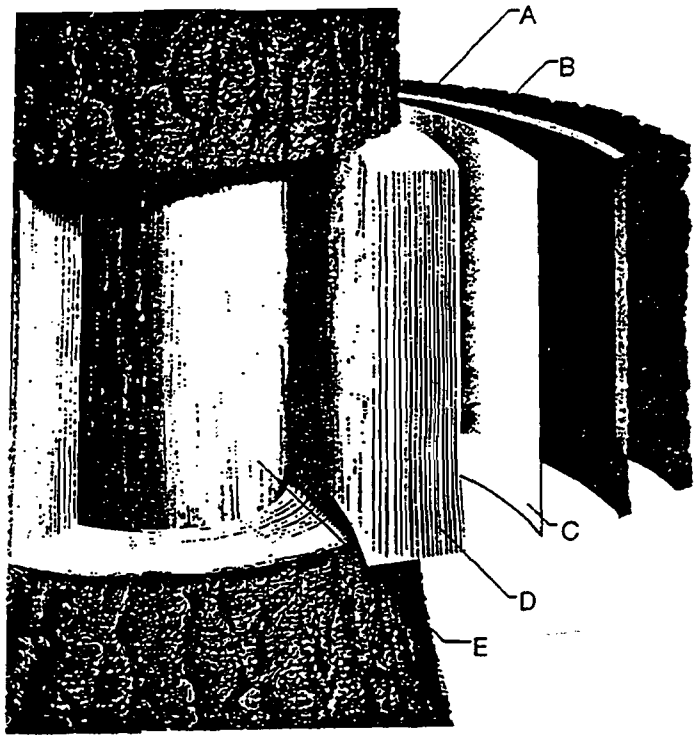
How Trees Grow

Parts of a tree

There are essentially three growing regions or areas within a tree: roots, bole (trunk), and crown.

Roots. Roots are important anchoring mechanism to prevent trees from blowing over. More importantly, roots adsorb water and nutrients from the soil and transport them to the bole of the tree. Root tips have microscopic root hairs which greatly increase the surface area of roots so more water and nutrients can be adsorbed by the tree. Beneficial fungi, call mycorrhizal fungi, reside in the root hairs and assist the tree in adsorbing additional water and nutrients. Every year new roots are produced in order to supply enough water and nutrients to the crown as the tree matures and increases in size. Roots also store food to be used by the roots and by the tree during the dormant months (fall and winter).

Bole. The bole, or trunk, links the roots with the crown. The bole is comprised of protective bark on the outside and cambium, sapwood, and heartwood on the inside. Just under the bark is a thin layer of cells called the cambium. The outside portion of the cambium, nearest the bark, give rise to a layer of cells called the phloem, sometimes referred to as the inner bark. The phloem is a thin layer of cells where food moves down the bole from the crown to the roots. It is this area that bark beetles bore into when they attack a tree because it is rich in nutrients. The inside portion of the cambium, nearest the wood, gives rise to new wood cells or the ring of wood that is produce around the bole. Each ring represents one year's growth and makes up what is



—Water and nutrients move in the sapwood. Immediately outside the cambium is the phloem, through which food is transported from the leaves to the rest of the tree. (A) The outer bark insulates the tree from extreme heat and cold, helps keep out rain, and protects the plant against insect enemies. (B) The phloem conducts food from leaves to the rest of the tree. Eventually, it becomes part of the tree's bark. (C) The cambium layer produces new bark and new wood annually in response to hormones, called auxins, that stimulate the growth of cells. (D) Sapwood is the pipeline for water moving from roots to the leaves. When its inner cells lose their vitality, they turn into heartwood. (E) Heartwood is the central, supporting column of the mature tree. Although it is dead, it will not decay or lose strength as long as a tree's outer layers remain intact. Illustration courtesy of The St. Regis Paper Company, New York, N.Y.

Figure 3. Cross-section of bole area.

referred to as sapwood. Sapwood is considered "living" wood because it transports water and nutrients up the tree to the crown to be used in photosynthesis.

The innermost or central portion of the bole is called heartwood. It contains dead wood that is often darker in color than the sapwood. The function of heartwood is primarily for structural support. The heartwood also contains protective chemicals which resist decay if the tree is injured.

Crown. The crown is the green area containing the branches, buds, and leaves. The crown is the photosynthetic "factory" of the tree where all food is produced. Each year new needles, leaves and buds are produced. In addition, reproductive structures such as cones and seeds are produced in the crown. Because reproduction is an energy-intensive process for a tree, some conifers and hardwoods produce heavy cone and seed crops only every 3 to 15 years.

Photosynthesis

Photosynthesis is probably the single most important biological process on earth. Photosynthesis is a process by which all green plants manufacture food (in the form of various sugars) for growth, reproduction, and maintenance.

Photosynthesis takes place in the leaves or needles or, more specifically, in millions of microscopic green chloroplasts, which give the leaves their green color. The basic building blocks for the tree's food is carbon dioxide from the air and water and nutrients (like nitrogen) from the soil. Carbon dioxide moves into the leaves through microscopic openings or holes called stomates which can open and close. When stomates are open, carbon dioxide moves into the leaf from the atmosphere; oxygen and water move out of the leaf. As water passes into the atmosphere an evaporative pump is created. This pump essentially pulls water and nutrients up the tree from the roots to the leaves and is powered by the sun. Literally, hundreds of gallons of water can be "transpired" into the atmosphere on hot summer day by a tree, depending on tree size, species and water availability in the soil. When water is in short supply, the tree can conserve water within by closing stomates and prevent drying out; photosynthesis then stops.

Energy is needed for photosynthetic process. Chloroplast trap energy from the sun and, in the presence of other chemical activators, carbon dioxide, water, and various nutrients are converted into simple sugars. With the help of enzymes these sugars can be converted to other compounds such as oils, starches, proteins and fats. The tree uses these compounds to produce new roots, wood, buds; and fruits, nuts and seeds for reproduction. Some of these compounds are used to maintain and repair cells and to provide protection from insects, disease, and mechanical damage.

Site Resources/Quantifying Site Quality

Site resources needed for trees and plants

Trees and other plants require four basic resources in order live and compete with other plants: moisture, nutrients, light, and space.

Moisture

Moisture is often in short supply to trees seedlings and even mature trees. In Oregon, 80 percent of the moisture that falls comes between November and June. During the growing season rainfall is scant. Therefore, plants must obtain water stored in the soil. The soil, in many ways, acts as a sponge or reservoir that is tapped by tree roots. Deep, fine-texture soils (loams) can store a considerable amount of water between soil particles. Shallow or sandy soils hold less water because of fewer pore spaces are available to store water.

Nutrients

Nutrient are uptaken in water solution by roots and used for photosynthesis. Mycorrhizal fungi greatly aid the tree in nutrient uptake. The amount of nutrients available to trees is determine by the type of soil and parent material (underlying rock) on any particular site. Some nutrients are used by plants in greater amounts and are called macro-

nutrients. Nitrogen, calcium, phosphorous are examples of macronutrients. Nutrients used in minute amounts are call micronutrient. Examples of micronutrient are boron and manganese. Although used in small amounts, micronutrient are no less important for tree growth.

Light

Light from the sun provides the energy to fuel the process of photosynthesis. Young tree seedlings planted or naturally established in an opening after a fire or timber harvesting can often be overtopped by surrounding vegetation, shading the young seedlings and reducing growth. If seedlings remain in dense shade for a long period (2-4 years), they eventually die and the other vegetation continues to dominate the side. On the other hand, if seedlings are able to persist in this competitive environment and eventually dominate the site, then the surrounding vegetation becomes shaded and eventually dies out. In either case, light becomes limiting, photosynthesis impaired and growth declines.

Space

For plants to remain competitive in a plant community, there needs to space. Having enough space is critical in order for plants to develop to their full potential. Crowding reduces plant size and increases competition for moisture, light, and nutrients.

Quantifying site quality

Forest productivity can be determined by measuring various forest attributes. Some attributes useful to land managers include:

Forest Attribute	Measure
Total biomass (leaves, branches, stem, roots)	tons per acre
Total usable wood	cubic feet per acre
Boards	board feet per acre
Basal area*	basal area per acre
Leaf area+	leaf area index

* basal area is the cross-sectional area of a tree at 4.5 feet measure in square feet.
\+ the square foot (or square meter) of leaves compared to a square foot of ground surface.

Mature, productive forests in western Oregon, for example contain about 500 to 1,000 tons per acre of above-ground biomass; another 100-300 tons per acre of roots exist below-ground. Dry-site forests of eastern Oregon would support less biomass.

Because forest productivity can varying from site to site, land managers need a way to quantify these differences for management purposes. For example, on more productive Douglas-fir sites, board foot growth may be two three time higher than on the least productive Douglas-fir site.

Site index and site class for Douglas-fir, 100-year basis

Total age (years)	Tree height (feet)													
20	21	24	26	29	31	34	37	39	42	44	47	49	52	54
30	37	41	46	50	55	60	64	69	74	78	83	88	92	96
40	48	54	60	66	72	78	84	90	96	102	108	114	120	126
50	56	63	70	77	84	91	98	105	112	119	125	132	139	146
60	63	70	78	86	93	101	109	117	124	132	140	148	156	163
70	68	77	85	94	102	110	119	127	135	144	152	161	170	178
80	73	82	91	100	109	118	127	136	145	154	163	172	181	190
90	77	86	96	105	115	125	134	144	153	163	172	182	192	201
100	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Site index	80	90	100	110	120	130	140	150	160	170	180	190	200	210

Figure 4. Site index table for Douglas-fir

One method used to classify forest and site productivity is the site index system. This system quantifies the ability of trees (of a particular species) to grow to a specific height over a given time period. Usually, this time period is 50 or 100 years (called base age-50 or -100). Below is an example of site indices for Douglas-fir for a base age-100. Note that over a 100 year period, Douglas-fir on the most productive site can growth to 210 feet whereas on the least productive site dominant trees only growth to 80 feet. This has a significant impact on wood production as well other ecosystem features

Why is site productivity so important? Knowing the productive potential of sites is important for management purposes. On good sites, more usable wood can be grown in a given time period. Therefore, productive sites are much more valuable because of their ability to grow wood.

From a ecosystem perspective, higher productivity sites can recover quicker from disturbances such as fire or timber harvesting. In addition, productive sites are generally more diverse structurally, providing higher quality habitat for wildlife and other organisms.

Factors affecting site productivity include tree genetics, tree species, aspect, slope, slope position (upper vs lower), soil depth and texture, and climate.

Environmental tolerances of trees

Over hundreds of thousands of years, trees have evolved adaptations to tolerant environmental stresses. These adaptations allow trees to persist and compete successfully in a wide variety of climates and habitats.

Comparison of Pacific Northwest tree species' characteristics: tolerance to shade, drought, flooding and frost.

Species	Tolerance to* Shade	Drought	Flooding	Frost	Species	Tolerance to* Shade	Drought	Flooding	Frost
Western hemlock	1	S	2	3	Red alder	S	4	3	4
Western redcedar	2	4	1	3	Bigleaf maple	2	3	4	3
Incense cedar	4	2	3	3	Oregon oak	S	1	2	2
Grand fir	2	4	2	3	Black oak	S	1	4	2
Douglas-fir	3	3	S	3	Oregon ash	3	3	1	3
Pacific silver fir	1	S	4	1	Black cottonwood	S	S	1	3
Noble fir	4	4	4	2	Madrone	4	2	4	2
Lodgepole pine	S	2	1	1	Bitter cherry	S	4	4	3
Ponderosa pine	S	1	3	2	Chinkapin	2	3	4	2
Sugar pine	4	2	3	3	Tanoak	1	3	4	4
White pine	3	2	2	1	Myrtle	2	3	2	4
Engelmann spruce	4	4	2	1	Canyon live oak	4	1	3	3
Western larch	4	3	2	2					

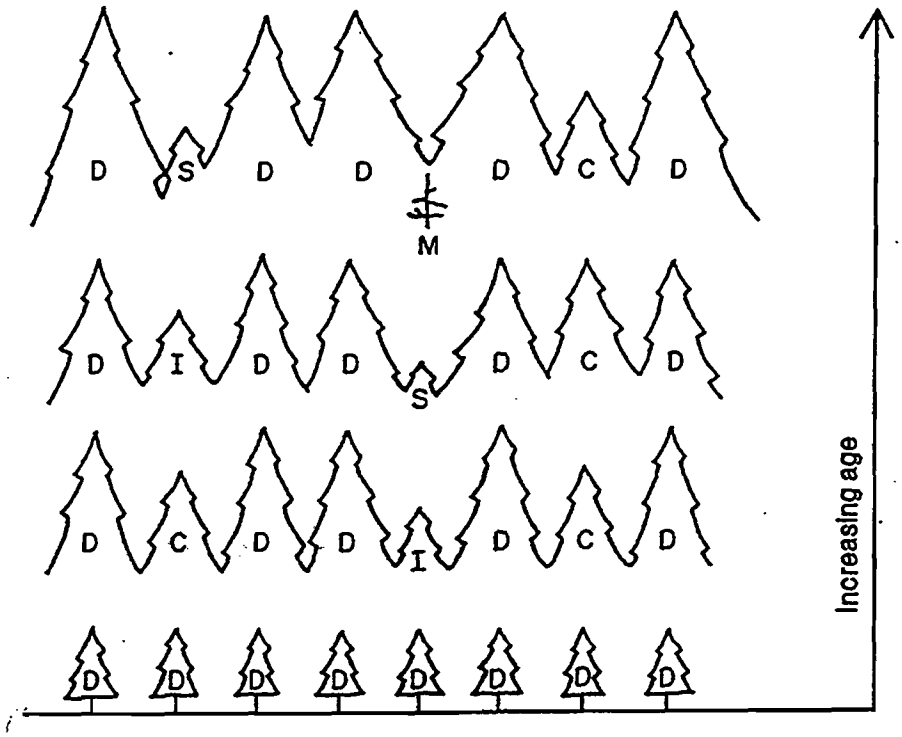
* 1 = high tolerance of _____.
S = low intolerance of _____.

Figure 5. Comparison of Pacific Northwest tree species tolerances to: shade, drought, flooding, and frost.

Adaptations to shade, extreme temperatures, varying moisture regimes allows trees to seed in, colonize, and persist for long periods of time within a stand, a watershed or region.

Each tree species has it's own set of adaptations or tolerances to environmental stresses. We often rank tree species according to their ability to withstand or tolerant these stresses. The ranking is relative and the ranking can change for a given species as you change sites or regions. The type of stresses that are most important to trees survival include their ability to withstand shade, drought, fire, frost, heat, flooding, wind and low soil fertility. Below is table that ranks the important conifers and hardwoods according to their ability to tolerate four environmental stresses: shade, drought, flooding and frost.

How is this information useful to ecosystem worker? A tree's ability to withstand these stresses allows it to occupy a certain niche in the stand or landscape for long periods of time. For example, in conducting riparian restoration planting on a western Oregon stream that typically floods, you would chose tree species that have a high tol-



—Trees differentiate into crown classes as stands become older.

Figure 6. Stand development process.

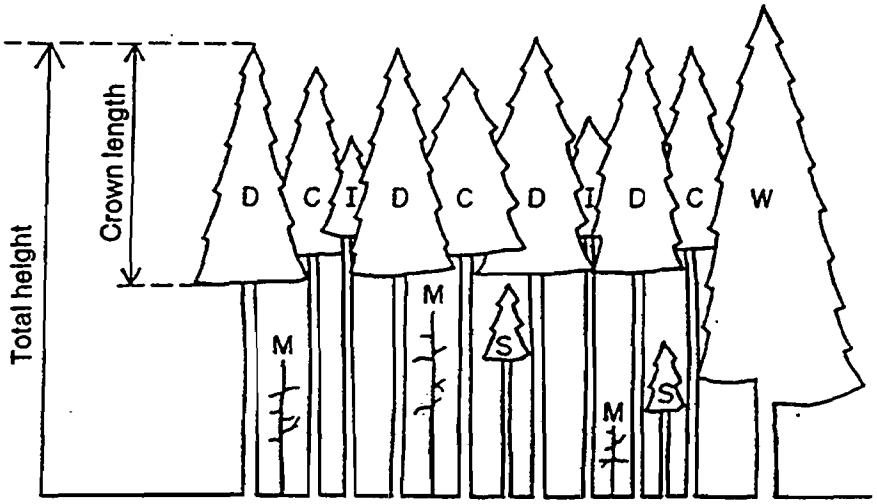
erance to prolonged, wet conditions. In this case, Oregon ash, black cottonwood or western red cedar would be good candidates. Likewise, if you were involved with a reforestation effort on a harsh, south-facing slope in southwestern Oregon, you would want to chose a tree species adapted to hot, dry sites. An appropriate species for this situation would be ponderosa pine.

Competition and Stand Development

Competition is the struggle for limited site resources. When trees naturally seed in or are planted on a recently disturbed site, they must compete with entire array of other plants: forbs, grasses, shrubs, and other hardwood trees. Competing vegetation is often better-suited to open, sunny conditions than tree seedlings because they have the capacity to grow fast, reproduce profusely, and spread their seed long distances. At this stage of development, competition for light, moisture, nutrients and space is fierce.

If tree seedlings are able to establish quickly and begin to outgrow the surrounding vegetation, eventually they begin to dominate the site. As the trees grow into saplings, more and more of the site resources are channeled into the trees as their root systems continue to spread. At this stage, competing vegetation is overtopped and becomes increasingly subordinate to the trees.

Eventually, tree crowns begin to touch and competition between trees begins. At this stage all the tree are more or less the same size. However, as stand development continues, competition for light, moisture, nutrients and space intensifies. As trees become larger in diameter and height, we often see some trees begin to slow down in growth, while others continue to grow and become dominant. As competition increase (because



—Crowns of trees in even-aged stands are classified into crown types: D = Dominant, C = Codominant, I = Intermediate, W = Wolf, S = Suppressed, M = Mortality. The "crown ratio" is equal to the proportion of total tree height that is occupied by live crown. In this illustration, the dominants have a 50 percent crown ratio, while the wolf tree has an 80 percent crown ratio.

Figure 7. Crown classification.

trees size increases), individual growth continues to decline on some trees and they become overtopped by neighbor trees and become suppressed. As the surrounding trees continue to grow, the suppressed trees eventually die and resources the suppressed trees used are reallocated to adjacent trees. This process of competition and tree death in even-age stands is called "self-thinning" and is illustrated below.

During this process of stand development, trees differentiate according to size or dominance. For example, in the illustration below, after 60 years of competition a Douglas-fir stand may look like this. This stands contains dominant, codominant, intermediate and suppressed trees as well as trees that have died from competition. Dominant trees are the largest in the stand and typically receive light on all sides of its crown. Dominant trees are vigorous and display good diameter growth and have large crowns.

Codominant trees are smaller in height and diameter receive light at the top of the crown and some on the sides. They are less vigorous than dominant trees and have smaller crowns.

Intermediate trees are smaller than codominant trees and intercept light only at the top of the crown. Intermediate trees have small crowns and, as a result, tree growth is poor. Intermediate trees will eventually become suppressed.

Suppressed trees usually occupy the understory and display very poor diameter and height growth. Little light intercepts their small crowns. Suppressed trees will soon die and fall to the forest floor.

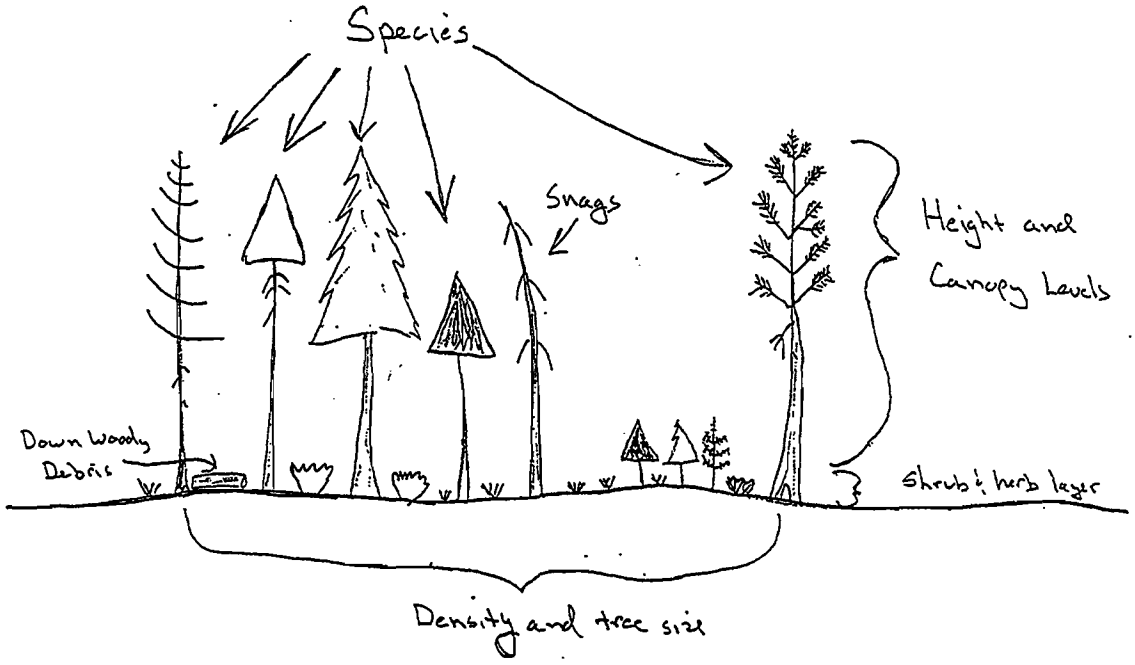


Figure 8. Forest structure.

Forest Structure

Simply stated, structure refers to "pieces" of the ecosystem, such as trees and shrubs, and how they are arranged in space. Some structural attributes useful to ecologists and wildlife managers include the following:

1. The number of large and small trees per acre.
2. The number of canopy layers
3. The amount of down wood and snags present per acre.
4. Tree species or composition
5. Percent cover and composition of grasses forbs and shrubs.
6. Size: size of stand or patch.

Why is forest structure important? Individual wildlife species or species groups depend on certain structural features of forests for habitat. For example, some species of wildlife require snags and down logs. Maintaining or creating this "dead wood" structure in stands is essential in order to maintain populations of woodpeckers, songbirds, bats and ants and termites. Snags are important for woodpeckers which excavate cavities for nesting. These holes are later used by squirrels, songbirds, owls and other wildlife. Many species songbirds and woodpeckers prey upon insects which kill or defoliates trees. Snags and down wood are to home ants, which are the main prey for several species of woodpeckers. So without a structural component of dead wood in forest ecosystem, the system becomes simplified and wildlife diversity is lowered.

Likewise, we can provide or create forest structure that prevents or promotes the buildup of certain kinds of insects and diseases. For example, the western spruce budworm, which defoliated several millions acres of mixed-conifer forest in central and

eastern Oregon, prefers multi-storied stands dominated by fir species. Managing existing stands or creating new stands (and landscapes) that are single-canopy and contain a lower proportion of fir species is one way to manage "forest structure" to reduce budworm habitat and reduce the potential for future large-scale outbreaks.

Forest structure varies across the landscape due to changes in topographic position, site productivity and disturbance history.

Disturbances and Forest Succession

Forest disturbances

Disturbance to forest ecosystems affects forest succession and alters forest structure and habitat for wildlife. Disturbances can speed up or reverse the process of succession depending which plant species remain or colonize a site after a major disturbance event, like a fire or wind storm.

Natural and human-caused disturbances

For thousands of years forest ecosystems have been shaped and changed by natural disturbances, including those disturbances caused by Indian burning. Only in the last few hundred years have human-caused disturbances begun to significantly alter the natural disturbance pattern in forest ecosystems.

Probably the most significant natural disturbances affecting forest ecosystems in the Pacific Northwest have been fire, insects and wind. In other parts of the North America, wind storms and hurricanes are more prominent.

Human-caused disturbances have greatly affected natural disturbance regimes in forest ecosystems and, therefore, have change the makeup or structure of the forests over large areas. Timber harvesting, for example, has created a forest landscape that is dominated by younger forests. Older forest conditions make up a smaller percentage of the forest, thus some populations of wildlife species dependent on old forest conditions have declined. On the other hand, younger forests have provided beneficial habitat to other species like elk and deer and their populations have increased.

However, retrospective studies also show that in Northwestern Oregon, for example, the forest was not a "sea" of old growth as once believed. In fact, before Euro-American settlement began in the 1840's, as much as 60 to 70 percent of the original forest consisted of younger forests less than 200 years. This was the result of large, stand-replacement fires that occurred every 125 to 250 years.

Below is list of natural and human-caused disturbances common to the Pacific Northwest.

Natural Disturbances	Human-caused Disturbances
Fire	Fire
Insects	Timber harvesting
Disease	Grazing
Volcanic	Exotic weeds
Floods	
Landslides	
Wildlife browsing	
Wind	

Effect of intensity, frequency, and size of disturbances

The intensity, frequency, and size of natural and human-caused disturbances has a profound effect on forest development and, consequently, on forest and landscape structure (habitat).

Intensity refers to the severity of the disturbance. This can be measured by how much of the original plant community remains after the disturbance, the amount of mineral soil exposed, and site resources available for exploitation or colonization by other species. An example of a severe disturbance would be large, stand-replacement fire in a second-growth or old-growth Douglas-fir forest. An event like this would kill many trees and expose a large area of mineral soil available for colonization by trees and other plants. The new plant community may or may not progress to another old-growth forest.

The *frequency* at which disturbances occur in forest ecosystems also affects succession and thus forest structure (including species composition). In systems where disturbances are frequent, trees and other plants develop adaptations to survive. For example, in the ponderosa pine ecosystem, cool surface fires occur quite frequently on average every 5 to 20 years. As a result, ponderosa pine has developed thick bark (and other features) for protection. Other plants, such as certain shrubs and hardwoods, have developed sprouting capabilities in order to persist in fire-dominated ecosystems.

The size of the disturbance has a effect on landscape structure and diversity. In most forest systems, disturbances can be both large and small; frequent and infrequent. As a result, disturbance events create patches on the landscape each with its own distinct structure. This mosaic of different patch sizes and structures creates a landscape with a high level of species diversity.

Succession

Succession is the gradual replacement of one set of plants or plant community with another. As the plant community changes so does forest structure. Thus wildlife species

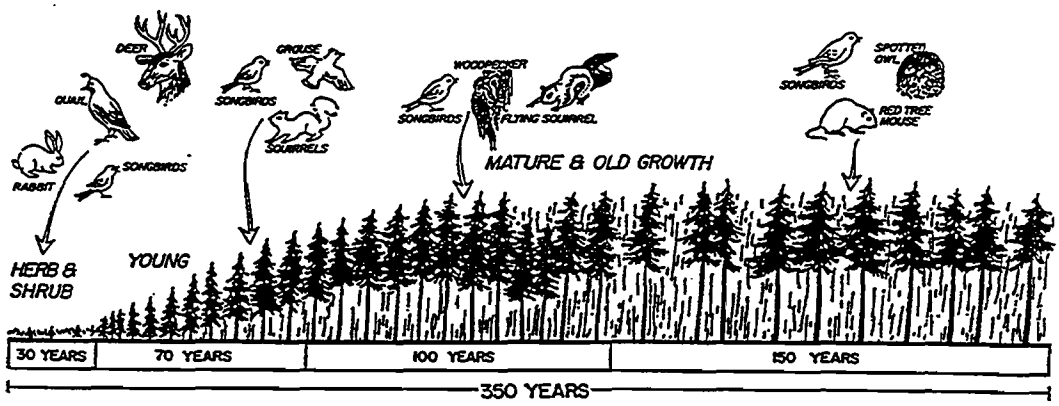


Figure 9. Forest succession showing changes in forest structure and wildlife habitat.

will also be replaced as habitat becomes more suitable to another group of wildlife species. At each stage of succession, species dominance changes.

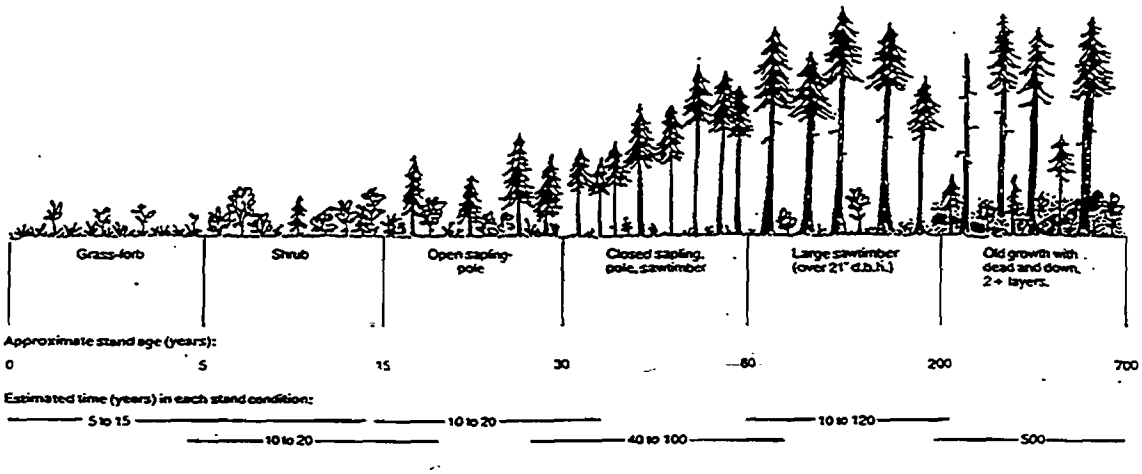
Primary succession

Primary succession means the development of a plant community from virtually bare rock. It occurs in areas having no pre-existing plant community, or, if there was, all traces of that plant community have been wiped out (such as after volcanic eruptions and landslides).

A good example of primary succession is when lichens colonize rock producing acids which help weather rock down to soil. Frost action can assist this process by fracturing rock into progressively smaller fragments. Wind may speed this process up a bit by depositing soil particles in cracks and small depressions.

All these actions help in soil formation, which is the primary resource needed for plant colonization. Because nitrogen — a critically important plant nutrient — is in such short supply on these site, many of the first plant to colonize have the ability of extracting nitrogen from the air and using it for plant growth. As these plants die and decay, the organic matter produced helps enrich the soil and allows other plant species to colonize the site. Primary succession is an extremely slow process.

There are aquatic analogies to the above example. For example, the conversion of a pond to a bog , to a wet meadow and, finally, to wetland-forest. Another example is primary succession on a coral reef.



— Stages of forest development (succession), from Hanley et al. 1992

Figure 10. Secondary succession.

Secondary succession

Secondary succession is when an existing plant community is removed or altered by disturbance but the soil, seeds, roots, and soil organisms remain intact.

Secondary succession proceeds faster than primary succession because soil is already present and the site can be colonized by plants species that prefer open, sunny conditions. Colonization can be from seeds or other propagules (roots, sprouts, spores) already on the site or from wind-born seed or seed carried in (by wildlife and humans) from long distances.

Plant species that colonize sites soon after a disturbance are called "pioneer species." Pioneer species include forbs, grasses, and shrubs. Some trees species seed in and grow well after disturbances and are considered pioneer species as well. Some notable examples include red alder and Douglas-fir in western Oregon and lodgepole pine in eastern Oregon.

Successional pathways

Succession in forest ecosystems can take many pathways. The successional pathway on a particular site after disturbance depends on the type (fire, insects, landslides) or intensity, the frequency and size of the disturbance, site productivity, as well as factors of chance, such as the availability of seed. Trees do not produce abundant seed crops every year. Thus, succession in a Douglas-fir stand after an intense stand-replacement fire may take different paths depending on the available of seed: seed from surrounding stands or surviving trees or from buried seed on site.

The diagram on the next page shows four possible successional pathways; there may be other pathways.

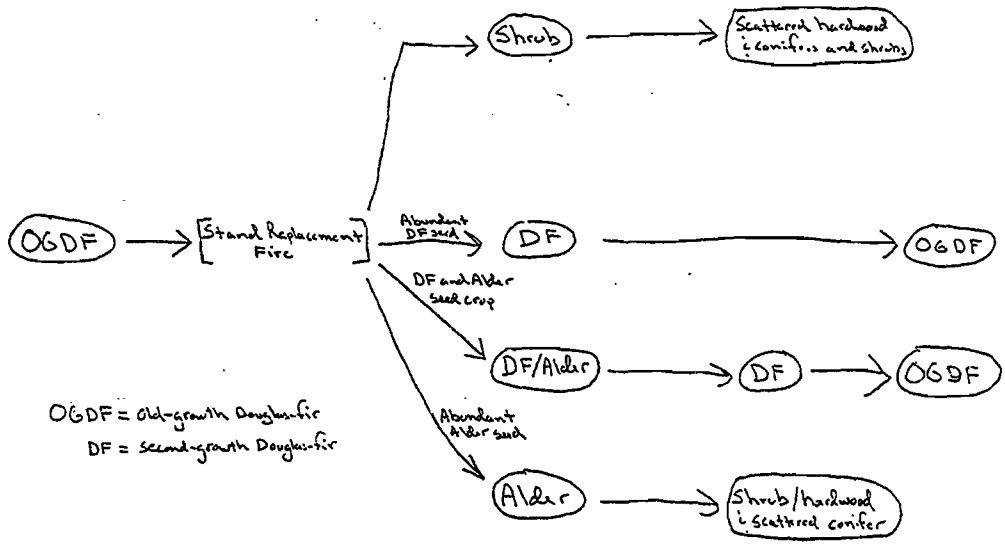


Figure 11. Possible successional pathways after an intense fire in coastal Douglas-fir stands.

Climax forest conditions

Climax forest conditions refers to the final stage of forest succession where trees species have been replaced with other trees species that can reproduce, establish and grow under shade (shade-tolerant) or develop in small gaps as overstory trees die and are replaced. At this stage of forest succession the forest is thought to be stable or in a "steady state" and will remain at this stage barring another disturbance.

An example of this process is an old growth Douglas-fir stand that is being replaced with the more shade-tolerant western hemlock. Without another disturbance, western hemlock will come to dominate the site and would be considered the climax species.

Because disturbances are the norm rather than the exception in forest ecosystems, few forests ever reach this "final" stage of succession. Forests are dynamic and always changing.

Forest landscape development

Disturbances at many different scales and intensities — from the death of a single tree creating a gap in the forest canopy to large stand-replacement fires — and at different intervals — frequent to infrequent — creates landscapes that are comprised of many different stages of succession. The result is a landscape that has complex forest structure, containing diverse niches (patches or mosaics) that provide habitat to a variety of plant and wildlife species.

In landscapes where natural disturbance patterns are allowed to occur, patches (stand conditions) do change one place to another, but the relative amounts of each successional stage across a broad landscape remain the same over a long time period.

However, over the past 150 years hundred years or so, humans activities have altered the natural disturbance regimes in the Pacific northwest due to land settlement, timber harvesting, grazing, fire exclusion from fire suppression, introduction of exotic weeds and other activities. These activities have changed forest landscapes dramatically. Today, forest landscapes are dominated by younger forests across a much broader landscape; other conditions, such as old-growth forest, make up a smaller proportion. These changes in landscape dynamics have created some forests that are more vulnerable to insects, disease and stand replacement fires.

A structural diverse forest landscape is not only beneficial to a wide variety of wildlife species, but may be essential in order to have forest that are resilient and better-able to withstand and sustain themselves in the long run after natural and human-caused calamities. The concept described here, and the main driving force behind ecosystem management, follows the old saying: "don't have all your eggs in one basket." In many areas, you, the ecosystem worker, will be designing and carrying out projects aimed at restoring or enhancing (creating more baskets) certain aspects of ecosystem structure and diversity.

Suggested Classroom and Field Exercises

Classroom exercises

1. In the introduction section to Forest Ecology, on a flip chart write the words: *forest ecology, fire, ecosystem, ecosystem management, disturbance, succession,* and *biodiversity.* Before you begin your introductory lecture, have the students define these terms in their own words out loud to the entire class. This process lets the instructor know the knowledge level of the students and is a good "icebreaker" activity for instructor and students.
2. During the section on disturbances and forest succession, have the students make a list of natural and human-induced disturbances in our forested landscapes. Record them on a flip chart or blackboard. Refer back to them in your lecture.

Field exercises

1. In the field find examples of recent and past disturbances: fire, insects, wind, etc. Describe what effect these disturbance had on forest structure and succession on that site.
2. In a stand of Douglas-fir, discuss or show crown classification. Have some students find a dominant tree and stand by it. Have them discuss why they believe it is a dominant tree. Repeat this for codominant, intermediate and suppressed trees. Are there any suppressed trees that recently died? If you were to thin this stand, which trees would be the best to leave?
3. In a recently planted clearcut, evaluate the growth and health of seedlings. Are the seedlings out-competing the surrounding vegetation, or is the surrounding vegetation overtaking the seedlings.

4. Visit an old-growth stand. Describe the structural features: species composition by canopy layer, snags and down logs, shrubs and understory vegetation. Is there any evidence of fire? Without any further disturbance, how will this old-growth area change? After a severe disturbance, what new plant community would result?

Literature Cited

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FOREST MANAGEMENT

Mike Cloughesy

Introduction

Overview

This chapter on forest management attempts to cover all aspects of forest management that would be applicable to crews performing ecosystem management work. The topics are handled in a very applied manner, but some technical detail is necessary. Topics covered in this chapter include:

- Forest measurements
- Reforestation
- Thinning
- Fertilization
- Pruning
- Silvicultural systems
- Harvest systems

How this topic fits into the other topics in this section

Forest management is treated as part of the science section of this curriculum. Understanding forest management is dependent to a large degree on understanding of forest ecology and on understanding of land measurement.

Competency measures

After completing the forest management session, students should be able to explain in their own words:

- the purpose of **forest measurements** and how to take a stand examination;
- the steps in the **reforestation process** and how to conduct a site evaluation for a reforestation plan;
- how to develop a **thinning** prescription and how to properly thin a forest stand;
- the purpose and method of **forest fertilization;**
- the purpose and method of forest **pruning;**
- the types of **silvicultural systems** and what kinds of forest stands they are applicable to; and
- the types of **harvest systems** and what kinds of forest stands they are applicable to.

Forest Measurements

Forest measurements involves estimating characteristics of individual trees or characteristics of forest stands. This section will first discuss the individual tree and stand characteristics that are commonly measured and then will describe a system to take stand examinations with fixed area plots

Tree and stand characteristics

DBH

- Diameter at breast height (4.5 ft. on uphill side).
- Use diameter tape, Biltmore stick or calipers to measure.
- Average diameter of stand measured by fixed area plots.
- Measured in inches and tenths, or in one- or two-inch diameter classes.

Height

- Can be total tree height or height to a merchantable top such as 6 inches. Use clinometer or Merritt hypsometer (on cruiser or woodland stick) to measure.
- Measured in feet (total height) or in 16 or 32 foot logs (merchantable height).

Age

- Can be total age or breast height age. Add 6 to 10 years to breast height age to get total age. Use increment borer, count stump rings or count whorls to measure.
- Measured in years.

Trees per acre

- A measure of stand density.
- Measured on fixed area plots.

Basal area

- Summation of the cross sectional area at breast height of all stems per acre. Based on summation of individual basal areas on fixed area plots. Measured in square feet per acre.

Volume

- A measure of the amount of harvestable wood in a tree or on an acre.
- Based on height and diameter using volume tables.
- Must deduct for defect and breakage to get net volume.
- Measured in cubic feet or board feet.
- A board foot is the volume in a board 12"x12"x1".

Site quality

Site quality is the combination of living and nonliving factors that influence a particular tree's or stand's growth and survival. Site includes soil, climate, and competition

from other vegetation. Site indices and classes have been developed to reflect the fact that better sites produce taller trees over a prescribed time period.

1) Site index is the average height of dominant and codominant trees of a particular species at a specified age. The most common index ages are 50 years at breast height and 100 years total age; 50 is more appropriate for young-growth forests. Fifty-year site index for Douglas-fir ranges from 60 on dry, shallow, or poorly drained soils to 150 on deep, well-drained soils in a moist climate. Site indexes are based on trees in unmanaged stands.

2) Site class is a particular range of site indices. The most common classification gives Site Class I (140 and above for 50 year DF) down to Site Class V (80 and below).

3) Estimating Site Index:

   a) Select at least three taller trees per stand.

   b) Estimate age with increment borer (add 6-10 years for total age) or stump ring counts (add 2 years for total age) or count whorls of branches.

   c) Estimate total height.

   d) Look up site index in appropriate table. See examples below: Appendix A, B and C from EC 1128, *Estimating Site Productivity in Your Woodland.*

Stand examination with fixed area plots

A stand examination is a type of inventory or forest survey done to estimate the stand parameters of trees per acre, basal area per acre, volume per acre and average diameter. This information is then used to make silviculture or forest management decisions for a given stand. This is much simpler and less detailed than a cruise that gives merchantable volumes by species and grade for purposes of a timber sale or real estate transaction.

Stand examinations can be conducted with fixed area plots using the tariff method of volume estimation as described in EC 1190 , *Stand Volume and Growth: Getting the Numbers.* Tariff access tables, tree volume tables, sample plot cards, tariff tree forms, and volume computation forms are included in subsequent pages (Appendices A1, A2, A3, A4, A5, B1, B2, B3, C, D and E).

The following steps should be used:

a. Set up the sample

Identify distinct stands (uniform in species, size, stocking) and sample areas. Locate stand or area boundaries on a map or aerial photo.

Decide how many plots to take (usually 1 per acre or more).

Plot centers should be marked on map or aerial photo.

b. Determine plot size

Objective is to get 5-8 sample trees per plot.

Measure average distance between trees by "zig-zag" method for 10 trees. The greater the distance, the larger the plot size needed. [<8'=1/100 acre; 8-16'=1/50 acre;

>16'=1/20 acre or larger]. Each plot size has an associated Plot Size Correction Factor (PSCF) of 1/plot size. [1/100 acre: PSCF=100; 1/50 acre: PSCF=50; 1/20 acre: PSCF=20]. The same plot size should be used for all plots in a stand.

c. Count and measure trees

Locate and mark each plot center on the ground. Measure diameter of all "in" trees on each plot. See plot card for radius of each size plot. Record diameters on plot card (Appendix C). Measure total height of tariff trees (fourth tree on each plot). Record diameters and heights of tariff trees on tariff tree form (Appendix D).

d. Calculate trees per acre

Multiply total plot trees in each diameter class by Multiplication Factor (MF=PSCF/# of plots) to get trees per acre by diameter class. Total trees per acre over all diameter classes.

e. Calculate tariff number

Look up tariff number for each tariff tree from appropriate access table (Appendix A). Calculate average tariff number for stand.

f. Estimate stand volume

Use tariff volume tables (Appendix B) for appropriate tariff number. Use Scribner and cubic feet volume tables to a 6 inch top. Record volumes per tree for each diameter class on Volume Computation Form (Appendix E).

Transfer trees per acre from Plot Card to Volume Computation Form and multiply by volume per tree to get volume per acre by diameter class. Total volumes over all diameter classes to get volume per acre.

g. Estimate basal area

Multiply trees per acre by basal area per tree for each diameter class. Total basal areas over all diameter classes to get basal area per acre.

h. Estimate average stand diameter

Use the following equation to calculate average stand diameter:

$$D = SQRT ((SBA) / (TPA * 0.005454))$$

Where:
D = average stand diameter
SQRT = square root
SBA = stand basal area
TPA = trees per acre

Appendix A.—*Site index and site class for Douglas-fir, 100-year basis*

Total age (years)	Tree height (feet)													
20	21	24	26	29	31	34	37	39	42	44	47	49	52	54
30	37	41	46	50	55	60	64	69	74	78	83	88	92	96
40	48	54	60	66	72	78	84	90	96	102	108	114	120	126
50	56	63	70	77	84	91	98	105	112	119	125	132	139	146
60	63	70	78	86	93	101	109	117	124	132	140	148	156	163
70	68	77	85	94	102	110	119	127	135	144	152	161	170	178
80	73	82	91	100	109	118	127	136	145	154	163	172	181	190
90	77	86	96	105	115	125	134	144	153	163	172	182	192	201
100	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Site index	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Site class	V		IV			III			II			I		

Appendix B.— *Site index and site class for Douglas-fir, western Oregon, 50-year basis.*

Breast height age (years)	Total height (feet)									
10	16	18	20	22	24	27	29	32	34	37
20	30	35	40	44	49	54	59	63	68	73
30	42	49	56	63	70	76	83	90	97	103
40	53	61	69	78	86	95	103	112	120	129
50	60	70	80	90	100	110	120	130	140	150
Site index	60	70	80	90	100	110	120	130	140	150
Site class	V		IV		III		II		I	

Appendix C.—*Site index and site class for ponderosa pine, 100-year basis*

Total age (years)	Total height (feet)												
20	6	9	12	16	20	25	30	35	40	45	50	55	60
30	11	15	20	26	32	38	44	51	57	64	70	77	84
40	16	22	28	35	42	49	55	63	70	77	85	93	100
50	21	28	35	43	51	58	65	73	80	89	97	105	113
60	26	34	42	50	58	66	73	81	90	99	107	115	124
70	30	39	47	56	64	73	80	89	98	108	116	125	134
80	34	43	52	61	70	79	88	97	106	116	124	133	143
90	37	47	57	66	75	85	94	104	113	123	132	142	152
100	40	50	60	70	80	90	100	110	120	130	140	150	160
Site index	40	50	60	70	80	90	100	110	120	130	140	150	160

Extension Circular 1190
Reprinted January 1993

$1.75

The Woodland Workbook

Forest Measurements

Stand Volume and Growth: Getting the Numbers

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Appendixes

Tarif access tables

Appendix A1.—Tarif access table for coastal Douglas-fir; condensed from *Tree Volume TARIF Access Tables for Pacific Northwest Species*, volume 2, section 2 (Bulletin 201, Access Table for Douglas-fir), State of Washington, Dept. of Natural Resources, June 1972 (out of print).

		Tree height (feet)									
		40	50	60	70	80	90	100	110	120	130
	7	21	26	30	34	37					
	8	20	24	29	33	36	40				
	9		24	28	32	35	39				
	10		23	27	31	34	38				
	11		22	26	30	33	37	40			
d	12		21	25	29	32	35	38			
b	13		20	24	28	31	35	38			
h	14		20	24	27	31	34	37			
	15			23	26	30	33	37	40		
(inches)	16			22	26	29	32	36	39		
	17			22	25	28	32	35	38		
	18			21	24	28	31	34	37	40	
	19			20	24	27	30	33	36	40	
	20			20	23	26	29	32	35	39	
	21				23	26	29	32	35	39	
	22				22	25	28	31	34	37	40
	23				21	24	27	30	33	36	39
	24				21	24	26	29	32	35	39
	26				20	23	26	29	32	35	39
	28					22	25	28	31	35	38
	30					21	23	28	31	34	37

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Oregon State University Extension Service

Appendix A2.—Tarif access table for western yellow pine; condensed from *Tree Volume TARIF Access Tables for Pacific Northwest Species*, volume 1, State of Washington, Dept. of Natural Resources, June 1972 (out of print).

d b h (inches)	Tree height (feet) 50	60	70	80	90	100	110	120
7	22	27	32	37				
8	21	25	30	35	40			
9	20	24	29	34	38			
10	20	24	28	32	37			
11		23	28	32	37			
12		22	27	31	35	39		
13		22	27	31	35	39		
14		22	26	30	34	38		
15		21	25	29	33	37		
16		21	25	29	33	37		
17		21	25	29	33	36	40	
18		21	24	28	32	36	40	
19		21	24	28	31	35	39	
20		20	24	28	31	35	39	
21		20	24	28	31	35	39	
22		20	24	27	31	35	38	
23		20	24	27	31	35	38	
24		20	23	27	31	34	38	
26		20	23	27	30	34	38	
28			23	27	30	34	37	
30			22	26	30	33	37	

Appendix A3.—Tarif access table for balsam species (grand fir, white fir); condensed from *Tree Volume TARIF Access Tables for Pacific Northwest Species*, volume 1, State of Washington, Dept. of Natural Resources, June 1972 (out of print).

d b h (inches)	Tree height (feet) 50	60	70	80	90	100	110	120
7	25	30	35	40				
8	23	28	33	38				
9	22	28	33	38				
10	22	26	30	35	39			
11	21	25	29	34	38			
12	20	24	29	33	37			
13	20	24	28	32	36	40		
14	20	23	28	31	35	39		
15		23	27	31	35	38		
16		22	26	30	34	38		
17		22	26	30	34	37		
18		22	26	30	33	37		
19		22	25	29	33	37	40	
20		22	25	29	33	36	40	
21		21	25	29	32	36	39	
22		21	25	28	32	35	39	
23		21	25	28	32	35	39	
24		21	24	28	31	35	38	
26		20	24	27	31	34	38	
28		20	24	27	30	34	37	
30		20	23	27	30	33	37	

Appendix A4.—Tarif access table for young-growth western hemlock; condensed from *Tree Volume TARIF Access Tables for Pacific Northwest Species*, volume 1, State of Washington, Dept. of Natural Resources, June 1972 (out of print).

d b h (inches)	Tree height (feet) 50	60	70	80	90	100	110	120
7	24	30	37					
8	23	28	33	38				
9	21	26	31	36				
10	20	25	30	35	40			
11	20	24	29	34	39			
12		24	28	33	37			
13		23	28	32	37			
14		22	27	31	36	40		
15		22	26	31	35	39		
16		21	26	30	34	39		
17		21	26	30	34	38		
18		21	25	29	33	38		
19		21	25	29	33	37		
20		21	25	29	33	37		
21		20	24	28	32	36	40	
22		20	24	28	32	36	40	
23		20	24	28	32	36	40	
24		20	24	28	31	35	40	
26		20	23	27	31	35	39	
28			23	27	30	34	38	
30			22	26	30	34	37	

Appendix A5.—Tarif access table for interior Douglas-fir; condensed from *Tree Volume TARIF Access Tables for Pacific Northwest Species*, volume 1, State of Washington, Dept. of Natural Resources, June 1972 (out of print).

d b h i n c h e s	Tree height (feet) 50	60	70	80	90	100	110	120	130	140
7	21	27	32	37						
8	20	25	30	34	40					
9		23	28	32	37	42				
10		22	26	31	35	40				
11		21	25	30	33	38	43			
12		20	24	29	33	37	41			
13		20	24	28	32	36	40			
14		17	23	27	31	35	39			
15			22	26	30	34	38			
16			22	25	29	33	37	41		
17			21	25	29	32	36	40		
18			21	24	28	32	35	39		
19			20	24	27	31	35	38		
20			20	23	27	30	34	37	41	
21			20	23	26	30	33	37	41	
22			19	23	26	30	33	37	40	
23			19	22	26	29	33	36	40	
24			19	22	25	29	32	36	39	
26				21	25	28	31	35	38	
28				21	24	27	30	34	37	
30				21	24	27	30	33	36	40

Appendix B1.—Tree volume table, board feet (Scribner board-foot volume, to 6-inch, top 32-foot logs), condensed from *Comprehensive Tree Volume TARIF Tables*, 3rd edition, State of Washington, Dept. of Natural Resources, October 1980 (out of print).

		Tarif numbers																				
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	7	3	3	3	4	4	4	4	5	5	5	5	6	6	6	7	7	7	8	8	8	8
	8	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17	18	19	20	21	21	22
	9	13	14	16	17	18	19	21	22	23	25	26	28	29	30	32	33	35	36	38	39	40
	10	20	22	24	26	28	30	32	34	36	38	40	43	45	47	49	51	53	56	58	60	62
	11	28	31	34	36	39	42	45	48	51	54	57	60	63	66	69	72	75	78	81	84	87
	12	37	41	44	48	51	55	59	63	67	71	74	78	82	86	91	95	99	103	107	111	115
d	13	47	51	56	60	65	70	74	79	84	89	94	99	104	109	114	120	125	130	135	141	146
b	14	57	63	68	74	80	85	91	97	103	109	115	122	128	134	140	147	153	160	166	173	179
h	15	69	75	82	89	95	102	109	116	124	131	138	146	153	161	169	176	184	192	199	207	215
(inches)	16	81	89	96	104	112	121	129	137	146	154	163	172	181	190	199	208	217	226	235	245	254
	17	94	103	112	121	130	140	150	159	169	179	190	200	210	221	231	242	252	263	274	284	295
	18	108	118	128	139	150	161	172	183	195	206	218	230	242	254	266	278	290	302	315	327	340
	19	123	134	146	158	170	183	196	208	221	235	248	261	275	289	302	316	330	344	358	373	387
	20	138	151	165	178	192	206	221	235	250	265	280	295	310	326	341	357	373	389	405	421	437
	21	155	169	184	200	215	231	247	264	280	297	314	331	348	365	383	400	418	436	454	472	490
	22	172	189	205	222	240	257	275	293	312	330	349	368	387	407	426	446	466	486	506	526	546
	23	190	209	227	246	265	285	305	325	345	366	387	408	429	450	472	494	516	538	560	582	605
	24	210	230	250	271	291	314	336	358	380	403	426	449	473	496	520	544	569	593	617	642	667
	26	251	275	299	324	350	376	402	429	456	483	511	538	567	595	624	653	682	711	741	770	800
	28	296	324	353	383	413	443	474	506	538	570	603	636	669	703	736	771	805	840	875	910	945
	30	344	377	411	445	481	516	552	589	626	664	702	741	780	819	859	898	939	979	1020	1061	1102

Appendix B2. — Tree volume table, board feet (16-foot logs); condensed from *Comprehensive Tree Volume TARIF Tables*, 3rd edition, State of Washington, Dept. of Natural Resources, October 1980 (out of print).

		Tarif numbers																				
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	7	4	4	5	5	5	6	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
	8	11	12	13	13	14	15	16	16	17	18	19	19	20	21	22	23	24	24	25	26	27
	9	20	21	23	24	25	27	28	30	31	33	34	35	37	38	40	41	43	44	46	47	49
	10	31	33	35	36	38	41	43	46	48	50	52	55	57	59	61	64	66	68	71	73	75
	11	43	46	49	52	55	58	61	64	67	70	73	76	80	83	86	89	92	96	99	102	105
	12	56	60	64	68	72	76	80	84	88	92	96	101	105	109	113	117	122	126	130	135	139
d	13	71	76	81	86	91	96	101	106	111	116	122	127	132	138	143	148	154	159	165	170	176
b	14	87	93	99	105	111	117	124	130	136	143	149	156	162	169	175	182	189	195	202	209	216
h	15	104	111	119	126	133	141	148	156	163	171	179	187	195	202	210	218	226	235	243	251	259
(inches)	16	123	131	140	148	157	166	174	183	192	202	211	220	229	239	248	257	267	276	286	296	305
	17	142	152	162	172	182	192	203	213	223	234	245	256	266	277	288	299	310	321	332	344	355
	18	163	174	186	197	209	221	232	244	257	269	281	293	306	318	331	344	356	369	382	395	408
	19	186	198	211	224	237	251	264	268	292	306	320	334	348	362	377	391	406	420	435	449	464
	20	209	223	238	253	268	283	298	313	329	345	361	376	393	409	425	441	458	474	491	507	524
	21	232	250	266	283	300	316	334	351	368	386	404	422	440	458	476	494	513	531	550	568	587
	22	260	278	296	314	333	352	371	390	410	429	449	469	489	510	530	550	571	592	612	633	654
	23	287	307	327	348	368	389	410	432	453	475	497	519	542	564	587	609	632	655	678	701	724
	24	316	338	360	383	405	428	452	475	499	523	547	572	596	621	646	671	696	721	747	772	798
	26	378	404	430	457	484	512	540	568	597	626	655	684	713	743	773	803	833	863	894	924	955
	28	444	475	506	538	570	603	636	669	703	737	771	806	841	875	911	947	982	1018	1054	1090	1126
	30	516	552	588	625	663	701	739	778	817	857	897	937	978	1019	1060	1101	1143	1185	1227	1269	1311

Appendix B3.—Tree volume table, cubic feet (cubic-foot volume to 6" top); condensed from *Comprehensive Tree Volume TARIF Tables*, 3rd edition, State of Washington, Dept. of Natural Resources, October 1980 (out of print).

		Tarif numbers																				
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	7	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
	8	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	7	7	7	7
	9	6	6	7	7	7	7	8	8	8	9	9	9	9	10	10	10	11	11	11	12	12
	10	9	9	9	10	10	11	11	12	12	12	13	13	13	14	14	15	15	15	16	17	17
	11	11	12	13	13	14	14	15	15	16	15	17	18	18	19	19	20	20	20	21	22	22
	12	14	15	16	17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	27	28	29
d	13	18	18	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35
b	14	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38	39	40	41	42
h	15	25	26	27	28	29	31	32	33	34	36	37	38	40	41	42	43	44	45	47	48	49
(inches)	16	28	30	31	33	34	35	37	38	40	41	42	44	45	47	48	50	51	52	54	55	57
	17	32	34	36	37	39	40	42	44	45	47	48	50	51	53	55	56	58	60	61	63	65
	18	36	38	40	42	44	46	47	49	51	53	55	57	58	60	62	64	66	67	69	71	73
	19	41	43	45	47	49	51	53	55	57	59	61	63	65	67	70	72	74	76	78	80	82
	20	46	48	50	52	55	57	59	61	64	66	68	71	73	75	77	80	82	84	87	89	91
	21	50	53	55	58	61	63	66	68	71	73	76	78	81	83	86	88	91	93	96	98	101
	22	56	58	61	64	67	70	72	75	78	81	83	86	89	92	94	97	100	113	106	108	111
	23	61	64	67	70	73	76	79	82	85	88	91	94	97	100	104	107	110	113	116	119	122
	24	66	70	73	76	80	83	86	90	93	96	100	103	106	110	113	116	120	123	126	130	133
	26	78	82	86	90	94	98	102	106	110	114	118	121	125	129	133	137	141	145	149	152	157
	28	91	96	100	105	109	114	119	123	128	132	137	141	146	155	150	160	164	169	173	178	182
	30	105	110	115	121	126	131	136	142	147	152	157	163	168	173	178	184	189	194	199	295	210

Appendix C.

Plot card

Your Name _____ Date _____

Stand Name _____ Plot Size _____

Multiplication factor (MF) = plot size correction factor (from table 3) For example: MF = 100/10 = 10
# of plots

Tree tally by diameter and plot

dbh (in.)	plot number 1	2	3	4	5	6	7	8	9	10	total plot trees	trees/acre total x mf
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
26												
28												
30												
TOTAL												

Key for Dot Count

. = 1

. . = 2

. . . = 3

. . . . = 4

. . . . . = 5

. . . . . = 6

. . . . . = 7

. . . . . = 8

. . . . . = 9

. . . . . = 10

	Distance between trees less than 8 ft	8 to 16 ft	more than 16 ft
Plot size (acres) to use	1/100	1/50	1/20
Plot radius (feet)	11.8	16.7	26.3
Plot radius (feet & inches)	11'10"	16'8"	26'4"
Plot size correction factor (for use on plot card)	100	50	20

Suggested Plot Size, Plot Radius and Correction Factor

Appendix D.

Tarif tree form

Stand name: _____ Date: _____

Tarif trees				
plot number	1) dbh (inches)	2) height (feet)	3) radial growth for ___ years in twentieths of an inch (1"=20 twentieths)	4) tarif number (from appropriate tarif access table in appendix A)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
tree species _____			total	total

Average tarif number = $\frac{\text{total of column 4}}{\text{number of tarif trees}}$ = _____

Average radial growth per tree (ARG) = $\frac{\text{total of column 3}}{\text{number of trees measured}}$ = _____

Appendix E.

Volume computation form

Stand name _____ Tarif #_____ Date: _____

DBH	1 Trees per Acre from figure 3	2 Board-foot volume/tree from tarif volume table (Note 1)	3 Board-foot volume/acre Col 1 x Col 2	4 Cubic-foot volume/tree from tarif volume table (Note 2)	5 Cubic-foot volume/acre Col 1 x Col 4	6 Basal area/tree	7 Basal area/ diameter class Col 1 x Col 6
7						.267	
8						.349	
9						.442	
10						.545	
11						.660	
12						.785	
13						.922	
14						1.069	
15						1.227	
16						1.396	
17						1.576	
18						1.767	
19						1.969	
20						2.182	
21						2.405	
22						2.640	
23						2.885	
24						3.142	
26						3.687	
28						4.276	
30						4.909	
	total 1		total 3		total 5		total 7

total 1 = _____ trees/acre

total 3 = _____ board-foot volume/acre in _____ foot logs

total 5 = _____ cubic-foot volume/acre

total 7 = _____ square feet of basal area/acre

(1) From Appendix B1 or B2
(2) From Appendix B3

Reforestation

Reforestation planning: a checklist

Introduction

Reforestation, following timber harvest or natural disturbance such as fire, is a complex series of steps or decision points. Successful reforestation can best be assured by paying close attention to detail in all steps. The steps in the reforestation process can be likened to links in a chain. If any of its links break, the reforestation chain is less likely to succeed.

The reforestation steps are well-documented in the literature. See the "For Further Reading" section for specifics. The purpose of this reforestation checklist is to provide: 1) a brief description of each step or decision point and 2) a worksheet or checklist to record the decisions made for a given reforestation unit. This checklist will provide a planning tool to identify the actions to be taken in the future and a record keeping tool to show what actions have been taken in the past.

Reforestation steps

1) **Site information.** Site factors such as elevation, rainfall, slope, aspect, and soils help to determine the species, stock type, site preparation, vegetation control and shading that are best for a unit.
2) **Management objectives.** The management objectives for a tract of land may help to determine some of the details of a reforestation plan. Examples of management objectives include: timber, wildlife, and recreation.
3) **Purpose of reforestation.** Some reforestation is done after timber harvest, some after wildfire, some to rehabilitate underproductive lands, etc.
4) **Type of reforestation.** Options here include: Natural Reforestation, Direct Seeding, Planting Seedlings, and Managing Advanced Regeneration.
5) **Harvest method.** The first step in the reforestation process is usually the timber harvest. Harvest methods include: clearcut, shelterwood, group selection, and individual tree selection. Different harvest methods create different degrees of vegetative disturbance. The degree of vegetative disturbance along with factors relating to climate and vegetation helps to determine the species, stock type, site preparation and vegetative control that are best for a unit.
6) **Species of prior stand.** The species present in an existing or prior stand and their relative proportions are often good indicators of species to be managed in new stands.
7) **Residual stocking.** The amount of residual stocking (trees or basal area per acre) are indicators of how much reforestation needs to be done and what species may succeed.
8) **Understory vegetation.** The species and relative abundance of understory vegetation prior to disturbance are excellent indicators of vegetation problems to be expected in the new stand.

9) **Site preparation.** Different sites have different needs to control slash, brush, and other competing vegetation before planting. Important site preparation decisions to document include types and dates.
10) **Planting.** Several important decisions regarding planting need to be made including: species, seed zone, stock type, nursery, seedling handling, tools, spacing and date. Each of these decisions can have major implications in the composition and success of the new stand.
11) **Vegetation control.** Important decisions to document regarding vegetation control include expected problems, treatments and dates. Problems relate to species, cover and height. Treatments include tools such as manual release or herbicide sprays and all relevant information.
12) **Animal damage.** Important animal damage decisions include expected problems, treatments and dates. Problems include: mice, rabbits, mountain beavers, deer, elk and others. Treatments include: physical barriers, chemical treatments, and habitat manipulation.
13) **Shading.** Important decisions related to shading include expected problems, treatments and dates. Sun-scald on seedling stems at the groundline can be a serious problem on steep, rocky, south-facing slopes. Treatment options include: shade cards, styrofoam cups and milk cartons.
14) **Insects and diseases.** Important insect & disease decisions include expected problems, treatments, and dates. Problems include: root diseases, foliage diseases, aphids, etc. Treatments include: species manipulation, chemical treatments, sanitation, etc.
15) **Stocking survey.** For reforestation to be successful it must stand the test of time. Stocking surveys are usually done at one, three and five years after planting to document survival, stocking, vegetative competition and animal damage. Important decisions regarding stocking surveys include type of survey and dates.

REFORESTATION CHECKLIST

1. SITE INFORMATION

   a. OWNERS NAME:_____

   b. UNIT NAME:_____

   c. LOCATION:_____ d. SIZE (AREA): _____

   e. ACCESS: _____ f. ELEVATION: _____

   g. ANNUAL RAINFALL: _____ h. SLOPE: _____

   i. ASPECT: _____ j. SOILS: _____

2. MANAGEMENT OBJECTIVES: _____
3. PURPOSE OF REFORESTATION: _____
4. TYPE OF REFORESTATION:_____
5. HARVEST METHOD:_____
6. SPECIES OF PRIOR STAND: _____
7. RESIDUAL STOCKING: _____
8. UNDERSTORY VEGETATION:_____
9. SITE PREPARATION

   a. TYPE: _____

   b. DATE:_____

10. a. PLANTING STOCK

      1) SPECIES: _____

      2) SEED SOURCE:_____

      3) STOCK TYPE:_____

      4) NURSERY: _____

      5) DATE ORDERED: _____

REFORESTATION CHECKLIST (continued)

10. a. PLANTING STOCK (continued)

    6) DATE LIFTED:_____ 7) DATE RECEIVED: _____

    b. PLANTING TOOL: _____

    c. PLANTING SPACING:_____

    d. PLANTING DATE:_____

    e. OTHER:_____

11. VEGETATION CONTROL

    a. EXPECTED PROBLEMS:_____

    b. TREATMENTS:_____

    c. DATE(s):_____

12. ANIMAL DAMAGE

    a. EXPECTED PROBLEMS: _____

    b. TREATMENTS: _____

    c. DATE(s): _____

13. SHADING

    a. EXPECTED PROBLEMS:_____

    b. TREATMENTS:_____

    c. DATE(s):_____

14. INSECTS and DISEASES

    a. EXPECTED PROBLEMS: _____

    b. TREATMENTS: _____

    c. DATE(s):_____

15. STOCKING SURVEY

    a. TYPE: _____

    b. DATE(s): _____

Site preparation

Definition

Site preparation is any planned operation that enhances natural or artificial regeneration by modifying unfavorable conditions of site. Site preparation is an important first step in reforesting after harvest operations or in reclaiming brush fields for timber production.

Objectives of site preparation can include:

- reducing logging slash to reduce fire hazard and remove obstacles to improve access and facilitate planting or natural seeding;
- controlling competing vegetation to improve seedling survival and growth by making moisture, nutrients and sunlight more available to seedlings;
- reducing habitat of unwanted wildlife to minimize the buildup of animals that clip, browse, and kill young seedlings;
- exposing mineral soil to provide a seedbed for natural regeneration establishment;
- improving the general appearance by ridding the area of unsightly slash;

  improving soil conditions by reducing soil compaction or improving soil drainage; and
- controlling insects and disease by removing trees infected with diseases such as dwarf mistletoe and beetle-infested slash.

Methods

1) **Manual site preparation** involves using a planting hoe to manually remove (scalp) vegetation 2' to 6' in diameter around seedling planting spots or cutting vegetation with a chain saw.

   Advantages include:

- effective spot treatment for some types of brush and grass,
- good in areas where other methods might pose an environmental or safety hazard,
- effective for removing duff and litter from planting spots.

  Disadvantages include:

- can be expensive so limited to small acreages,
- provides only a temporary release from vegetative competition,
- difficult to manually clear planting spots in heavy slash,
- does not reduce potential animal habitat, and
- very labor intensive.

2) **Mechanical site preparation** involves using a crawler tractor equipped with a toothed blade (brush blade) to move slash and brush into piles or windrows.

   Advantages include:

- effective for breaking up heavy fuel concentrations,
- very effective for exposing mineral soil,
- can reduce planting costs by improving access,

- flexible so it can achieve varying degrees of site preparation to meet other objectives and constraints,
- not labor intensive,
- moderately effective for controlling competing vegetation, and
- effective for eliminating cover for wildlife pests.

Disadvantages include:

- equipment limited to slopes of 35% or less;
- increases chance of soil compaction, top soil disturbance, and erosion, which reduce site productivity;
- moderate to high in cost per acre;
- competing vegetation can recover quickly; and
- equipment scheduling could be a problem.

3) **Prescribed fire** site preparation involves igniting cutover areas and brushfields with hand-held drip torches or by a helicopter equipped with a helitorch. Areas are burned in a systematic and controlled fashion.

Advantages include:

- can be used in flat or steep terrain;
- doesn't cause soil compaction;
- reduces slash and fuel hazard;
- can expose mineral soil for natural regeneration;
- reduces hiding cover for wildlife;
- controls some competing vegetation;
- creates plantable spots and improves access for planting crews, which reduces planting costs; and
- generally low to moderate costs per acre.

Disadvantages include:

- smoke pollution;
- liability and costs can become very high if fire gets away;
- success of burning depends greatly on climatic conditions and moisture content of fuels, which makes results variable;
- risk of increased erosion on steep slopes;
- timing of burn is tightly regulated, making it difficult to schedule burning opera tions;
- rapid recovery of sprouting brush and certain grasses after burning and increased germination of plant species such as ceanothus and manzanita;
- potential for heat damage to the soil and for nutrient losses, particularly nitrogen; and
- labor intensive and high skill level required.

4) **Chemical site preparation** includes applying herbicides before planting to kill target vegetation. Application methods include helicopter and backpack spraying and direct injection into target plants.

Advantages include:

- kills or controls vegetation longer than other methods;
- less expensive than some alternatives;
- with aerial application, large acreages can be treated at one time;
- aerial application is not labor intensive;
- can be used in most terrain conditions; and
- results in the least disturbance to the site and doesn't compact, remove, or expose mineral soil.

Disadvantages include:

- doesn't rid the area of slash or standing brush, which pose obstacles to planting crews;
- doesn't remove animal hiding cover;
- doesn't create mineral soil if natural regeneration is the objective;
- controversial public issue;
- risk of herbicide drift to non-target areas;
- restricted by weather conditions; and
- herbicide can damage or kill crop trees if improperly applied.

5) **Combinations of fire/chemical/mechanical methods** include:

- pile and burn;
- spray and crush;
- spray and burn;
- brown and burn; and
- spray, pile and burn.

Advantages include:

- very effective at reducing fuels,
- excellent vegetation control,
- removes animal hiding cover,
- provides good access for planting crews, and
- can be done in most terrain.

Disadvantages include:

- moderate to high costs per acre;
- possibly more impacts to site, such as soil compaction and erosion;
- certain combinations are limited by terrain conditions;
- certain combinations are limited by weather conditions; and
- certain conditions involve higher risk and liability.

Species and seed source

Species

In deciding what types of seedlings to plant the first decision to be made regards species. Not all species are suited to all areas or all sites. A good place to start in deciding what to plant is to look at what has grown on the site in the past and on similar sites in the vicinity.

The attached table shows a comparison of Pacific Northwest tree species characteristics including tolerance to shade drought, flooding and frost. This table will also provide some ideas for which trees may be appropriate for a particular regeneration site.

County soil surveys usually list appropriate species for reforestation on forested soil series, give a range of productivity to be expected for those soil series and can also be used to identify soil series present on a given planting unit.

Seed source

Planting seedlings grown from seed collected from a seed source similar to the planting unit is important to avoid off-site problems such as excessive frost or drought damage. Seed source generally includes seed zone from the Oregon Tree Seed Zone map (see attached) and 500 feet elevation bands.

Seed zones were established in 1966 and revised in 1973 by the Western Forest Tree Seed Council. These zones were based on geographic areas and the same for all species. New seed zone maps should be released in 1996.

Tree seed zone numbers consist of three digits such as 062, 252, or 491. The first digit indicates major geographic region: 0 = Coast or Columbia River, 2 = east slope of coast range or Willamette or Umpqua Valley, 4 = Cascade Mountains, 5 = Siskiyou Mountains, 6 = Central Oregon, 7 = South-Central Oregon, 8 = Blue and Wallowa Mountains, and 9 = Ochoco Mountains.

The second digit refers to geographic sub-regions within a region, such as 7 in 471, 472, & 473 indicating the McKenzie River Drainage within the Cascade Mountains. The third digit refers to minor sub-sub-regions such as 471 = lower McKenzie, 472 = main McKenzie, and 473 = upper McKenzie.

Seed from within the same seed zone as the reforestation unit is generally the best to use. Seed from seed zone with the same first two digits, such as 471 and 472 is the next best alternative. Using seed from zones with different middle numbers should usually be avoided unless you know they were collected from close proximity to the planting site. Using seed from zones with different first digits should be avoided.

In terms of elevation bands, it is generally considered OK to move seed down in elevation one 500 foot band. However, moving seed up in elevation should be avoided due to problems with frost damage in the spring.

The location of the nursery in terms of seed zone and elevation does not matter. The genetic potential of the seedling is determined by the seed zone and elevation of the stand where the seed is collected.

Table 1.—*Relative performance ratings for various tree species in climatic regions of Western Oregon.*

Coast	Tree performance: Level of Use	Growth	Shade Tolerance	Big Game Damage	Frost	Drainage	Comments
Douglas-fir	5	5	2	3	2	1	Good on most forest sites with good soil and drainage. Brush must be controlled before it overtops seedlings.
Western hemlock	3	5	5	3	3	2	Will tolerate more brush competition than Douglas-fir.
Western red cedar	2	4	4	2	1	4	Good in areas with high water table. Can be browsed heavily.
Grand fir	2	5	3	3	4	4	Good on moist sites.
Sitka spruce	1	5	4	2	5	3	Good only near coast. Spruce tip weevil is a serious pest.
Shore pine	1	1	1	5	5	5	Grows on droughty sand or hard pan sites. Good early growth but slower long-term growth.
Noble fir	1	3	3	4	4	1	For timber planting above 2,000 feet in the coast range.
Red alder	1	3	1	3	3	3	Used in riparian and root rot areas.

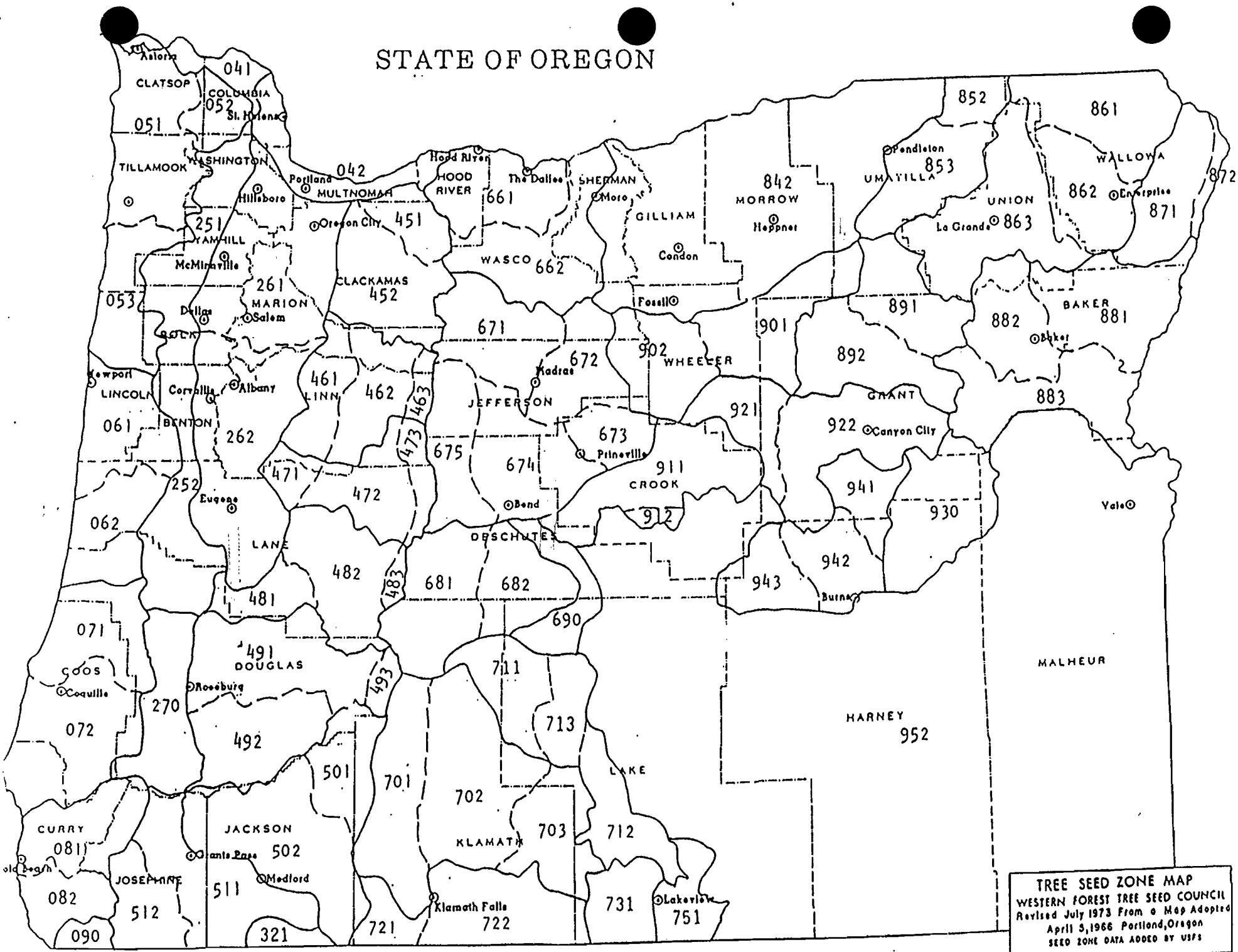
Willamette Valley Cascade - West Slope	Level of Use	Growth	Shade Tolerance	Big Game Damage	Frost	Drainage	Comments
Douglas-fir	4	5	2	3	2	2	Brush and grass control is important.
Noble fir	2	3	3	4	4	2	Used above 1,500 feet elevation; avoid clay soils.
Grand fir	1	4	3	3	4	3	Good for valley uplands where game damage can be a problem.
Western red cedar	1	3	4	2	1	4	Do not plant on poorly drained clay soils.
Ponderosa pine	1	3	1	5	4	1	Good on sandy soils or clay soils that become droughty in summer.
Western hemlock	1	3	5	3	3	2	Used on north aspects.
Cottonwood	1	4	1	3	1	5	Used on river bench alluvial soils.

Table 2.—*Relative performance ratings for various native tree species in Southwestern and Eastern Oregon.*

Southwest Oregon	Level of Use	Tree Performance: Growth	Shade Tolerance	Frost	Heat	Drought	Comments
Douglas-fir	4	5	3	3	3	4	Shade cards may be necessary on hot, dry sites.
Ponderosa pine	2	5	2	5	4	5	Gopher control is needed in many areas. Porcupines also can cause damage.
White fir (mid-to upper Cascades)	2	4	5	4	2	3	Plant above 3,000 feet on moist, well-drained soil.
Grand fir (mid-to lower coast)	2	4	5	3	2	2	Avoid poorly drained soils.
Incense cedar	1	2	3	4	5	5	Can tolerate serpentine soils somewhat. Pocket rot can be a problem.
Eastern Oregon	**Level of Use**	**Growth**	**Shade Tolerance**	**Frost**	**Heat**	**Drought**	
Ponderosa pine	5	4	1	4	5	5	Most widely planted east-side species. Good survival and early growth.
Lodgepole pine	3	4	2	5	5	4	Adaptable to a variety of harsh sites.
Douglas-fir	3	3	3	2	3	4	Risky on south slopes with less than 20" annual rainfall.
Grand and White fir	2	3	5	1	2	3	Tolerates some shade in partial cut situations. Slow growth first 2 years.
Western larch	1	5	1	4	3	3	Excellent juvenile growth.
Engelmann spruce	1	3	4	5	2	2	Planted above 3,500 feet. Good on moist sites.

Characteristic	Rating
Level of Reforestation Use	5 = Planted on over 90 percent of the sites 1 = Infrequently planted
Height and Volume Growth	5 = Superior 1 = Slow/poor
Shade Tolerance	5 = Able to grow well with overstory shade 1 = Requires full sunlight
Drainage	5 = Can tolerate poor drainage or some standing water for short periods. 1 = Requires well-drained soils
Frost Resistance	5 = High resistance to low temperatures 1 = Easily damaged by frost
Big Game Damage	5 = Not frequently browsed by deer or elk 1 = Frequently browsed where big game animals are present
Drought	5 = Can withstand drought 1 = Die when drought stressed
Heat Resistance	5 = Can stand high temperatures 1 = Sensitive to heat

STATE OF OREGON



TREE SEED ZONE MAP
WESTERN FOREST TREE SEED COUNCIL
Revised July 1973 From a Map Adopted
April 5, 1966 Portland, Oregon
SEED ZONE DATA ADDED BY USFS

Seedling acquisition

Reforestation seedlings are grown in forest tree nurseries either on contract for specific buyers or as speculative stock grown for the general public. There are nearly 50 tree nurseries in Oregon producing 80-100 million seedlings per year. Current Oregon Forest Tree Nursery lists are available from local offices of the Oregon Department of Forestry and the OSU Extension Service.

Different seedling or stock types available include container grown, bare root, and transplants.

Container grown seedlings or plugs are grown in a greenhouse usually for one year. They are grown in plastic tubes or styrofoam blocks and the planting soil or rooting medium remains attached to the roots. Advantages of plugs include reduced growing time, extended normal planting season, well balanced shoot to root ratios and undisturbed roots. Disadvantages include smaller size which can be a problem on brushy sites or where deer browse is expected.

Bare root seedlings are grown in an outdoor nursery bed, usually for two years (2-0), but 1 year old (1-0) are becoming more common, and 3 year old (3-0) may be appropriate for slower growing smaller species. Advantages of bare root include being less expensive, less risky, less complicated and adapted to larger seedling size.

Transplant seedlings are either plugs or bare root seedlings that are lifted and transplanted into outdoor nursery beds for an additional year. Container transplants or plug-ones (P-1) and bare root transplants (2-1 or 1-1) are similar in characteristics. The main advantage is a larger seedling that is well balanced in shoot to root ratio and performs well in brushy and browsy situations.

Seedling care and handling

Seedlings are living things and must be handled carefully to be kept alive. Many past planting failures are due to poor handling practices resulting in planting trees that were dead on arrival. Three key factors to control in handling are water, temperature and physical damage.

Water

Out-of-soil seedlings must be kept moist, either by restricting water loss with a water vapor barrier or by adding water to the roots at regular intervals. A shipping bag or box usually contains an effective vapor barrier made of either polyethylene or wax. Roots loose water faster than the tops and need the most protection. During planting a waterproof planting bag can help keep roots moist, but water is still lost through the top, especially in warm dry conditions. Water can be added to seedlings in the shipping box or planting bag, or the roots can be dipped in a bucket of water for about i minute. Do not submerge roots for more than a few minutes as they need oxygen.

Temperature

Live seedlings burn food (stored sugars) through respiration to keep alive during the winter. Reducing food burned before planting, will help to ensure that reserves remain to support growth and avoid transplant shock. Respiration rate is controlled by tempera-

ture; as temperature increases, respiration increases, and heat given off by respiration drives the temperature up higher. Temperatures should be kept below 40 degrees F to prevent damage. Seedlings should be kept out of direct sun and or protected with a reflective space blanket. Do not cover with a tarp.

Physical damage

A seedling can be damaged by physical pressure caused by crushing, dropping, or excessive vibration. Seedlings are best protected from physical damage by minimizing handling.

Planting guidelines

When to plant

Plant when the upper 10 inches of soil is moist; when the soil is not frozen more than 1/2 in inch deep, when snow cover is less than 2 inches, when the air temperature is between 30 and 65 degrees Fahrenheit, and when wind velocity is less than 20 mph. The best time is rainy days from January 1 to March 15.

Keep the roots moist

Keep the root system covered and moist from the moment the plants are taken from the shipping bundle until they are planted. Plant trees in the rain if possible. This keeps the roots from drying out. Never carry a handful of trees exposed to the sun and wind. Take one tree at a time from the carrying container and plant it immediately, after the hole is dug.

Dig a good hole

Most planting errors come from not digging deep enough and wide enough planting holes. This can be done with either a hoe dad or a planting shovel, but must be done right. The hole should be more than deep enough to hold the root system with ease and allow for broken soil all around the root system to promote root growth. If the roots are 9 inches long, dig the hole at least 12 inches deep, so you can have broken soil under the seedling and still have plenty of depth.

Plant at the right depth

Trees should be planted at the same depth that they grew in the nursery or a little deeper. Planting too shallow is a common planting error and leads to upper roots drying out. Planting too deep can be a problem if lower twigs and needles are buried.

Get the roots in a natural position

Be sure the planting hole is large enough in width and depth so the root system will not be crowded or j-rooted.

Firm the soil around each plant

While holding the tree in an upright position at the correct depth, baring loose, most soil in around the root system. Do not let soil, rocks, or surface litter fall in around the roots. When the hole is filled in with moist soil, press it down firmly.

Plant at correct spacing

Seedlings are small and the tendency is to plan them thicker than they need to be. Spacing of 12' x 12' gives 300 trees per acre. This is a good spacing if high survival rates are expected . Spacing 10' x 10' gives 435 trees per acre. This spacing has been used a lot in the past, but can lead to a need for precommercial thinning if survival is high.

Choose a good planting spot

Spacing is important, but you need to be flexible in choosing the planting spot. On sites that become hot and dry in summer, try to choose a protected spot for each seedling. "Dead shade"—the north and east side of stumps and logs - is good. Avoid planting on game trails, in rock piles, in animal burrows, and in the middle of clumps of brush.

Vegetation Management: Weed Control

Introduction

Why control weeds?

Weeds compete with crop trees for water, light and nutrients.

Survival of crop trees

Growth of crop trees

Physical damage to crop trees

Hardwoods blowing against conifers and causing mechanical damage to tops and stems.

Vines, poison oak and morning glory pulling sapling crop trees over.

Animal habitat

Deer browse increased by presence of shrubs.

Rodent habitat improved by presence of grass.

Alternate hosts for disease

Bracken fern - Uridenopsis rust on true firs.

Currants and Gooseberries - White pine blister rust

Aesthetics/people

Horse tails in Christmas trees

Poison oak

Blackberries

How to control weeds

Manual

Includes chopping, hoeing, and pulling. Very time consuming and may not be effective with perennial species that sprout back from roots or rhizomes. May need to repeat several times per year.

Mechanical

Includes mowing, bulldozing, tilling and cultivating. Very time consuming and may not be effective with perennial species that sprout back from roots or rhizomes. May need to repeat several times per year.

Biological (animals)

Includes cattle, sheep, goats, and geese. Can be effective if you understand animal management. Can lead to crop tree damage, if you don't. If trees taste better than weeds or if weeds are all gone, then trees will be eaten. Very time consuming, unless animals are already part of your enterprise. Insects such as cinnabar moth have also been effective on weeds such as tansy ragwort.

Physical (smothering)

Includes mulching with straw, bark or paper. Can be expensive, but will work with herbaceous vegetation (grasses and forbs). May improve habitat for animal damagers. May not be practical for large acreage or steep slopes.

Thermal (fire)

Short term, expensive, limited effectiveness, dangerous and socially unpopular.

Chemical

Usually the cheapest, safest, and most effective way to control weeds. Technical knowledge required to kill weeds without damaging crop trees, applicator or environment. Highly regulated and can be socially unpopular.

Strategies

Site preparation

No crop trees present or at least not enough to worry about.

Emphasis is on preparing the site for planting of crop trees.

May involve burning, brush piling, plowing, disking, ripping, use of herbicides, or a combination.

Non-selective herbicides can be used since we are not trying to protect crop trees.

Some herbicides are labeled for site preparation only and not for conifer release.

Release

Crop trees are already present.

The emphasis is on removing or controlling the competing vegetation, while doing little or no damage to the crop trees.

Need to use only selective herbicides to avoid injury to crop trees.

Often need to use lower rates of chemicals than for site preparation.

Need to be sure herbicides are specifically labeled for conifer release.

Animal damage: Deer browse control

Animal damage problems include mice, rabbits, mountain beavers, deer, elk and others. Treatments include physical barriers, chemical treatments, and habitat manipulation. We can't cover all potential animal damage problems here, so will focus on deer

browse, as it is the most widespread animal damage problem in Oregon.

While deer browse on conifer seedlings occurs throughout the year, spring damage appears to be most serious on woodland property. Just when the new, lush foliage is beginning to expand and grow, local deer decide to make a meal out of it.

We all know deer have to eat too, and tree farmers wouldn't mind if they chewed lateral branches, but in most cases the top of the tree is munched off and with it an entire year's growth. That's discouraging when you are trying to grow a new forest.

What is available to forest managers interested in avoiding this problem? What are the pro's and con's of each method?

Note: These same methods can be used to prevent elk browse, but no method is completely effective with elk.

DEER-AWAY big game repellent (BGR)

- Available as a two-part liquid for spraying or as powder for dusting. Developed originally by Weyerhaeuser Company, BGR consists of putrified inedible egg solids in a latex sticker.
- Best applied to trees after bud break and when new foliage is at least 2 inches in length (and before browse occurs). Application timing is important. As the foliage expands the latex stretches on the new foliage. The more it stretches, the less effective it becomes.
- BGR does reduce browsing, but lasts only 6 to 12 weeks, depending on weather. It's a contact repellent, therefore is only effective when sprayed on foliage. Multiple applications may be necessary in some situations. BGR can be washed off trees if rain occurs before it has dried in place.
- The liquid repellent must be applied to dry seedling foliage in dry weather. It can be applied with a plastic spray bottle or backpack sprayer.
- The powder form is applied to wet or damp foliage. It absorbs moisture and sticks tightly to vegetation. Tying short lengths of flagging near top of seedling and treating flagging along with foliage has been shown to prolong effectiveness.
- There's no need to spray the entire seedling. Application to top and 1 or 2 laterals is adequate. Only new growth need be treated; no need for penetration.
- The product is registered with EPA for use on conifers in the Pacific Northwest. 85+% effective in eliminating browsing and clipping by deer and rabbits. It will not repel other rodents.

Vexar tubes

- Vexar tubes are plastic mesh tubes placed over seedlings for browse protection. Bamboo stakes are used to support and secure the tubes. Many sizes are available. Popular size is 3-1/4 inch diameter, 36 inches long. The cost is approximately 1 cent per inch of length. With a bamboo stake for support cost can be as much as $ .50 per tree or more.
- Once installed the tree grows up through the tube, protecting the terminal leader. By the time the leader grows through the tube it is no longer within range of browsing deer.

- Like most plastics, the mesh tubes decompose in sunlight within 1-4 years. Various UV levels are available. Some people remove and reuse the tubes a second time.
- Vexar tubes have proven very effective, but are also expensive.
- Tubes may be placed over the seedling at the time of planting or may be installed at a later date. Some nurseries will even install tubes for you. For best results, install the tube at the time of planting, covering the entire seedling, letting 10-12 inches of the tube extend beyond the top of the seedling, allowing for growth before the tree is exposed.
- The tube may be adjusted upward as tree grows.

Bud caps and sleeves

- Bud caps and sleeves consist of small cylinders fastened below the terminal bud of the seedlings in early spring. They protect leader growth for 4-6 weeks after bud break, the time when most browsing occurs.
- Bud caps are available as flat sheets of waterproof (Rite-in-the-Rain) paper or reemay (spun polyester fabric).
- The paper or reemay sheets measure 5-1/2 X 8-1/2 inches. To install a bud cap, staple one end to make cylinder. Slip this over seedling terminal, so approximately 5 inches extend over top and 3-1/2 inches down the stem. Cap is stapled against stem, taking care not to staple into the stem.
- Pre-sewn reemay sleeves come in rolls and can be cut to any length. Short lengths are installed as bud caps. Long lengths can be used to cover the entire seedling. Some staking may be necessary for full length sleeves.
- Reemay and paper bud caps are inexpensive. Large diameter reemay sleeves are more expensive. Material cost ranges from $ .03 to .08 per tree.
- Bud caps and sleeves are low cost and application can be done anytime after bud set in fall and prior to bud break in spring.

Vexar netting

- Netting is like vexar tubing, but is flexible. It's the same kind of plastic mesh that grapes are packaged in. This netting is stretched over the tree. As it contracts, a tube is formed, through which the tree's leader grows.
- It is usually not staked and can be used to cover the entire seedling or only the leader. A disadvantage to netting is possible tangling of the tree.
- Material costs are approximately $ .02 to $ .04 per tree.
- Netting is also available in a heavier gauge material that appears to have more advantages. The more rigid construction keeps it from bending over during rainy weather allowing the leader to grow straight and uninhibited. Because this material is thicker plastic, small flimsy seedlings may not be able to support the additional weight and might require a stake for support.

Vegetation management

- In some areas the best deer browse control has been shown to be controlling vegetation to allow trees maximum growth, rather than doing anything to directly prevent browse.
- One western Oregon study compared all above methods of deer browse control including doing nothing. In addition to deer browse control, vegetation management was also varied from aggressively controlling everything except the trees to doing nothing.
- The study found that after 10 years the largest and healthiest trees were on the plots that had total vegetation control, but no deer browse control.
- All methods of deer browse control had some adverse effects on seedling growth. Total vegetation control allowed trees to put on a second flush of growth during midsummer when browse pressure was much lower.
- Some trees that are browsed, even heavily, but still survive seem to put extra effort into root growth. After a few years of repeated browse, these trees will suddenly put out a leader long enough to get above the browse line.

Thinning

Definition of thinning: Removal of some trees in immature stands in order to stimulate growth of remaining trees and increase yield of usable wood.

Precommercial thinning: removal of products that are not salable or don't pay their way out of the woods.

Commercial thinning: removal of products that are salable and pay their way out of the woods.

Objectives of commercial thinning

Capture mortality: use or sell trees that would otherwise die or decay.

Increase timber production: concentrate growth on fewer stems, thereby increasing board foot volume production.

To reduce investment in standing volume, thus reducing risk.

To provide periodic incomes to pay off investments in reforestation, precommercial thinning, stand improvements and taxes.

Stand protection: increase vigor of stand to reduce risk of bark beetle and other insect attacks.

Enhance non-timber values: grazing, wildlife, recreation and aesthetics.

Reasons for not commercial thinning

Increased windthrow potential: especially shallow rooted species and shallow or poorly drained soils.

Financially may be a poor investment: if stand is too old or if thinning costs are too high.

Damage to residual stand: can be a problem in the spring and with some species such as grand fir.

Too steep: cable yarding is very expensive for partial cutting.

No potential growth response: if live crown ratio of potential leave trees is <30%.

Crown classes (see diagram)

Dominant - Trees with the crown extending above the general level of the crown canopy receive full sunlight from above and some from the side. The sides of the crowns are well developed, but may be somewhat crowded.

Codominant - Trees with crowns forming the general level of the crown canopy, receive full sunlight from above but little from the sides. The tree crowns are medium sized and are more crowded than the dominants.

Intermediate - These trees are usually shorter than those in the preceding crown classes, with small, crowded sides. The crowns extend into the canopy and receive a little direct light from above, but none from the sides.

Suppressed (overtopped) - The crowns on these trees are below the level of the crown canopy. They receive no direct light from above or from the sides.

Wolf - These trees develop and grow in the open. They have full crown on all sides, with branches well below the canopy level. The crowns are uncrowded on two or more sides and receive full light from above and well down on two or more sides.

Mortality - These are dead trees within the stand. Suppressed trees usually die and trees of any crown class may die from insect or disease attack.

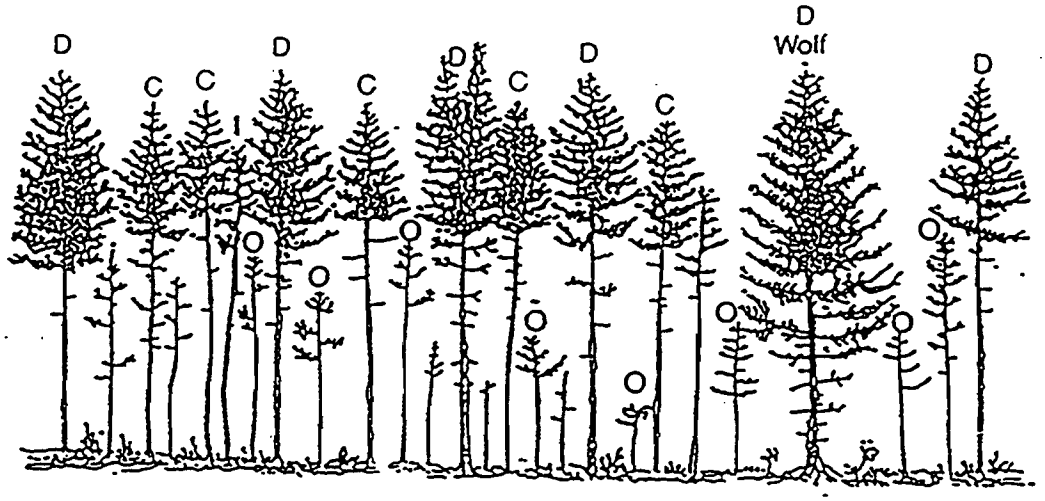
Types of commercial thinning

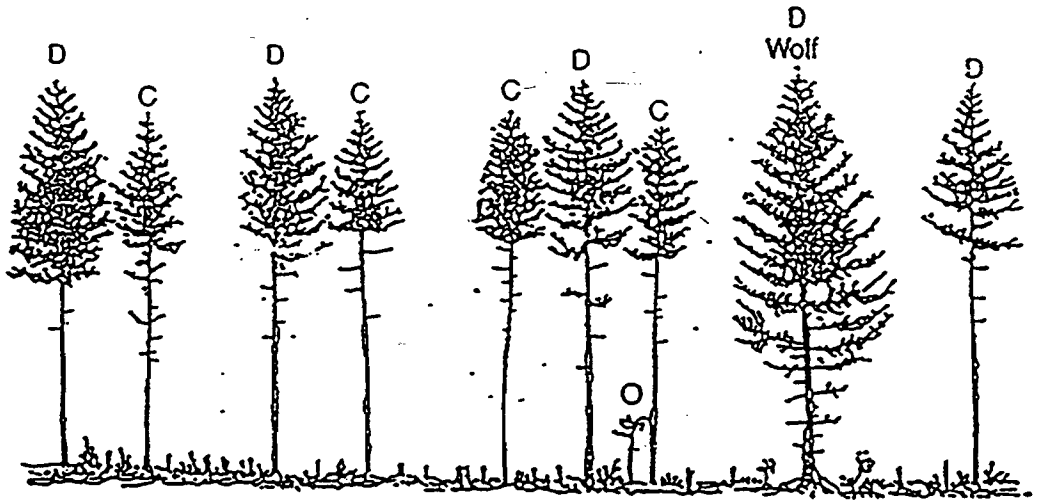
Low thinning - Removes all suppressed, most intermediates, many codominants and even some dominants. The remaining stand consists of uniformly spaced dominant and codominant trees. Up to three quarters of the trees are removed and the average stand diameter increases. (See diagram for a graphic depiction of low thinning).

High thinning - Removes relatively few dominant and codominant trees to release a large number of remaining trees. To be effective leave trees must have live crown ratios of at least one-third. Care must be taken to avoid high grading, removing all the good trees and leaving the junk. (See diagram for a graphic depiction of high thinning).

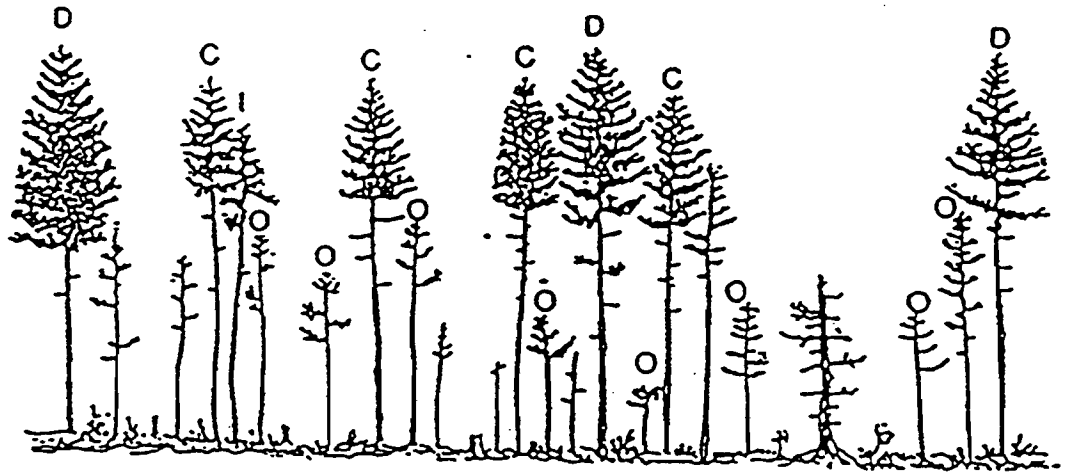
Which to use - One common practice is to use high thinning in the first thinning when trees in the lower crown classes are still high in crown ratio. High thinning removes trees that are larger than the average diameter so you can enter a stand much earlier with high thinning and have merchantable sawlogs.

As the stand matures low thinnings are more commonly used to capture mortality of suppressed and intermediate trees and to avoid damage to residual trees often encountered in falling large dominants and codominants.





Low Thinning



High Thinning

Intensity of thinning

Intensity refers to how heavily you thin. If you thin lightly you will need to thin frequently to keep the trees growing well. If you thin heavily you will need to thin infrequently.

D+ Rule - A common spacing or intensity guide for Douglas-fir is the D-plus rule. It specifies that the average spacing (in feet) of remaining trees should be equal to the average stand diameter (in inches) after thinning, plus some constant.

Commonly D+4 or D+5 thinnings are made in early years and D+6 or heavier thinnings are made in later years.

For example, if you have a stand which will be thinned to leave an average diameter of 12 inches and are using a D+ 5 rule, the average spacing of leave trees should be about 17 x 17 feet, leaving about 150 t.pa.

Douglas-fir thinning guide (see diagram) - Another spacing guide is the Douglas-fir thinning guide. This complicated looking diagram is really simple to use.

You simply enter the average diameter of your trees along the bottom and the number of trees per acre on the right and locate yourself on the diagram. If you find yourself in the cut zone it is time to thin. If you will be thinning, then you find the average diameter of your leave stand at the upper edge of the "optimum growth zone" and read across to either your leave density in trees per acre or to your distance between trees or spacing in feet.

For example, if your stand has an average diameter of 12 inches and a density of 360 trees per acre or an average spacing of about 11 x 11 feet, then you are in the cut zone and will need to thin. If you plan to do a low thinning, you will raise the average diameter to maybe 13 inches. According to the thinning guide you should thin to a leave spacing of about 17 feet, leaving about 150 trees per acre. This is equivalent to thinning to about a D+4 spacing.

The advantage of the Thinning Guide over the D-plus rule is that it tells you whether you need to thin or not and at what size tree you will need to thin for a given density.

Selection of leave trees

The following types of trees should be selected to be left as crop trees:

Dominant and strong codominant trees

Trees with >30% live crown ratio

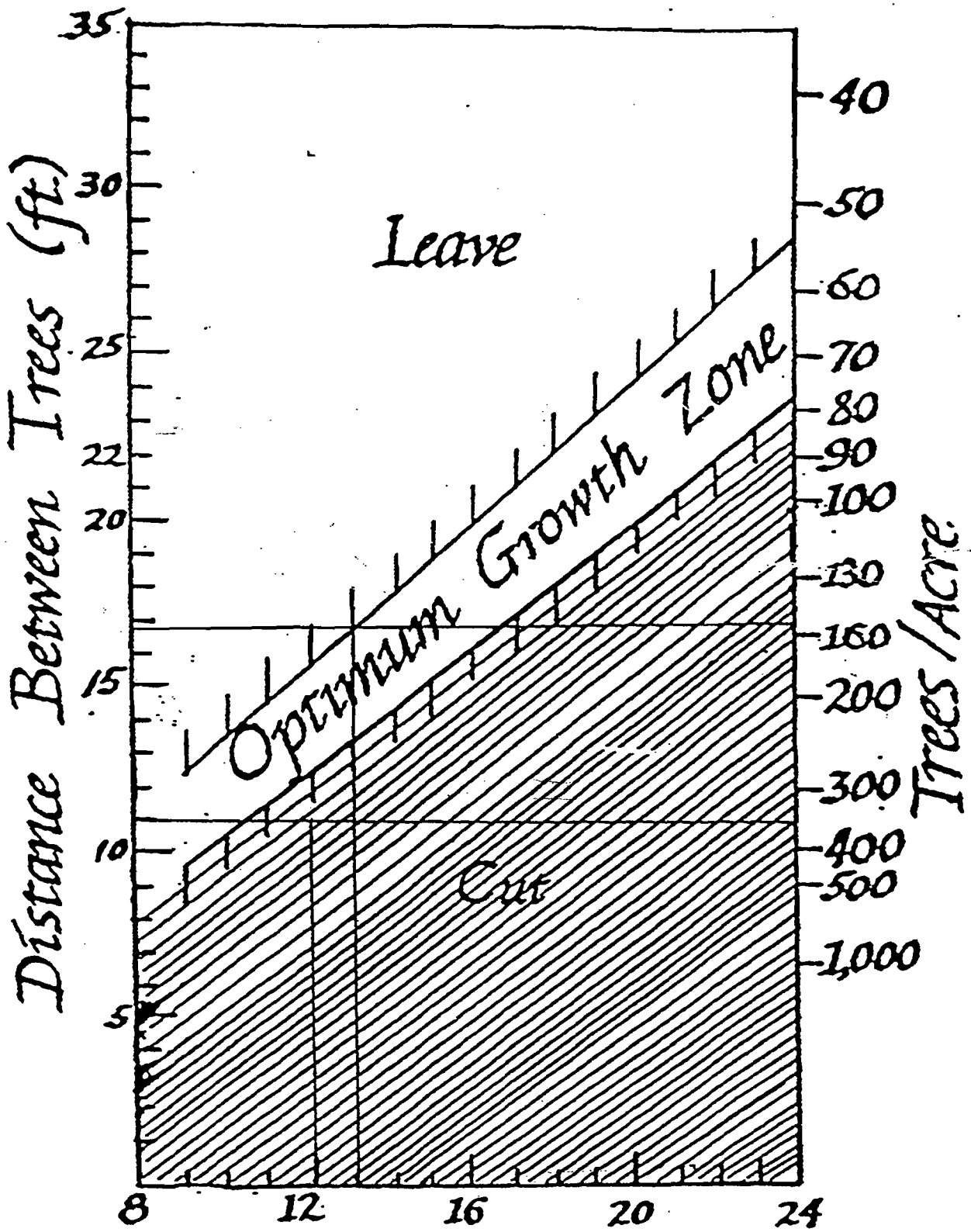
Trees at proper spacing

Healthy trees

Trees of good form

Trees of desirable species

Douglas fir Thinning Guide



Diameter of Trees (in.)

OREGON STATE UNIVERSITY
Extension Service

Columbia County

Selection of cut trees

The following types of trees should be selected to be cut:

Dying trees

Rough limby dominants

Trees competing with crop trees

Diseased trees

Trees of poor form

Trees of undesirable species

Pruning

Introduction

Pruning defined

"Pruning is the operation of removing the limbs, both living and dead, along the lower trunk of trees."

Process of natural pruning

Natural pruning proceeds from the ground up, no significant advantage (i.e. clear wood) is gained until the branch stubs are covered.

Three distinct steps in natural pruning:

- Branch death,
- Branch shedding, and
- Healing of branch stub.

This 3-step process is determined by initial stand density and rate of growth.

Old-growth quality versus second-growth stands. Old-growth stands have a high proportion of high-quality stems because the pruning process occurred long ago and branch trees have had long time periods to heal over and lay down substantial amounts of clear wood.

Today we do not hold our trees long enough to get this clear wood. Because Douglas-fir takes so long to self prune, initial tight spacing and long rotations were necessary to obtain high quality stems.

Without pruning, high quality stems do not begin to appear until age 80 to 100, because dead limbs persist long enough to prevent the formation of clear wood.

Factors affecting tree quality

Tree spacing - The wider the spacing the faster trees grow in diameter. Because lower branches are not shaded, branches remain alive and continue to gain in size. Even if they die later, the increased branch size allows the dead branch to persist for decades. Wider spacing also increases the number of branches per whorl, thus more knots.

Internodal length - The longer the section between branch whorls, the more knot-free wood. This depends on site quality and, to a lesser extent, stand density.

Site class - Better sites produce faster growing trees, both in diameter and height. The longer the internodal length, the more clear wood. Fast diameter growth on good sites produces larger trees in a shorter time period.

Time - Because natural pruning takes so long, growing a tree with increased quality, would require long time periods to cover over branch stubs and to lay down substantial amounts of clear wood.

Pruning strategies

Optimum diameter - Given that rotations will be shorter in the future, little will be gained unless the knotty core is held to 8 inches or less. Also, the younger the stand at pruning, the smaller the branches; small branches heal over quickly, reducing the chance of fungal decay. Managed stands in the future will only produce an average stand diameter of 16 inches (age 50), thus with a knotty held to 6 inches, 5 inches of clear wood will be produced.

Timing with respect to crown - Pruning will not only remove dead limbs, but also a significant amount of green crown may be removed in the process. Generally, remove no more than 50% of the live crown in any pruning operation and leave a live crown ratio of at least 40%. To make pruning operational, delay until all branches can be removed up to 18 feet in height in one operation. This will minimize pruning cost and reduce shock to the tree. It may mean a trade-off of increasing the knotty core, however.

Height of pruning - Trees should be pruned to a height of 18 feet to gain full market value of the first log. There is little to be gained by pruning just the lower 8 or 9 feet of the bole. Because 40 to 50 percent of the value of the tree is in the first log, landowners may not want to prune above the 18 foot level. Generally, pruning proceeds in a two-step operation to avoid removing too much of the crown, while keeping the knotty core to a minimum. Because there many be greater costs to a two-step operation, landowners may want to consider a one-step operation. The major drawback to a one-step operation is that it may leave a knotty core of larger diameter.

Timing with thinning operations - The time it takes to heal over pruning wounds depends on the rate of diameter growth and diameter and length of the branch stub. Minimizing the time it takes to heal over reduces the risk of disease infection. Accelerated diameter growth also increases the amount of clear wood produced, once wounds are healed. Pruning should always follow thinning, as some trees may become damaged during the thinning operation and require removal.

Number of trees to prune - There is no doubt that pruning will improve the quality and, most likely, the future value of the tree. However, pruning is expensive. Therefore, it is unlikely that the landowner can afford the time and the labor cost of pruning all the trees in a given stand. Since some trees will die from natural agents, pruning trees that would die is would be a waste of capital. Thus, most pruning is limited to the 75 to 100 crop trees per acre targeted for harvest at the end of a rotation. All others will either die naturally, or be removed during thinning operations.

By pruning only the faster growing crop trees, you are concentrating limited capital on your best trees.

In summary, for the 75 to 100 trees to be pruned, all should be straight, free from defect, and have proportioned crowns. Pruning should also be done only on the better sites, since they will yield the greatest return.

Tools for pruning

Hand pruning saws: good for removing the lower, dead branches.

Pole pruners: needed for removing limbs on the upper portion of the bole.

Mechanical pruners: e.g. tree monkey - it is fast and can prune up to 30 or 40 feet.

Economics of pruning

The return on the pruning investment is influenced by the cost of pruning, the investment period, the interest rate, the rate of clear wood production and the future value of the product.

The cost of pruning is influenced by branch size, internodal length, number of branches per whorl, height of pruning, and cost of labor. The rate of clear wood production is influenced by site class, branch diameter, age of pruning, rotation age and other intermediate stand treatments such as thinning and fertilization.

Many people currently believe that pruning is a good investment for small woodland owners on better sites, when thinning is also being done.

Fertilization

Because many sites in the Pacific Northwest and elsewhere show nitrogen deficiencies, forest fertilization can substantially increase growth, yield and financial return on many sites. As such, fertilization has become a common practice on many private and public forestlands. However, not all species respond on all sites.

Objectives of fertilization — Why fertilize?

increase growth of merchantable stands

shorten the rotation age

capture the site faster by speeding crown closure

maintain soil fertility or restore it where it has been depleted

increase financial return

increase the allowable cut

Nitrogen — The limiting nutrient

The total amount of nitrogen (N) in the forest floor and mineral soil can vary from 800 to over 17,000 pounds per acre. Organic N accumulates on a site from litterfall, root death, and by additions from nitrogen-fixing plants. Most of the N resides in the organic matter and upper soil horizons.

Unfortunately, most of this N is not in the form trees and other plants can readily use. In fact, only about 5 to 10 percent of the total N pool is in a form plants can

use for growth. It is this 5 to 10 percent that all plants, including trees, must draw on and compete for to maintain growth.

Nitrogen requirements of trees and stands vary over the life of the stand. Soil N uptake increases directly with crown growth, usually peaking at or near crown closure. It is at this point in stand development where maximum crown, root and wood growth occurs. As lower branches and needles die from excessive shading, N contained within is recycled to other growing points within the tree. Thus N uptake will decrease over time because the tree's N requirement can be met, in part, by this reallocation process.

Effects on conifer growth

Conifer growth response: Fertilization generally causes the foliage to darken, length, and remain on the tree for one or two additional years. In addition, needles per unit of twig length and needle photosynthetic efficiency increase as well. The net effect is that crown volume increases. With more crown the tree is able to manufacture more carbohydrates needed for growth. This translates into greater diameter and height growth and results in increased volume production on most sites.

Length of response: Sites that are fertilized generally receive 150 to 400 pounds of N per acre. Trees respond quickly to N additions, peaking three to five years after application. Heavier dose of N usually increase growth, but at a decreasing rate. Total length of response varies from 8 to 15 years depending on site and species.

Site quality also has a profound effect on the growth response to N. Generally, growth response of trees on more productive sites shows a decreasing positive effect to N additions. This makes sense since good sites already have more favorable N levels.

Which species respond?: Not all conifers respond consistently to N fertilization on all sites. For example, western hemlock is considered a "non-responder," whereas Douglas-fir and ponderosa pine respond over a wide range of sites.

Do thinned and unthinned stands respond differently?: Response of Douglas-fir to N fertilization depends a great deal on whether the stand has been thinned. Long-term fertilized growth plots located in stands throughout the Northwest show that only 67 percent of the unthinned plots respond to N additions of 200 pounds per acre. Mortality also significantly increased in these stands.

In contrast, over 90 percent of the stands that were first thinned and later fertilized responded to N additions of 200 pounds per acre. This shows that other factors may limit growth even when N levels are favorable. Thus, stands where trees are free to grow, having room for crown and root expansion, respond the best. In addition, wood added in response to fertilization on thinned stands is on trees of higher value and of greater growth potential.

Silvicultural systems

Even-aged systems

Operations take place over a short portion of the rotation.

Ages of trees in stands are the same age within 20 years.

Diameter distribution is normal, bell shaped.

Clearcutting method: removal of the entire stand in one cutting with reproduction obtained artificially or by natural seedling from adjacent stands or from trees cut in the clearing operation.

Seed-tree method: removal of the mature timber in one cutting, except for a small number of seed trees left singly or in small groups

Shelterwood method: removal of the mature timber in a series of cuttings, which extend over a relatively short portion of the rotation, by means of which the establishment of essentially even-aged reproduction under the partial shelter of seed trees is encouraged.

Uneven-aged systems

Operations take place throughout the rotations.

Trees of all ages are present

Diameter distribution is J-shaped.

Single tree selection method: removal of the mature timber as scattered individuals at relatively short intervals, repeated indefinitely, by means of which the continuous establishment of reproduction is encouraged and an uneven-aged stand is maintained.

Group selection method: removal of the mature timber as small groups at relatively short intervals, repeated indefinitely, by means of which the continuous establishment of reproduction is encouraged and an uneven-aged stand is maintained.

Harvest/logging systems

There are several timber yarding systems available for logging in Oregon. They can be compared by general performance categories to determine their feasibility for certain situations.

Horse logging

Horse logging can generally yard only small timber <24" DBH. Production potential is low. Cost of production is low. There are no limits on silvicultural systems. Topography is limited to gentle terrain with some short pitches over 50% and downhill logging preferred. Haul roads must be close to skid roads (300-500' preferred). Stream protection can be excellent with proper practices. Site disturbance is minimal. There is limited slash disposal capability. Landings are small (50' diameter). Availability is fair.

Tractor and wheeled skidders

Tractors and wheeled skidders are capable of handling all sizes of timber within the design range of the machine. Production potential is high. Cost of production is low. There are no limits on silvicultural systems. Topography is limited to slopes up to 35-45% and downhill logging preferred. Long skid distances are feasible, but not economical. Stream protection can be excellent depending on proximity to stream and practices; crossings need preparation. Medium to high site disturbance; soil compaction potential; damage to residual stands possible. There is good slash disposal capability. Landings are medium (75' diameter). Availability is excellent.

Mechanized harvesting systems

Mechanized harvesting systems include feller-bunchers and tree processors working in tandem with log forwarders. These systems are capable of handling only small to medium timber <24" DBH. Production potential is high. Cost of production is low. There are no limits on silvicultural systems. Topography is limited to slopes up to 35-45%. Medium skid distances up to 1,500' to the road are feasible. Stream protection can be good with proper practices; crossings need preparation. Medium to high site disturbance; soil compaction potential; damage to residual stands possible. There is some slash disposal capability. Landings are medium (75' diameter). Availability is poor to fair.

Cable and skyline systems

Cable and skyline systems are capable of handling medium to big timber; small timber in thinnings. Production potential is medium to high. Cost of production is medium to high. Clearcuts are most suitable silvicultural system, but partial cutting is possible. Deflection is necessary, but suitable to steep slopes. High lead logging is possible with yarding distances up to 1,500'. Some skyline are operational at 5,000'. High lead offers poor stream protection if crossing streams, otherwise good; skylines can lift logs over streams, offering excellent protection. Minimal to medium site disturbance with proper practices; damage to residual stands possible in partial cuts. There is slash disposal capability. Landings are medium (75' diameter). Availability is good.

Helicopter logging

Helicopter logging systems are capable of handling medium timber, with strict weight limits per turn. Production potential is very high, but weather limits operability. Cost of production is very high. There are no limits to silvicultural systems. There are no topography limits. There is no limit of road access, except by economy. Stream protection is excellent. Site disturbance is minimal. There is no slash disposal capability. Requires a 100' diameter landing + 50' x 100' setdown/ maintenance area. Availability is poor.

Suggested Field Exercises

Forest measurements

Stand examination

Visit a stand that the crew will be thinning or working in. Discuss a strategy for doing a stand examination of the unit, including how many plots to take, what size of plots to take and how to locate plots. Maps or aerial photos of the unit would be very helpful, if available.

The stand exam will use the method discussed in EC 1190, *Stand Volume and Growth: Getting the Numbers.*

Teach crew members how to measure dbh and total heights using whatever tools are available. Master Woodland Manager Sticks are available from the OSU Extension Service, Forestry Program for $1.

Take one plot with the whole crew together making sure that each person understands all tasks involved.

Divide the crew into teams of 3 and have each team take at least two plots, trading jobs on the team.

Bring the teams back together and go through the calculations as a group.

Thinning

In same stand as stand exam was taken in exercise 1 or another stand, use stand exam information or "zig-zag "method to estimate average diameter and average spacing or trees per acre.

Discuss concepts of live crown ratios and crown classes using examples from the stand.

Use the D+ rules and the Douglas-fir Thinning Guide to develop a thinning prescription for the site. Thinning prescription should include approximate spacing of leave trees, expected average diameter of leave trees, species preference, live crown ration preference, and crown class preference for leave trees.

Mark part of the stand to the crew's thinning prescription using flagging.

Take a few stand exam plots in the marked section to determine trees per acre and average diameter of leave trees. Compare this leave tree information to the prescription, to the D+ rule and to the Douglas-fir Thinning Guide.

Reforestation

Visit a unit that is to be reforested and using the Reforestation Planning Checklist, develop a basic reforestation plan for the unit.

Visit a planted unit and do a stand examination/stocking survey using fixed plots. In addition to trees per acre by species, have the crew estimate animal damage and vegetative competition.

Demonstrate seedling handling and tree planting techniques.

Visit a forest tree nursery.

Demonstrate deer browse control techniques and/or back sprayer calibration techniques as applicable.

Resources for Further Information

Extension publications

These publications are available from Extension and Experiment Station Communications, Publications Orders, Administrative Services Bldg. 422, Oregon State University, Corvallis, OR 97331-2119.

EC 858, *Timber Harvesting Options,* by J.J. Garland, Oregon State University Extension Service (Corvallis, 1983). No charge.

EC 956, *Logging Woodland Properties,* by J.J. Garland, Oregon State University Extension Service (Corvallis, 1983). $0.75

EC 1095, *Seedling Care and Handling,* by B.D. Cleary and D.R. DeYoe, Oregon State University Extension Service (Corvallis, 1982). $0.25

EC 1127, *Measuring Timber Products Harvested from Your Woodland,* by P.T. Oester, Oregon State University Extension Service (Corvallis, 1993) $2.00

EC 1128, *Estimating Site Productivity on Your Woodland,* by S. Woodard, Oregon State University Extension Service (Corvallis, 1984). $1.00

EC 1129, *Tools for Measuring Your Forest,* by S. Woodard, Oregon State University Extension Service (Corvallis, 1993). $1.25

EC 1132, *Thinning Systems for Western Oregon Douglas-fir Stands: What is Best for You?,* by W.H. Emmingham and D. Green, Oregon State University Extension Service (Corvallis, 1984). $1.00

EC 1188, *Site Preparation: An Introduction for the Woodland Owner,* by S.A. Fitzgerald, Oregon State University Extension Service (Corvallis, 1989). $1.00 EC 1189, Using Precommercial Thinning to Enhance Woodland Productivity, by P.T. Oester, Oregon State University Extension Service (Corvallis, 1993). $1.25

EC 1190, *Stand Volume and Growth: Getting the Numbers,* by R.A. Fletcher, W.H. Emmingham and S. Woodard, Oregon State University Extension Service (Corvallis, 1993). $1.75

EC 1196, *Selecting and Buying Quality Seedlings,* by R.E. Duddles and C.G. Landgren, Oregon State University Extension Service (Corvallis, 1993). $1.25

EC 1201, *Understanding and Controlling Deer Damage in Young Plantations,* by D.D. DeYoe, D.S. deCalesta, and W. Schaap, Oregon State University Extension Service (Corvallis, 1985). $1.75

EC 1388, *Introduction to Conifer Release,* by R.E. Duddles and M.J. Cloughesy, Oregon State University Extension Service (Corvallis, 1992) $1.00

EC 1457, *Pruning to Enhance Tree and Stand Value,* by W.H. Emmingham and S. Fitzgerald, Oregon State University Extension Service (Corvallis, 1995) $1.50

EM 8241, *Reforestation Planning Guide: Helping Insure Reforestation Success for Woodland Owners,* by D.R. DeYoe and B.D. Cleary, Oregon State University Extension Service (Corvallis, 1983) $2.50

EM 8532, *Oregon Pesticide Applicator Manual: A Guide to the Safe Use and Handling of Pesticides,* T.L. Miller, editor and coauthor, Oregon State University Extension Service (Corvallis, 1994) $14.50

PNW 184, *Thinning: An Important Timber Management Tool,* by W.H. Emmingham and N.E. Elwood, Oregon State University Extension Service (Corvallis, 1985) $1.00

PNW 320, *Calibrating and Using a Backpack Sprayer,* by C.G. Landgren, Oregon State University Extension Service (Corvallis, 1987) $1.00

College of Forestry publications

These publications are available from Forestry Publications Office, Oregon State University, Forest Research Laboratory 227, Corvallis, OR 97331-7401

FRL-SP1, *Five Steps to Successful Regeneration Planning,* by B.D. Cleary, B.R. Kelpsas, and D.R. DeYoe, Oregon State University, Forest Research Laboratory (Corvallis, 1986).

Reforestation Practices in Southwestern Oregon and Northern California, by S.D. Hobbs, S.D. Tesch, P.W. Owston, R.E. Stewart, J.C. Tappeiner II, and G.E. Wells, Oregon State University, Forest Research Laboratory (Corvallis, 1992).

WILDLIFE HABITAT MANAGEMENT

W. Daniel Edge

Introduction

In this section of the curriculum we review some of the principles of wildlife management. We will examine how wildlife make their living in forest ecosystems and general wildlife habitat requirements. We will look at some of the special or unique habitat components that occur in forest ecosystems that may require special attention during forest management operations. Once we have examined the basics of wildlife habitat requirements then we will examine some of the processes that operate at larger spatial scales. It is these processes that provide us with the challenges of managing forest ecosystems because they require us to think about how to manage across multiple property boundaries and over time periods that are longer than the normal management horizon.

Management for most species of wildlife in forest ecosystems is accomplished as a by product of timber and watershed management. Thus, understanding wildlife habitat requirements and needs is an important component of managing any forestry property. Forest management practices are generally considered compatible with maintaining wildlife species. However, historical patterns and practices have placed some wildlife species at risk, because some species are sensitive to loss of special habitats or habitat components, or because landscape patterns created by forest managers interfere with life histories of some species. Ecosystem management, if successful will prevent the loss, or further declines in the populations of these sensitive species.

Glossary

Biodiversity

The variety of living organisms considered at all levels, from genetics through species, to higher taxonomic levels, and including the variety of habitats and ecosystems

Alpha diversity. The variety of organisms occurring in a particular place or habitat. Often called local diversity. This would be analogous to stand-level diversity.

Beta diversity. The change in variety of organisms among habitats in a particular region. This would be analogous to among-stand diversity and is dependent on the number of different habitats within a region and the contrast of adjacent habitats. For example, a clearcut adjacent to an old-growth stand would have higher beta diversity than an old-growth stand adjacent to a saw-timber stand.

Gamma diversity. The variety of organisms summed over all habitats within a region. This is analogous to landscape-level diversity.

Genetic diversity. The variety of genes within a particular species, variety, or breed. Species restricted to specific areas will usually develop unique genetic characteristics that allow them to survive better. Because a greater range of genetic diversity ensures that a species might survive an unexpected event (i.e., global warming), maintaining a high degree of genetic diversity is important for the conservation of species. An example is the listing under the ESA of salmon that return to particular river drainages. These runs or stocks are genetically different than runs in adjacent river systems and presumably are better adapted for survival within their particular river system.

Corridor

A patch of habitat connecting other isolated patches of habitat and providing for the movement of organisms among patches.

Ecotone

The area influenced by the transition between plant communities or between successional stages or vegetative conditions within plant communities.

Edge

The place where plant communities meet or where successional stages or vegetative conditions within plant communities come together.

Edge effect

An ecological process that is accelerated at the boundary (edge) between two or more habitats.

Edge species

Species that are associated with edges.

Habitat

The sum total of the environmental conditions of a specific place occupied by plant or animal species or a population of such species.

Habitat fragmentation

A process, usually driven by land use practices, in which the total amount of a habitat within a landscape is reduced and the remaining habitats are apportioned into smaller, more isolated patches.

Landscape ecology

The science of ecological functions and processes that occur on large spatial scales.

Metapopulation

A collection of subpopulations of a species, each occupying a suitable patch of habitat in a landscape of otherwise unsuitable habitat. The fraction of suitable habitat patches occupied at any given time represents a balance between the rate at which subpopulations go extinct and the rate at which patches are colonized.

Sink habitats

Poor habitats where local reproductive success is less than local mortality. Without immigration from "source" habitats, populations in "sink" habitats inevitably spiral "down the drain" to extinction.

Source habitats

Good quality habitats where local reproductive success is greater than local morality. Populations in source habitats produce an excess of individuals that must disperse outside their patch in order to find a place to settle and breed.

Species richness

The number of species present in an area. One of the most commonly used measures of biodiversity.

Structural diversity

The variation within a habitat that is a function of the structural complexity of the vegetation. Clearcuts have low structural diversity whereas uneven-aged managed stands have higher structural diversity.

Competency Measures

Competency in this topic will be accomplished by understanding the following concepts or questions:

- What are the basic components of wildlife habitat?
- What are the positive and negative effects of creating edge habitats in forest ecosystems?
- What is a metapopulations, and how might landscape patterns cause such populations to decline?
- What is habitat fragmentation and how have historical patterns of timber harvest created fragmented landscapes?
- What is biodiversity and what are some of the causes in declines in wildlife populations?
- What are patterns of species richness in forest ecosystems?

Wildlife Habitat Needs

Wildlife habitat is composed of four basic components: food, cover, water, and space. All wildlife species use these basic needs on a daily basis, and these needs become the basis of managing forest ecosystems for wildlife.

Food

Understanding food requirements for wildlife can be complicated because nutritional requirements of each species differs seasonally, different foods differ substantially in their nutritional components and these components may also vary seasonally. In addition, food is usually not evenly distributed in the animals environment.

Abundance refers to the quantity of food in the environment independent of the consumer whereas *availability* refers to the direct accessibility of food to the consumer. It is possible that food is very abundant but is unavailable to the animals. For example, big game species such as deer and elk rely heavily on shrubs for winter food in many areas of the western U.S. However, many shrub species, such as willow or serviceberry, can grow to be too tall for these species to browse. Because of this availability, big game winter ranges are burned with subscribed fire on a 10-15 year cycle. Burning causes many shrub species to resprout, thus improving the availability of these food sources. Likewise, a heavy snow with a hard crust can make grass and forbs underneath unavailable to some wildlife species.

Foods vary in their nutritional value and cost of capture and use, and wildlife species vary in their nutritional requirements. A basic difference occurs between animals that eat plants, *herbivores,* and those that eat meat, *carnivores.*

Because plants generally have low protein levels and because nutritional values differ among plant species and within a species throughout the year, herbivores can be subject to both quantitative and qualitative food stress. Thus, herbivores may have periods where they have difficulty obtaining sufficient food (quantitative food stress). But, even under conditions where some plants are abundant, herbivores may difficulty obtaining sufficient nutrition from the foods that are available (qualitative food stress). Carnivores, on the other hand, usually expend a lot of energy trying to capture prey, but their food is always high quality. Thus, carnivore populations are limited by the amount of food available and may be subject to quantitative food stress.

Cover

Cover, often called security, is the second basic wildlife habitat need. Cover is a component of the abiotic or biotic environment that prevents waste of energy. Energy can be lost by an animal either because of environmental conditions (heat or cold), or because of the ultimate energy loss, predation. Thus, cover is defined by function.

Hiding or escape cover

Hiding or escape cover is cover that provides an animal with security from predators. All species of wildlife use this type of cover and the availability of escape cover can limit a species use of its environment. For example, deer and elk use of clearcut open-

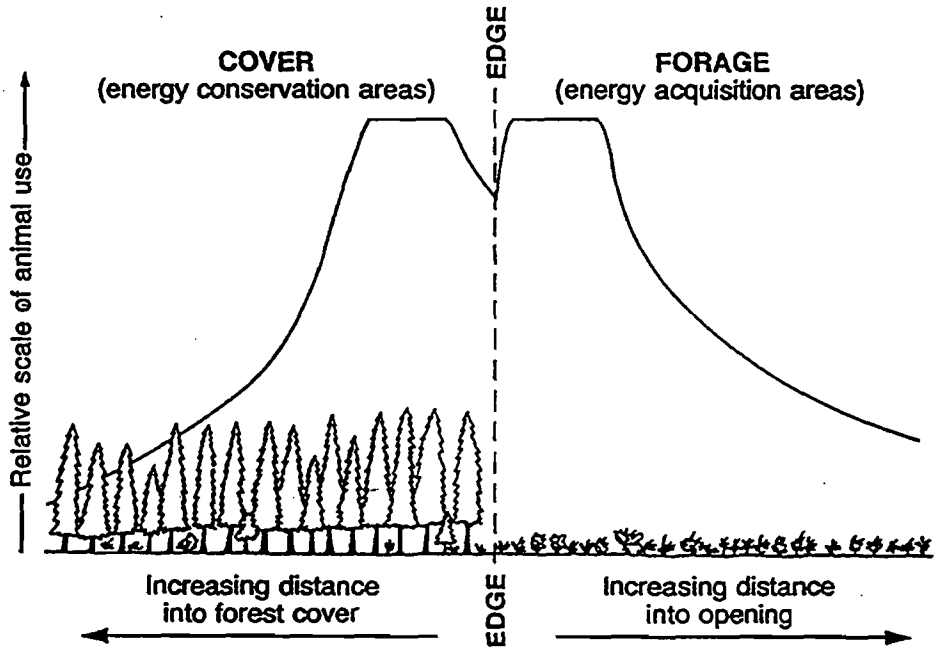


Figure 1. Elk and deer use of openings in forest environments declines with distance from the forest edge.

ings is limited by how far they will forage from forest cover (Figure 1). Because deer and elk use drops off substantially beyond 200 yards from cover, clearcuts on big game ranges have generally been limited in size so that most of the clearcut is within 200 yards of cover. Much larger clearcut would have central portions that were not used much by big game; regeneration in these areas would be subject to less browsing damage from big game.

Thermal cover

Thermal cover is vegetation that protects wildlife from loss of energy when they are exposed to excessive temperatures. Animals have an optimal temperature range for environmental conditions called a *thermal neutral zone,* and usually seek conditions and habitats within that range. Temperatures above the thermal neutral zone cause an animal to lose energy because of sweating or panting, and ultimately may cause the death of an animal if they cannot find thermal cover. Temperatures below the thermal neutral zone will also cause energy loss because of radiant heat loss and shivering. Thermal cover can prevent the loss of energy because of cold conditions as well. Cover may also function to intercept wind and thus reduce wind-chill and the associated energy loss.

Because wildlife use open areas that are adjacent to cover and because the distance that a species will travel from cover varies from species to species, there are a range of sizes of habitat patches that most wildlife species will use. Given what we know about many wildlife species, patches of habitat that range from about 40 to 120 acres in size meet the needs of many wildlife species.

Water

Water is the third basic wildlife habitat requirement. Water requirements of wildlife species vary seasonally in response to environmental changes or physiological condi-

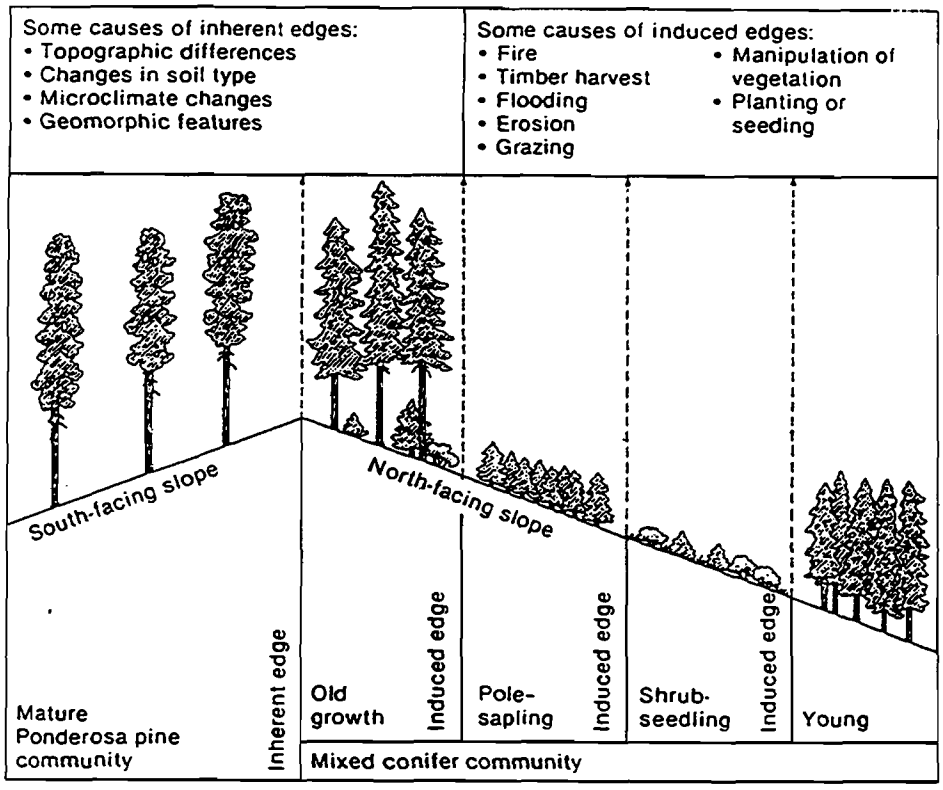


Figure 2. Inherent edges are created where plant communities meet. Induced edges are created where successional stages within communities come together (from Thomas 1979).

tions. For example, a lactating female has higher water demands that a nonlactating female. High summer temperatures also increase the need for water. Water comes in three basic forms: metabolic water, preformed water, and free water.

Metabolic water

Metabolic water is produced as a by-product of metabolizing fats. For example, during hibernation, black bears live entirely off of stored fat reserves, allowing them to go several months without eating or drinking. The use fats during hibernation produces sufficient amounts of water as well.

Preformed water

Preformed water is water that is contained in the food that wildlife species consume. Meats eaten by carnivores are in the range of 85% water by weight. Many plant species, especially during active growing periods, are high in water content as well.

Free water

Free water is water that is available to drink ranging from mud puddles to streams and lakes. Many wildlife species, especially those living in arid environments, have adaptations to reduce free water requirements. In regions where free water is generally available, such as western Oregon, wildlife have few of these adaptations. In these areas, seasonal water stress is common. For example, in much of western Oregon, there is a period of little rainfall from July through October. During this seasonal drought, reliable water sources such as riparian areas, streams, and lakes are very important.

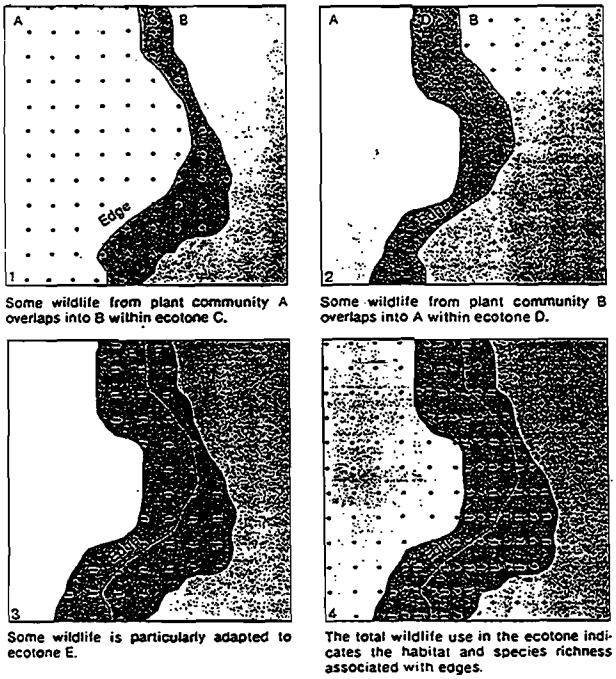


Figure 3. Species richness associated with edges is additive effect (from Thomas 1979).

Space

Space is the fourth basic wildlife habitat requirement. All animals need a minimum amount of area within which they carry out their daily and life-time activities. Animals display spacing patterns within a species, but usually do not space themselves relative to other species with the exception of predators and prey. Space requirements of a species is dependent upon the social system of the species as well as its body size and trophic level. Social animals such as elk have spacing patterns in which numerous animals can occupy the same area, while solitary animals, such as bears or cats often occupy areas exclusively.

Space requirements of animals increase with body size. Thus, deer have much larger home ranges than small mammals. Carnivores have much larger home ranges than herbivores of comparable body size because they must include large enough area to insure that they have a sufficient number of prey items. The larger the body size or space requirements of a species the more likely that multiple ownerships will be encompassed within the home range of that animal. A single clearcut might be an appropriate management scale for mice or songbirds while entire watersheds might be needed to adequately manage large raptors or carnivores.

Spacial Distribution of Habitats

Habitat types such as forest types or successional stages within a forest type vary in size and proximity to one another.

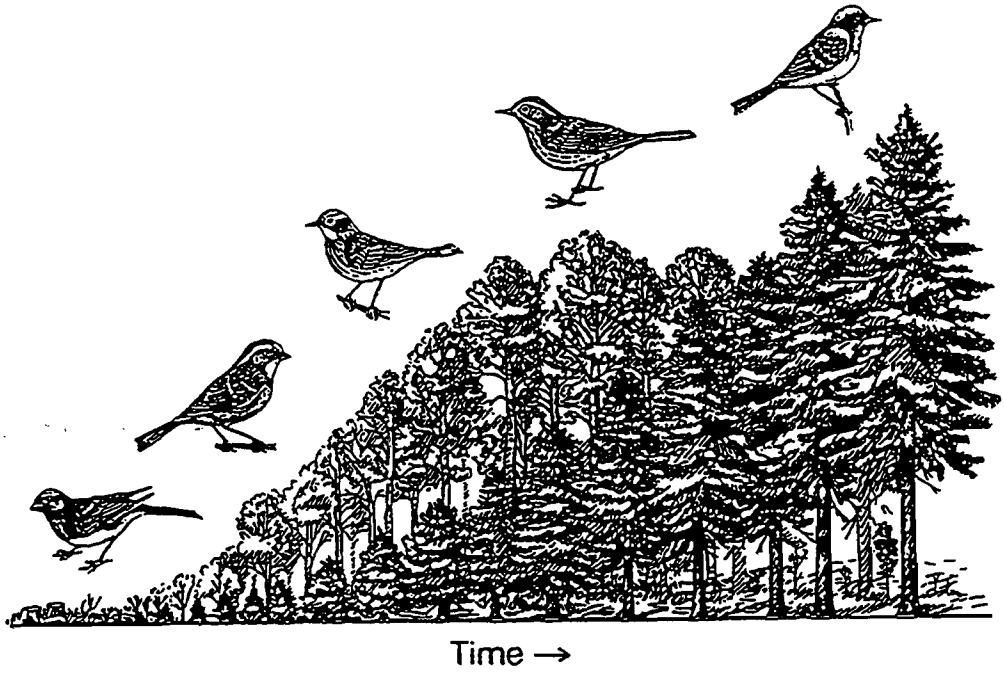


Figure 4. Succession in a spruce-fir forest is dominated by changes in the vegetation, but there are parallel shifts in animal populations as well (from Hunter 1990).

Interspersion

Interspersion refers to the geographic distribution of habitat types. The zone of transition between two habitat types is known as an *ecotone* or *edge*. Edges can be either inherent (long-term features of the landscape) or induced (relatively short-term edges occurring at junctions of distinct land uses or successional stages) (Figure 2). The *edge effect* is a major principle in wildlife habitat management. Many species are more abundant along ecotones, and edges typically attract species because of the varied conditions there (Figure 3). The amount of edge available is related to the shape of an area. The more an area deviates from a circular shape the greater amount of edge habitat it will have.

Standard habitat management guidelines prescribe the creation of as much edge as possible to benefit a large number of species. Increased emphasis on non-game and plant conservation has revealed characteristics of edges that are now considered undesirable for many species. These relationships will be discussed later in the section on landscape ecology.

Features of habitats are also variable in time. Characteristics of composition, structure, and productivity will change, some over short intervals and others over longer time periods. Daily, seasonal, and annual variations are common and familiar. The magnitudes of these changes differ from region to region. Successional sequences are stages of change that occur over longer time intervals, and these result in successional changes in wildlife species (Figure 4). Successional sequences result in changes in

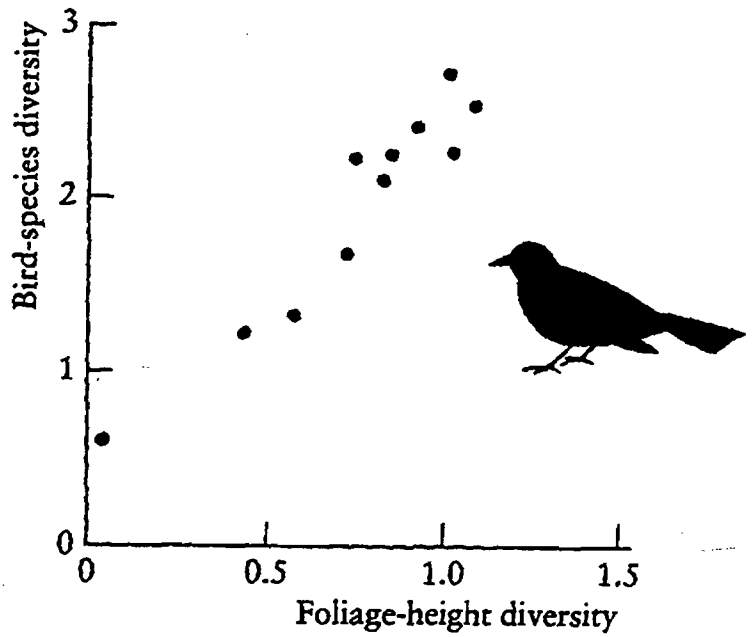


Figure 5. Bird-species diversity (richness) increases with increasing foliage-height diversity (vegetation layers) (after MacArthur and MacArthur 1961).

habitat structure and function. Different disturbance agents produce different characteristic effects: fires, windthrow, harvesting, animal damage. These differences matter to wildlife primarily because of their frequency and scale.

Biological Diversity

Biological diversity or biodiversity are terms that have been institutionalized during the past decade because of the concern over the increasing rate at which plant and animal species have become extinct. In addressing the issue of declining biodiversity, scientists and resource managers have used rarity as the basis for ranking species according to the urgency of conservation efforts. Implementation of the Endangered Species Act (ESA) is based on a species-by-species strategy resulting from such ranking efforts.

However, the ESA has been criticized for the species-by-species approach largely because the magnitude of the extinction threat was unanticipated when the act was developed in 1973. An average of 34 species per year were listed as threatened or endangered in the United States since 1976, and has increased to more than 50 per year over the past eight years. More than 3,500 species were listed as candidates for protection under the ESA in 1990. The feasibility of continuing a species-by-species strategy for protecting biodiversity is questionable given the sheer number of threatened, endangered, and candidate species. The new paradigm, ecosystem management, has emerged in part because financial, logistic, and ecological reasons all call for conservation strategies based on biological criteria above the species level.

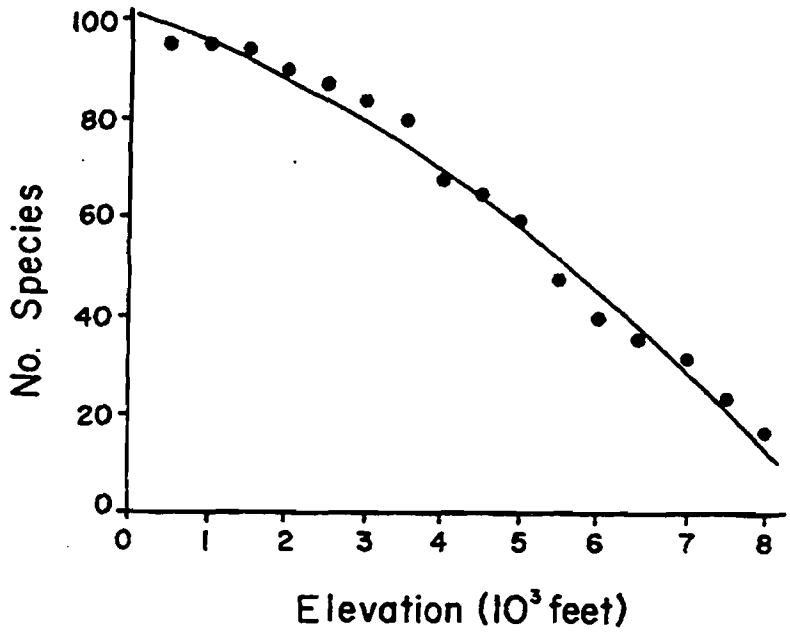


Figure 6. Succession in a spruce-fir forest is dominated by changes in the vegetation, but there are parallel shifts in animal populations as well (from Hunter 1990).

Patterns of Species Richness

As suggested by the different types of diversity, species richness is highly variable both within and across regions. There are several basic patterns of species richness that explain how you may be able to manage properties to increase biodiversity or why those properties may be an important component within an ecosystem for maintaining biodiversity. Four basic patterns that relate directly to management of woodland properties are: (1) species richness increases with structural diversity, (2) elevational gradients in species richness, (3) species-area relationships, and (4) spatial patterns of species endangerment.

Species richness increases with structural diversity

Structural diversity increases as the number and complexity of vegetation layers increase. Shrub habitats are more structurally complex than grassland habitats, and likewise, old-growth stands are more structurally complex than even-aged saw-timber stands. Structural diversity increases with stand age under clearcut silvicultural practices. However, habitat components that are remnants from the previous stand, such as logs, snags, and green trees, will increase structural diversity within clearcut units.

As vegetation structure increases, the number of niches available to organisms increases. This increasing availability of niches results in species richness increasing with structural diversity (Figure 5). Thus, within any forest type, greater structural diversity will increase species richness. Clearcuts with remnant logs, snags, or green trees retained will have higher species richness than clearcuts without these components.

Elevational gradients in species richness

Another pattern in species richness is a decline in the number of species as elevation increases (Figure 6). This pattern occurs because the more productive forest lands are generally at lower elevations and species richness increases with productivity. Also, as you move from low elevation forests to subalpine forests to alpine areas, habitats become less structurally complex and the environment become harsher, further reducing species richness. However, these harsh, isolated habitats often have species that are found nowhere else, and thus are important from a gamma diversity or landscape perspective. Because most lower elevation areas in the Pacific Northwest are in private ownership, the bulk of species richness occurs on private lands in this region. Thus, landscape-level strategies designed to conserve biodiversity (i.e., ecosystem management) will need to solicit the cooperation and participation of private land managers.

Species-area relationships

One of the most universally applied theories in conservation biology is the theory of island biogeography. Although originally proposed to explain patterns of species richness on oceanic islands, this theory has been applied to mainland areas as well. Empirical support for the theory of island biography in mainland habitats is mixed (in some cases it works well, in other cases it does not). Nevertheless, an examination of this theory helps explain some patterns of species richness and will be important in understanding landscape ecology and some conservation strategies proposed for managing ecosystems.

As an area (stand, habitat patch, refuge, or national park) increases in size the number of species it contains also will increase. This occurs because of several reasons. First, on a landscape level, larger areas will contain a greater diversity of habitats and thus gamma and beta diversity increases. Second, larger areas contain more individuals of a species (larger population size) than smaller areas, which decreases the chance that a species may go extinct because of some environmental or population calamity. Third, some large vertebrates such as mountain lions, bears, or bobcats will be unable to use small habitat islands because their home ranges or territories are larger than the habitat islands. Fourth, larger areas are more likely to be colonized by a new species or recolonized by a species that has gone locally extinct than smaller areas (big target hypothesis).

A second component of this theory is how far these "islands" are from areas likely to provide a source of species. The farther these areas are from source habitats, the less likely they will be colonized by a new species or recolonized by a species that has gone extinct. Thus, large "islands" have more habitats and contain more species, have lower extinction rates, and are more readily colonized from source habitats than small islands. Small islands that are far away from source habitats will have high extinction rates and low colonization rate, and thus will have fewer species.

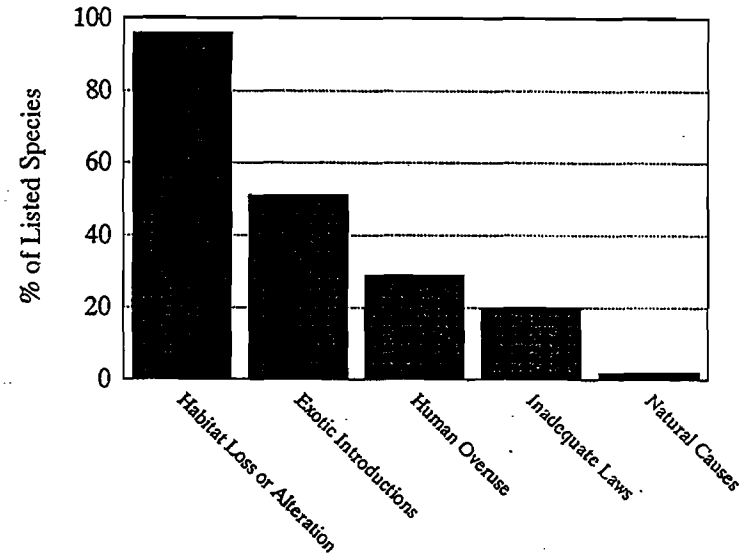


Figure 7. Percent of threatened and endangered species whose status is a function of general categories for causes of declines.

Spatial patterns of species endangerment

Within the United States, species that are listed for protection under the ESA are not evenly distributed across the country, but are concentrated in areas. Forest ecosystems contain the most threatened and endangered species, and the majority of these are animals rather than plants. Listed invertebrates primarily are associated with aquatic ecosystems, particularly those found in forested landscapes. Within forested ecosystems, coniferous forest types have more threatened and endangered species than mixed or deciduous types. Slightly more listed species are associated with mature and old-growth forests than with earlier successional stages. Wetland ecosystems, covering only 5% of the land base in the conterminous U.S., contain nearly 30% of the listed animal species and 15% of the listed plant species. Thus, on a national scale, forest ecosystems contain the most species listed under the ESA, probably because these habitats have higher beta and gamma diversity and because they are intensively managed.

Monitoring Biodiversity

Biodiversity is a complex concept including not only organisms, but also the variety of communities, habitats, and ecosystems. Consequently, monitoring of biodiversity will be a difficult task and should include more than simple counts of species. Monitoring of biodiversity is a topic of much debate among land managers and scientists, but should probably include some recognition of structural, functional, and compositional attributes at different levels of organization (from genetics to landscape patterns). Most private landowners who are interested in monitoring biodiversity will only be able to conduct species counts (species richness), monitor structural compo-

(logs, and snags) and map their properties within a watershed relative to other ownerships. Mapping of ownerships by forest type and stand age will allow private landowners to track changes in landscapes that may affect biodiversity.

Causes of Declines in Biodiversity

The causes of declines in biodiversity are numerous and include habitat loss and fragmentation, changes in land-use patterns, intensification of land use, urbanization, introduction of exotic organisms, overuse or exploitation, and natural causes (Figure 7). However, factors contributing to loss of species are primarily human caused. The single most important factor in species being listed under the ESA was habitat loss associated with land-use intensification. More than 50% of the listed species have been adversely affected by interspecific interactions, especially those associated with introduced species. Only about 2% of the listed species are threatened or endangered because of natural causes.

Practical applications

As pointed out above, most properties probably do or could support a large number of plant and animal species, and thus may be important for conserving biodiversity on a landscape or regional scale. Many of the things that woodland owners can do relate to considering their properties in a landscape context and will likely require coordinated management within a watershed. Landscape-level management for conservation of biodiversity will be addressed in a later section on landscape ecology. In this section I offer some management suggestions that woodland owners can consider to increase the alpha and beta diversity (within- and among-stand diversity) on their properties (Table 1).

Table 1. Checklist of management options for woodland managers to increase biodiversity.

To increase alpha (within stand) diversity

- Increase structural diversity.
- Increase number and size of logs and snags.
- Plant multiple tree species.
- Allow patches of competing vegetation develop.

To increase beta (among stand) diversity

- Protect or culture rare plant communities.
- Protect seeps, springs, and wetland sites with ample buffer zones.
- Increase riparian-zone protection by widening buffer zones and extending protection to first-order and ephemeral streams.

Increase structural diversity

Woodland managers directly influence structural diversity by the practices they use when managing their stands. Even-aged silvicultural practices that are commonly employed under intensive timber production objectives typically produce stands that are low in structural diversity. Woodland owners who wish to increase biodiversity on a stand level (alpha diversity) might consider using an uneven-aged silvicultural system. Structural diversity can be increased under even-aged management as well. For example, if you were using a seed-tree regeneration system, you might consider leaving some or all of the seed trees. Provide structural diversity by retaining snags, logs, and green trees when you harvest. During pre- and commercial thinning operations you might consider leaving small patches of unthinned trees in your stand, or some subdominant trees that are suppressed.

Maintain or increase microhabitat characteristics

Each woodland property most likely contains a number of microhabitat characteristics that could be protected or enhanced to increase alpha and beta diversity. Structural components such as snags and logs are a good place to start. Approximately 30% of the vertebrate species in your area use snags or logs for some part of their lifecycle. Depending on the forest practice requirements in your state, you may or may not be required to retain some of these structures when you harvest. Regardless of the rules in your state, these guidelines or regulations are management requirements. Because they are not stratified by plant community, snag or log type, or size, these guidelines or requirements will rarely provide for much more than a low level of habitat capability.

Too few studies have been conducted on logs to provide much guidance, but the snag literature indicates that increasing the number of snags up to or even beyond 10 per acre will result in increasing both the number of species as well as the population size of cavity-nesting species. Also remember that the larger the snag the better. Large snags can be used by all species that need them, whereas small snags can only be used a few species. Land managers interested in increasing biodiversity will want to provide as many of these structures as they can given other objectives and management constraints. Other microsite habitats such as seeps, springs, ponds, and other wetland type communities greatly increase the beta diversity of your property and should be protected with ample buffer strips if maintaining or increasing biodiversity is a management objective.

Increase plant community diversity

Increasing the diversity in plant species composition both within and among stands not only increases alpha and beta diversity because of the plant species component, but these different plant species also have different structural characteristics that in turn increase animal diversity. The typical clearcut silvicultural system where only Douglas-fir is planted will have lower biodiversity potential than a stand where several species adapted to the site are planted.

Woodland owners interested in biodiversity could further increase plant community diversity by taking a less aggressive approach to controlling competing vegetation and

allow some less-desirable species (from a timber-production perspective) to develop. Riparian zones typically have more plant species diversity than the surrounding upland vegetation. Landowners interested in enhancing biodiversity might consider widening riparian buffer zones and extending protection to first-order or even ephemeral streams.

Some plant communities themselves are rare or uncommon and disproportionately contribute to beta and gamma diversity. Examples might include Oregon white oak forests or the Willamette Valley race of ponderosa pine. Landowners interested in biodiversity might consider protecting or even promoting these plant communities where they occur on their properties.

Landscape Ecology and Wildlife

Landscape ecology, a scientific discipline that has developed rapidly over the past 15-20 years, examines ecological processes at large scales. Landscape ecology is one of the guiding principles of ecosystem management. Ecosystem management may require coordinating land-management activities at local scales in order to control ecological processes at landscape scales. Over use or uncoordinated use of management practices that are sound operations at local scales may cause undesirable effects at landscape scales.

At the landscape scale, ecosystems are collections of plant and animal communities that are interrelated by basic ecological processes such as primary production, nutrient cycling, predation, and competition. Disturbances that directly affect one segment of the ecosystem may or may not result in direct or indirect effects that are distributed throughout the ecosystem. Many of these relationships are very subtle and a cascade of effects is difficult to detect.

Watersheds are one of the simplest models of landscape-scale ecosystems, and have recently been the focus of various landscape-scale planning efforts. Because water flows down hill it is easy to demonstrate to people living in the watershed or relying upon resources within the watershed that water quantity and quality, and fish habitat quality in the mid and lower portions of the watershed are dependent on activities in the upper portion of the watershed.

Activities that directly harm human beings, such as dumping toxic wastes, are generally prohibited. However, many activities that are sound management practices at the local level can result in undesirable effects on other resources in other portions of the watershed. Yet, without coordinated management (ecosystem management?) regulatory agencies rely on uniform application of protective measures or target individual landowners who are stewards of critical environmental sites. In the face of a continual decline in resource conditions, regulatory agencies are forced to extend or expand protective measures and apply them across the landscape when in fact perhaps only a portion of the watershed actually needs expanded protection.

For example, fishermen in Coos Bay, Oregon may and probably do think that the current riparian protection rules on private timberland are inadequate to protect the resource that their livelihoods depend on. Future debate on riparian protection rules may

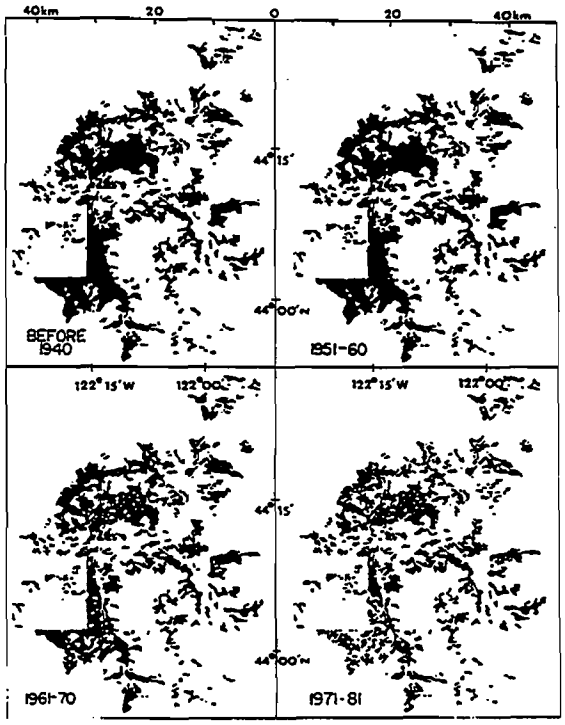


Figure 8. Distribution of old-growth stands on Blue River and McKenzie Ranger districts of the Willamette National Forests showing reduction in total habitat and isolation of remaining habitat patches. This scene might represent a metapopulation of organisms living in this habitat: some patches will be too small to maintain viable subpopulations of the species (from Harris 1984).

result in extended protection throughout the watershed where a coordinated management effort might result in less restriction in land-use practices.

Habitat Fragmentation

Habitat fragmentation is thought to be one of the most serious causes of the decline in native plant and animal populations. Fragmentation occurs in all vegetation types in the Pacific Northwest, but some of the most pronounced are in old-growth forest (Figure 8), westside white oak-savannah and ponderosa pine communities, and sagebrush habitats. Habitat fragmentation accelerates many ecological processes which in turn cause a decline in native plant and animal populations.

Edge effects

Habitat edges or ecotones are zones at the border of two different plant communities or different aged stands within the same plant community. Examples are the edge between riparian habitats and upland sites, or the edge between a recent clearcut and the adjacent saw-timber stand. As habitats become fragmented the amount of edge habitat increases. For many years the production of edge habitats has been a basic tenet of wildlife management. Many species (perhaps as many as 50-60% of all species in the

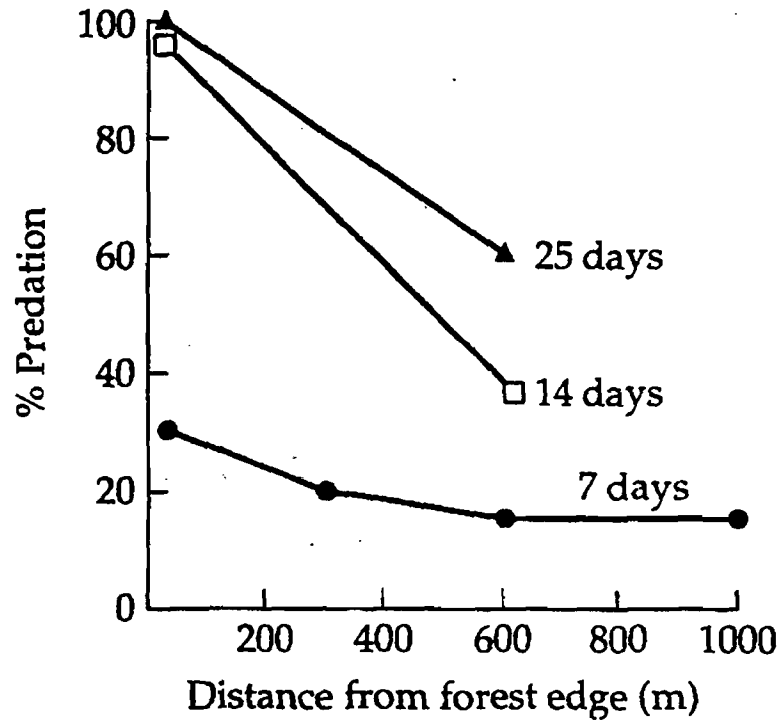


Figure 9. Percent of threatened and endangered species whose status is a function of general categories for causes of declines (from Flather et al. 1994.)

Pacific Northwest) will selectively use edges because the contrasting habitats provide choices for food and cover in close proximity to one another. Riparian areas are edge habitats that also have water, and consequently have high species richness. Thus, at first sight, the production of edges that result from habitat fragmentation would appear to increase both alpha and beta diversity. However, too much edge can have detrimental effects because some species, such as generalist predators, are successful at exploiting edges and therefore these habitats may become an *ecological trap.*

Many generalist predators preferentially hunt in edge habitats. If most of a remaining habitat is within a short distance to an edge, then species that live or reproduce in those habitats may be vulnerable to excessive predation pressure. Many examples abound but few are available from the Pacific Northwest because such studies have not been conducted here. In the deciduous forests of eastern North America increased predation rates by jays, crows, raccoons, opossums, foxes, squirrels, and skunks extend up to 600 m from an edge (Figure 9). In the prairie pothole region of the upper Midwest, drainage of wetlands for agricultural use has resulted in isolated islands of duck-nesting habitat in which duck recruitment is extremely low because of excessive predation pressure by skunks, foxes, and coyotes. A similar phenomena is likely responsible for declining populations of ring-necked pheasants in agricultural areas of the western United States.

Modern agriculture leaves few patches of habitat for cover and nesting, and those that do remain are easily searched by predators. These predator-prey relationships extend to herbivore-plant systems as well. Regeneration of deciduous forest species in small woodlots in the eastern United States is severely suppressed by white-tailed deer.

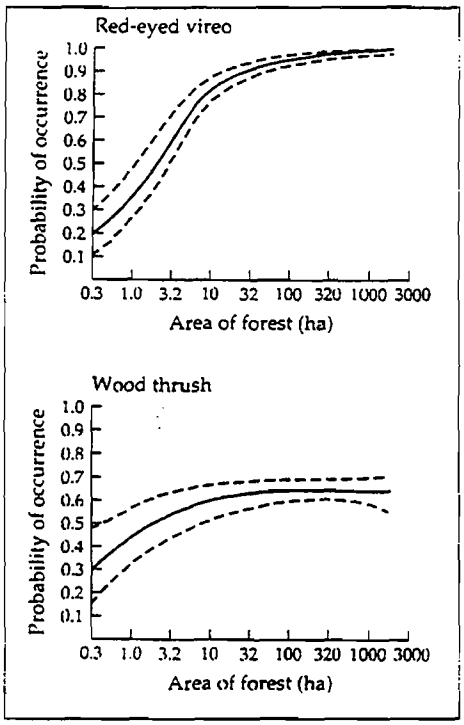


Figure 10. The probability of two songbird species nesting in eastern deciduous forest increases with patch size (from Robbins et al. 1989).

Here in the western United States it is likely that deer and elk browsing in forest plantations will be more pronounced near forest edges.

Brood-parasitism is another biological phenomena that is accelerated at forest edges. The brown-headed cowbird has an ingenious reproductive strategy. The female cowbird does not build a nest, but instead searches for active nests of other species. When she finds one, the female cowbird will remove one or more of the eggs and deposit one of her own. The most commonly parasitized nests are those of songbirds. The young cowbird is usually larger than the other birds in the nest and pushes them out of the nest so that the songbird raises only a single cowbird. Because cowbirds are edge-dependent species, brood-parasitism is especially severe within 200 m of a forest edge, and is a major reason for the decline of forest birds in heavily fragmented landscapes of the eastern United States. Similar studies have not been conducted in the western United States, but cowbirds do abound here and population trends for many western songbirds show declines similar to those documented in the east.

Edge effects can influence plant community composition and structure as well. Edge zones are usually drier and less shady than forest interiors, favoring shade-tolerant xeric plants over typical mesic forest plants. In Douglas fir forest of the Pacific Northwest, reduced humidities, increased rates of blowdown, and other physical effects may extend two to three tree-heights into a forest. These physical effects increase growth rates, elevate rates of mortality, reduce stocking density, and affect regeneration of confer species in old-growth forests up to 137 m from clearcuts in Washington and Oregon.

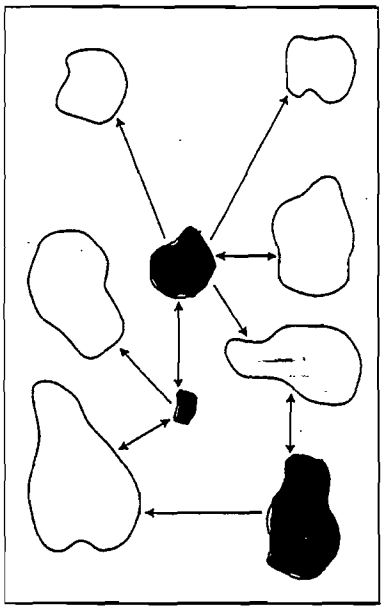


Figure 11. A schematic example of a metapopulation structure affected by source and sink patches. In this case, a few source habitats (shaded) provide excess individuals, which emigrate to and colonize sink habitats (open). The sink habitats may be spatially larger than sources, and may even have higher population densities, but their populations would go extinct were it not for the presence of the source habitats. Arrows indicate directions of movements of individuals: movements may be facilitated if corridors connected some patches (from Meffe and Carroll 1994).

Interior species: The corollary to edge-dependent species

Just as some species are edge-dependent and will seek-out ecotones between two or more habitats, some species show a response to landscape patterns by only using interior habitats. In highly fragmented landscapes the average patch size may be too small to contain these "core" habitats. Loss of these core habitats will result in a decline in species requiring these core areas. Again, most data on these relationships come from the eastern United States where woodlots are isolated in a matrix of agricultural or urban habitats. For reasons not entirely understood some species avoid using small tracts of seemingly suitable habitat. Many songbird species are "area-sensitive" and usually breed only in tracts of forests many times larger than the size of their territories (Figure 10).

Similar studies in grassland habitats in prairie fragments in Missouri showed that several species had similar responses and failed to breed in patches less than 10 ha even though this area is several times larger than the average territory size. One study conducted in the Oregon Coast Range found only weak relationships between landscape fragmentation and bird abundance and most species increased in abundance with increasing fragmentation. Winter wrens were the only species that demonstrated an association with less fragmented landscapes. The author noted, however, study limitations

and the relatively recent nature of landscape fragmentation in the Coast Range preclude definitive conclusions regarding the effects of forest fragmentation on bird species in his study area.

Source-sinks and metapopulation dynamics

As landscapes become more and more fragmented plant and animal populations become isolated on "islands" of suitable habitat. The entire population in an area or metapopulation becomes dependent on the dynamic relationship among subpopulations inhabiting these islands of habitat (Figure 11). Some islands will be too small to contain even a few individuals because of large territory sizes or because the species is area-sensitive. Some subpopulations will be vulnerable to environmental change, catastrophes, genetic problems and stochastic population declines and will go extinct.

Many population ecologists believe that all subpopulations go extinct over a timespan of 100's to 1,000's of generations. But, over the long-term, the metapopulation or species, would be less vulnerable to extinction because of immigration among habitat islands and recolonization of habitat islands where subpopulations have gone extinct. Metapopulation or species persistence becomes more tenuous with increasing habitat fragmentation; because of the total loss of habitats and because of habitat isolation, the metapopulation size is reduced and subpopulations go extinct more rapidly and are less likely to be recolonized.

Source-sink habitats and metapopulation dynamics have also been extended to habitats of varying quality. The availability of sink habitats where mortality is higher than reproductive success may cause a decline in a species because dispersing individuals are drawn off to areas where they do not contribute to the next generation. Recent studies using a metapopulation model for spotted owls suggests that spotted owl reserves should have "hard boundaries"; that is, the reserves should be separated from simple-structure saw-timber stands (sinks), so that dispersing birds would not settle in unproductive territories.

Determining which habitats are sources and which are sinks requires a great deal of knowledge about the natural history of organisms. One needs to know the birth and death rates of individuals in each habitat type, details of dispersal behavior, and other aspects of the species' life history. Without such knowledge, it will be difficult to design a conservation plan that considers realistic population dynamics.

Corridors

A basic element of most conservation plans is the maintenance or inclusion of corridors between patches of habitat. This concept is intuitively simple; corridors are designed to connect two patches of habitat and to provide for the movement of organisms among patches. There are two major needs for corridors: (1) to provide for periodic migration among habitat types, and (2) permanent immigration and emigration of individuals among habitat patches in a metapopulation context.

There are three types of corridors needed at different spatial and temporal scales because different problems exist at different levels of biological organization. The

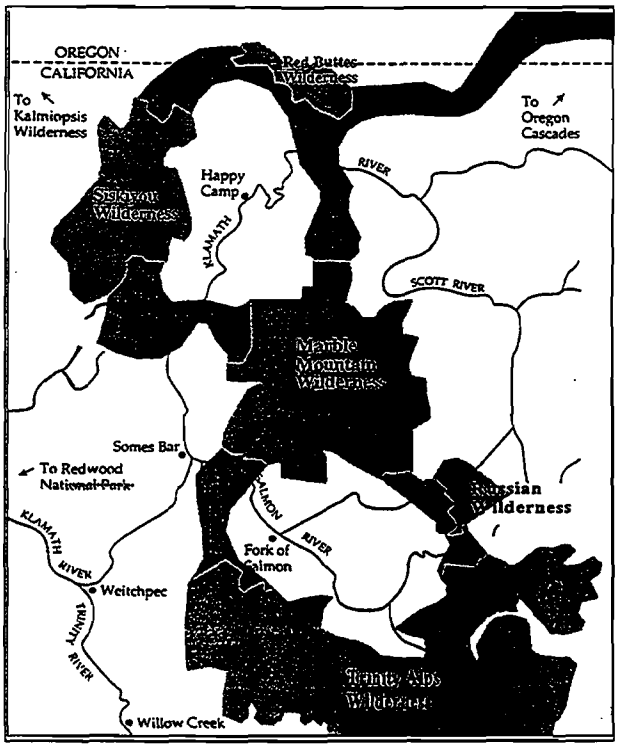


Figure 12. The probability of two songbird species nesting in eastern deciduous forest increases with patch size (from Robbins et al. 1989)

"fencerow scale" connects close habitat patches such as stands, and contains narrow rows of appropriate habitat. This scale provides for the movement of small vertebrates and because they are narrow these corridors are composed entirely of edge habitat and will not provide habitat for interior species. The "landscape mosaic scale" are broader, longer corridors that connect major landscape features (Figure 12). These function for daily, seasonal, or more permanent movement of both interior and edge species.

Such corridors might include large strips of forest connecting forest habitats separated by agricultural lands, riparian habitats along rivers, or habitats such as mountain ridges that follow natural gradients or topographic features. Regional scale corridors connect nature reserves in regional networks. For example, corridors have been designed to connect Glacier National Park in Montana to regional wilderness areas in Idaho, Montana, and Canada.

The utility of corridors to move animals has been a subject of debate among scientists. There is little empirical evidence that corridors function to move animals as they are designed. Corridors may actually function as sink habitats by pulling individuals away from source habitats into areas where they experience higher mortality. To be effective, corridors should be the result of detailed ecological analysis.

Practical applications

Applying concepts of landscape ecology to woodlands may require that manipulating habitats on one property while coordinating efforts with those of adjacent landowners. A good place to start is by obtaining contemporary vegetation maps or aerial photo-

graphs of the drainage or subbasin where the property is so that you can evaluate your efforts in the context of the landscape the property is a part of.

Distribution of small-scale habitat attributes across the landscape

Increasing the number of snags and logs throughout an area will increase alpha and beta diversity and will provide important habitat attributes throughout the landscape. Remember that most woodlands are second-growth forests, and virtually all of these have been harvested prior to forest practice rules or guidelines for maintaining logs and snags. A recent study indicates that private woodlands in Oregon and Washington provide only 6-40% of habitat capability for cavity-nesting wildlife depending on the forest type. Thus, while woodland owners are providing habitat for cavity-nesters, much more can be done.

Riparian zone management

Riparian zones themselves are important habitats for alpha and beta diversity, and are thought to be major corridors for species requiring moist habitats. These areas help protect aquatic habitats and our water quality, and are the most obvious attributes on the landscape that connect your property with your neighbors. Again, remember that 70% or more of woodlands in Oregon and Washington were harvested before any riparian protection rules or guidelines were in force. In Oregon, the proposed rules for strengthening riparian zone protection has actually resulted in accelerated harvest of these areas prior to initiation of the new rules. These are habitats that need additional protection and your attention. Depending on your other objectives consider widening riparian zones and extending riparian zone protection to sites not currently protected.

Beyond property boundaries

Looking at a single property in the context of what it provides relative to adjacent ownerships within a drainage or subbasin is where the rubber meets the road on ecosystem management. Depending on your objectives and those of adjacent ownerships—application of landscape ecology concepts will provide a number of alternatives. You may choose to manage a property independent of adjacent ownerships by looking at aerial photographs or vegetation maps of your drainage, or in order to be more effective, you may wish to discuss adjacent ownerships, objectives and future plans.

You might also consult State fish and wildlife biologists in determining the value of the property in maintaining biodiversity. Each property will differ in respect to what it contributes to the ecosystem, so hard and fast rules or guidelines are not possible. Some of the following questions may help you to begin to think about a property with a landscape perspective. Are there habitats that are uncommon in your watershed or region? Rare plant communities such as Oregon white oak, Willamette Valley ponderosa pine, or old-growth contribute disproportionately to the beta and gamma diversity. Can these habitats be managed to maintain or increase their occurrence in the watershed?

In some cases, protection will suffice, in others, creative application of silvicultural practices can accelerate occurrence of these habitats. For example, enhancing struc-

tural diversity within second-growth stands with thinning practices or uneven-aged silviculture may allow you to mimic old-growth conditions in relatively young stands. Can you treat a property to reduce habitat fragmentation? For example, can the landowner afford to defer harvest in a watershed that is largely in a late successional stage condition? Or perhaps you have a small stand of late successional stage forest in a watershed that has been largely converted to young plantations in the past decade, and late successional stage conditions are common elsewhere in your region.

Under such conditions, harvesting your stand so that most of the watershed is in early successional stage conditions would reduce habitat fragmentation. Does the property contain logical corridors in addition to riparian management zones that connect one uncommon habitat to another? Maintaining or planning for the widest strip possible within your objectives may allow for movement of animals among patches as well as provide habitat in itself.

Suggested Field Exercises

1. A common problem associated with maintaining snags in recently harvested areas is that they are subject to windthrow or are burned during site preparation.

   These problems are generally a function of presale planning (i.e., where do you put your snags). Look at some proposed timber sales or recent clearcuts and discuss placement of snags for long-term retention. Consider the harvest system (i.e., cable-yarder, skidder, etc.), potential for windthrow, site preparation.
2. Obtain aerial photographs or orthophotoquads of a watershed and outline the different habitat types (forest types and successional stages, riparian areas and special habitats). Discuss how the entire watershed might be managed to reduce habitat fragmentation. Identify potential corridors between uncommon habitat types in the watershed.
3. Examine a recently completed project and discuss the habitat changes that occurred as a result of the management. Discuss management alternatives that would have created different habitat conditions.

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WATERSHED MANAGEMENT, RESTORATION AND ENHANCEMENT

Derek Godwin

Introduction

Overview

This chapter outlines the core concepts that a person, group, or agency would follow to develop watershed management, restoration, and/or enhancement (MR&E) plans and implement projects for a particular watershed. Crew members performing ecosystem management work will use part, if not all, of this process in their future work. This chapter is not all theory, nor is it a manual for conducting restoration projects. This chapter is an attempt to a balance theory and instruction that will ,in turn, serve as a foundation for learning and performing ecosystem management work.

How does this topic fit into other topics in the science section?

Watershed MR&E involves understanding all the other parts in the science curriculum, and applying them as a whole towards planning and performing ecosystem management work.

Competency measures

After completing the watershed MR&E session, students should be able to explain in their own words:

- an outline of the core concepts typically used for planning and implementing restoration projects;
- how watersheds and projects are prioritized for restoration;
- describe a watershed assessment and name five different pieces of information it could entail;
- what is monitoring and why we should do it;
- one way they can educate people on restoration projects;
- name and give examples of the five most common types of restoration projects;
- describe the goals and general designs of three specific restoration projects; and
- name three different people, agencies, or papers that can provide information relating to watershed assessments and designs for restoration projects.

Choosing a Watershed

What's the "right" size?

Watersheds have a wide range of sizes and can be managed as a whole or as sub-basins. For effective MR&E plans the watershed should meet the following criteria:

- Contain relatively similar geology, climate, fish species, wildlife species, and possible land uses.
- Small enough for people involved in the management, restoration, and enhancement plans (private owners, agencies, interest groups, etc.) to identify it as their own watershed and feel they can enhance resource conditions.
- Property ownership and number of cooperating landowners won't prohibit communication and development of enhancement plans.

Prioritizing watersheds for MR&E plans

Watersheds are usually prioritized first by landowner cooperation and second by resource condition. Watersheds that are relatively healthy and/or next to prime habitat areas have priority over poor/destroyed habitat. It's easier to receive funding and enhance these areas. However, this approach only works with cooperating landowners.

Define Values to Consider

Before developing MR&E plans, the values that will be managed, restored, and/or enhanced must be identified. These values fall into three interrelated categories: Terrestrial, Aquatic, and Human.

Terrestrial usually includes: land resources (timber, pastures, agriculture, other vegetation, etc.), landscape patterns (size of openings, uneven aged forests, fire disturbances and how often, etc.), large woody material on the land, and wildlife.

Aquatic usually includes: water quantity, water clarity/color, water quality (sediment, temperature, dissolved oxygen, nutrients, bacteria, pH, algae, contaminants), large wood supply, organics, channel condition (width, depth, pools, riffles, wetlands, estuaries, etc.), fish population, fish distribution, fish habitat, and aquatic biota (insects, vegetation, algae, bacteria, etc.).

Human usually includes: a variety of land and water uses (timber, livestock, agriculture, recreation, road use, special use products, minerals, drinking water, etc.). It is important for watershed management and enhancement plans to include some form of human values.

Assessment of Conditions

What is an assessment?

Most people developing watershed MR&E plans follow the Active Management Principle. This principle is actually a four step process that includes:

1. Gathering data/information on conditions
2. Analyzing information and prescribe management/enhancement projects
3. Implementing management and enhancement projects
4. Monitoring conditions and specific projects and repeat these steps.

The assessment of conditions always includes gathering data/information on conditions, analyzing the information and prescribing MR&E projects. The depth of analysis changes with the amount of time available. Assessments usually include information from the following areas; climate and hydrology, water quality, riparian conditions, fish populations and habitat, geomorphology as it relates to topography, erosion, and stream morphology, wildlife, wetlands, and other related information. This information explains how terrestrial, aquatic, and human values are distributed throughout the watershed, their conditions, and factors affecting the conditions.

The following sections are brief summaries of information that is usually included in an assessment.

Climate and hydrology

Precipitation types, quantities, and distribution in the watershed

a. Precipitation types affect how much and how fast runoff occurs. Snow acts like a storage of water that can be released slow or fast depending on how fast it melts. A lot of the major floods have been attributed to rain-on-snow events.

b. The amount and rate of precipitation affects runoff. Runoff occurs when the ground is saturated or if the precipitation occurs faster than it infiltrates the ground.

c. Precipitation will vary throughout the watershed due to local weather patterns, the landscape, and elevation.

d. Here are a list of questions that should be answered in the assessment. How much precipitation is rain versus snow? What is the average annual rainfall for different elevations for the watershed (from the mouth to the headwaters)? How much precipitation normally occurs for each season? What are the high and average amounts of precipitation for each storm event, how long do these storm events last? Where are the local rain gauges and weather stations located in (or nearby) the watershed?

Quantity and velocity of streamflows

a. Understanding the hydrograph. The hydrograph is the plotting of stream flow (volume) over time. These are used with the measuring of precipitation over time. The shape of the hydrograph can tell a lot about streamflow, infiltration, and land use affects.

b. Measuring streamflow and velocities. Flow = velocity x area. The cross sectional area of a stream is measured and divided into sections. Then the velocity of each section is measured. The velocity and area is multiplied for each section and then summed for the total streamflow (Illustration). Stream gauges are strategically located in watersheds and measure the depth of water over time. This information is used to calculate the cross sectional area of the stream channel at the gauge site over time. Average velocity measurements are also taken that associate with the different cross sectional areas. The velocity and areas are used to calculate streamflow over time (hydrograph).

Storm return intervals. A "n" year storm event is a storm event that occurs on average once every "n" years (Replace "n" with a number of years). Engineering designs (culverts, stream enhancement projects, etc.) are based on a certain storm return interval.

Land use affects on streamflows. Land uses that affect evapotranspiration (i.e. change in vegetation types or amounts that alter the ability of the land to return water to the atmosphere), water infiltrating the soil (vegetation, soil compaction, concrete surfaces, etc.), and water rerouting (road drainage) may affect the streamflows.

Aspect and radiation. The amount of radiation varies with aspect and season. North slopes have less radiation and are usually moister than south slopes in the summer time. This could affect streamflows, stream temperatures, vegetation types, evapotranspiration rates, the length of time roads take to dry out (or thaw), etc.

Here are a list of questions that should be answered in the assessment. What are the average annual and monthly streamflows for different size streams in the watershed? What are some typical streamflows during each season (summer vs. winter)? What are some typical streamflows during storm events for different size streams in the watershed? Locate the stream network (perennial and intermittent streams) of the watershed on a topographic map. Where are the stream gauges located in (or nearby) the watershed.

Water quality

The quality of water in different locations of the watershed need to be measured/reviewed for the assessment. Different water uses require different levels of water quality (ex. drinking versus irrigation). In Oregon, the Department of Environmental Quality sets the water quality standards (acceptable levels) for different water uses.

There are several different variables (parameters) that are measured to indicate the quality of water. These parameters include: sediment, temperature, bacteria, dissolved oxygen, nutrients (nitrogen, phosphorus, potassium), pH, organic matter, algae, and pesticides and other chemicals. Once the water quality condition is evaluated, the natural and human-caused watershed processes that impact these parameters can be identified. This accomplished, potential enhancement projects can be generated to address water quality conditions.

Sediment

Sediment is solid particulate carried by water. It is a natural process, however excess amounts can lower water quality. The natural and human-caused processes that impact sediment in streams, and the potential enhancement projects will be discussed in the Erosion section.

Measurement. There are three types of measurements related to sediment transport/quantities in a stream: concentration of suspended sediment (milligrams of sediment per liter of water), bedload transport (quantity of bedload moving over a specific area per unit of time), and turbidity (amount of light absorbed in a column of water due to sediment and organics in the water).

Movement. Sediment reaches streams by force of water movement and gravity. Both of these forces dislodge various sizes of soil from the landscape and transport it to larger bodies of water. These pieces settle to the streambed at different rates depending on size and weight (clay vs. gravel).

Impacts. The most common concerns with excess sediment in streams is the potential decrease in aquatic life habitat and survival, decrease in stability and function of man-made structures (dams, bridges, culverts), and decrease in water clarity. The main impacts excess sediment has on salmonids include:

- covering eggs causing decrease in oxygen flow and fry emergence
- decreasing in stream clarity which impacts eating habits
- widening and making the stream channel more shallow causing less habitat
- increasing gravel in streambed and causing a decrease in stability of spawning gravels

The impact of excess sediment on other aquatic life has not been studied as much.

Temperature

Temperature is a measure of heat stored in water. All aquatic organisms have a preferred temperature range in which they can survive and reproduce successfully. Warm water increases instream plant (algae) growth, and holds less dissolved oxygen than cool water. Salmonids prefer cold water temperatures (usually less than 68 degrees Fahrenheit. Warmer temperatures affect their metabolism and cause a decrease in competition for food, decrease in ability for weight gain, decrease in appetite, and an increase in disease.

Stream temperature is mainly increased by solar radiation, while temperatures are mainly decreased by long wave radiation emission and cool water entering (groundwater influences) the stream. Therefore anything increasing the amount of solar radiation (removing shade, aspect, time of year, width of stream for larger surface exposure) would affect the stream temperature. Some unshaded streams contain a large groundwater influx of cool water that act as refuge for salmonids. Streamflow is also a major factor in affecting stream temperatures. Larger volumes of water take more radiation to heat. The potential enhancement projects to address stream temperature will be covered in the Riparian Area section.

Bacteria

Some bacteria that are derived from human and animal's stomachs and excreted in feces can be pathogenic. These bacteria do not survive long outside of their natural environment but can have prolonged life in bodies of water. Land management practices that affect the amount of bacteria entering bodies of water could impact human and animal life (ex. livestock management, septic and sewer systems, abundance of wildlife). Since pathogens are so hard to measure and detect, scientists measure bacteria that are easier to measure but have the same survival characteristics. These are routinely fecal coliform and fecal streptococcus. Water quality standards are based on the abundance of these found in bodies of water. The higher the abundance represents a higher potential of having pathogenic bacteria present.

Enhancement projects that address bacteria problems generally focus on keeping bacteria out of surface and groundwater. Manure storage, off-stream watering, and riparian fencing are typical livestock projects. Projects related to septic and sewer system management are usually educational programs on septic designs and awareness to housing regulations.

Dissolved oxygen (DO)

Dissolved oxygen is a measure of how much oxygen is in the water. All aquatic organisms need DO to survive. Warm water contains less DO than cooler water. Organic matter reduces DO as it decays in water. Management practices and natural events that affect stream temperatures and amounts of organic matter in streams also affect DO.

Nutrients (nitrogen, phosphorus, potassium) and algae

These nutrients are essential to plant growth on land and in water. Excess amounts can increase plant growth (especially algae) in water subsequently decreasing the amount of light penetration (water clarity), decreasing the dissolved oxygen, affecting the taste of drinking water, and significantly changing the dynamics of the food chain. These changes are usually called eutrophication of a water body. The main concerns are usually the impacts on native fish and aquatic life. High levels of nitrogen can also be toxic and cause methemoglobinemia (blue babies disease). It lowers the capacity of blood to hold oxygen, especially in infants.

These nutrients move with sediment, organic matter, and water in the landscape. Land management practices that cause excess application of nutrients (commercial fertilizer, human and animal feces) or erosion are usually the main concern for controlling these substances. Potential enhancement projects usually include education on plant uptake of nutrients, plant requirements, and how seasons affect these processes. Other educational projects would include various farming techniques (contouring, cover crops, vegetated filter strips) and riparian management (fencing and off-stream watering of livestock) to control erosion.

pH

pH is the concentration of hydrogen ions in a solution and determines whether a solution is acidic or alkaline (basic). The pH scale ranges from 1 (acid) to 14 (basic) with 7 as neutral. The number one is the highest concentration of hydrogen ions and four-

teen is the lowest. The scale is logarithmic so a change of one pH unit means a tenfold change in acidic or alkaline concentration. Most organisms have a narrow pH range in which they can live. Healthy water quality usually ranges from 6.5 to 7.5 (Figure). Forested areas tend to be slightly acidic (approach 6.0). Many soils in Eastern Oregon have a high alkaline content, and pH levels of some water bodies can rise above 10. As air falls through the atmosphere, the gases it contacts come into solution. As rain absorbs carbon dioxide, it becomes more acidic. "Acid rain" occurs when air pollution (mainly automobile and fossil fuel burning) has increased sulfur and nitrogen oxides in the air. These fall as weak acids causing "acid rain." Because factors determining pH can be far removed from a site, it is difficult to directly manage for pH. However, the measurement serves as a baseline measurement and can assist in the monitoring of future changes.

Organic matter

Excessive organic matter entering a water body is mainly a concern for decreasing dissolved oxygen, increasing nutrients and bacteria, and decreasing water clarity. These affects have been discussed previously. Water clarity is mainly attributed to the amount of suspended sediment and organic matter in the stream. The clarity is measured quantitatively (turbidity measuring instruments) or qualitatively (secci discs, depth of sight into the water).

Pesticides and other chemicals

Organic and inorganic chemicals vary widely in their affects on the environment. In order to understand the affects, the compound's characteristics must be understood. Each compound may be applied/spilt/formed in the environment with particular characteristics, but may also change into other compounds before becoming stable and not a threat to the environment. These chemicals need to be studied individually because of this complexity. Enhancement projects usually include education on chemical processes in the environment, proper handling, and application methods.

Riparian management

Assessments always include an analysis of the riparian areas for providing essential ecosystem functions. They also will identify land use practices that are impacting these functions, and generate a list of potential enhancement projects.

Riparian zone functions (forest, ag, urban)

Riparian zone functions include: provides cover and food for aquatic and terrestrial animals located above ground and instream, provides shade, slows overland and instream velocities and filters sediment, nutrients and bacteria from entering the stream, provides stability to streambanks and stream channel, and provides large woody material to stabilize streambeds, collect gravel, and develop habitat (pools and riffles).

Healthy riparian zones providing these functions require a diversity of vegetation (conifers, hardwoods, shrubs, grasses, etc.). Both public and private forest land have rules and regulations that promote healthy riparian zones, and agricultural lands are be-

ginning to develop rules and regulations based on water quality standards. However, ownership objectives and natural conditions vary greatly. It is important to predict how the riparian zone will function over short (1-10 years) and long periods of time (200 - 500 years) based on management objectives and natural changes. The most common concerns related to forest riparian management are long term recruitment of large woody material, cool stream temperatures, minimal erosion into the stream, and not damaging stream channel structure (natural wetlands, floodplains, off-channel ponds, etc.). Agricultural lands have these concerns as well as the establishment of large enough riparian areas, diversity of vegetation, and minimizing bacteria, nutrients, and chemicals into the streams. Urban areas have all of these concerns plus damage to the natural hydrology of the drainage network in the watershed.

Management practices

The rotation age of the forested stream and the number and location of trees not harvested impact the long term recruitment of large woody material. Large woody material begins entering the stream between 100 and 200 years. Large woody material that lasts a long time in the stream (more than 50 years) consist of older conifers and some hardwood species. Enhancement projects include inter-planting conifers and selected hardwoods, adding large wood to the stream and riparian area, and increasing number of unharvested trees in the riparian zone.

Stream temperatures are mainly affected by solar radiation. Since streams take longer distances to cool than to heat, logging along streams that removes shade trees should be staggered over time to maintain shade. Enhancement projects include planting a variety of trees in the riparian area with an emphasis on conifers.

Identifying highly erodible riparian areas and limiting vegetation removal and equipment operations minimizes sediment entering the stream. Forest road construction and maintenance are usually the largest human influenced causes of sediment entering the streams from forested lands. (Minimizing erosion will be discussed in a different section).

Protecting riparian areas around high value stream habitat and critical hydraulic areas should be priority (wetlands, floodways, off-channel ponds, etc.). These can provide some of the best improvements in fish habitat and stream health. Potential enhancement projects include enhancing/protecting wetland areas and floodways, building off-channel ponds and holding areas, and improving fish access to these areas.

Riparian buffer size should be examined. Riparian vegetation is often cleared for the purpose of increasing land area for agricultural and other land uses. Not only does this impact aquatic and terrestrial habitat, it can weaken streambank structure making it more susceptible to erosion and loss of land. Enhancement projects include streambank stabilization methods that increase the amount of trees and the buffer size.

Fish populations and habitat

The assessment should identify native fish species, their present abundance and distribution, limiting factors for improving abundance and distribution, and identifying potential enhancement projects to address limiting factors.

Numbers and distribution

Gather historic data on fish populations and distributions for each fish species and compare to present. Answer the following questions to help identify limiting factors related to essential habitat. Has there been decreases in all species or just certain ones? How does the present distribution compare to past? Are the populations increasing and decreasing in cycles related to weather patterns, ocean conditions, etc.? Which species are the most threatened, and which species should be targeted for restoration?

Bottlenecks in typical survival (handout)

Gather the present and historic habitat data available. Based on fish life cycles and critical needs for survival, what are the limiting factors? Are their critical habitat requirements that were present historically but not now? Are present fish populations utilizing available habitat? Suggestions: fish blockages denying full access to available habitat, inadequate pool to riffle ratios, inadequate large wood for stabilizing streambeds, providing cover, habitat, etc., inadequate spawning gravel recruitment, poor water quality, etc.

Hatchery and harvest management

What have been the past hatchery and harvest management practices? There has been a history of over harvesting the fish populations. However, do present management practices consider annual changes in stream and ocean conditions? Blanket fishing rules tend to over-harvest in poor conditions and under harvest in good conditions. Oregon has witnessed major changes in the philosophy of raising and using hatchery fish. There is little doubt that past hatchery practices had negative affects on wild populations. However, disagreement on the use of hatchery fish remains. The main goal is to use hatchery fish to help stimulate a wild population thereby assisting their recovery. Another goal involves to using hatchery fish to aid the fishing industry (produce them to be caught).

Management practices and potential enhancement projects

The management practices contributing to identified limiting factors usually include those relating to unhealthy riparian areas, excess erosion, water quality problems, etc. Natural conditions playing a large role in fish abundance include ocean conditions, drought, fire, disease, etc.

The following is a list of potential enhancement projects addressing common limiting factors; Riparian vegetation enhancement (planting trees with emphasis on conifers, enhancing diversity of tree species, fencing livestock, off-stream livestock watering, increasing buffer width), streambank stabilization to decrease sediment and increase vegetation, adding large woody material to the stream and riparian zone to increase cover and habitat, fixing barriers to passage (culverts, dams, etc.), addressing de-

graded stream channels (wide and shallow) by using structures and streambank treatments, building and enhancing off-channel pools, wetlands, and floodways, decreasing erosion by addressing hillslopes and stream crossings (roads), and implementing better chemical and fertilizer application methods and overall management.

Geomorphology and erosion

The assessment must include some descriptions and knowledge of the local geology. The geologic processes describe the landscape and topography of an area and therefore provide a basic understanding of local erosion processes and stream morphology.

Erosion types and processes

Mass wasting. Mass wasting is a natural process that occurs to some extent in most forested basins in the Pacific Northwest. There are four types of mass wasting; shallow-rapid landslides, debris torrents, small sporadic deep-seated failures, and large-persistent deep-seated failures. Shallow rapid landslides (debris slides) commonly occur on steep slopes (>70% slopes) where soil overlies a more cohesive material (bedrock, glacial till), soil thickness is small compared to slope length or the length of the landslide, the soil is saturated, and there is a loss of root strength. These slides typically occur where topography concentrates subsurface drainage, and may deliver sediment to streams and damage roads. Forest harvesting and road fills increase the occurrence of these slides. A debris torrent is basically a shallow-rapid landslide that hits a stream, becomes saturated with water, and continues down the stream channel picking up organic debris, sediment, and water. The torrents occur in stream gradients greater than 5 degrees, and can increase in size and damage potential as it moves downstream. They eventually stop with decrease in stream grade and can form debris dams, plug culverts, damage structures and habitat, and increase fine sediment in spawning gravels.

The deep-seated landslides differ mainly in size and frequency of occurrence. Both are caused by strong seismic shaking, geologic weakness, or channel down-cutting into the failure plane. Climatic changes ranging from major (such as glacial-interglacial transitions), to intermediate (runs of several wet years), to short-term (extreme storm precipitation) can also trigger or accelerate deep-seated failures. The failure planes are deep below the surface and may persist for a few years or centuries. Streams and road building can excavate the toe of a large slide mass and also cause failure. Land use that influences routing of water can influence movement in certain situations.

Stream crossings can be the site of debris flows and extensive down cutting when culverts and road drainages are not designed to handle larger flows. New culverts in forest roads have to be designed to hold streamflows from a 50 year flood event. However, improper routing of water along road ditches and natural debris flows that plug culverts can cause road failures. In addition, old roads will be maintained for many years before a culvert will be replaced. Road failures at stream crossings are the largest man-caused source of erosion.

Roads that are in serious danger of failing would have one or more of the following characteristics:

- a culvert with a high potential of plugging with debris from nearby landslides,
- have an increased drainage basin due to the routing of water along road ditches (inadequate water bars, drainage relief culverts),
- if the culvert was plugged, water would flow over road and back into the stream channel, and
- have a large amount of fill above the culvert.

Surface erosion. Surface erosion occurs when detachable soils on sufficiently steep slopes are exposed to overland flow and/or the impact of rainfall. Sediments introduced to streams from surface erosion processes are generally fine-grained and can influence water quality and aquatic habitat. Raindrop splash, freeze/thaw, dry ravel, wind throw and animal burrowing are natural causes for soil detachment. Gravity and overland flow of water are natural transporters of the material. Overland flow of water rarely occurs under forest conditions because the soil is usually protected by organic material that absorbs water and raindrop impact.

Streambank erosion is a type of surface erosion that is natural but can be excessive in some watersheds. The main cause of excessive streambank erosion is inadequate riparian buffer size and amount of stabilizing vegetation. Rivers and streams will meander naturally in floodplain areas and in confined valleys (to a much lesser extent) based on geology and soils, but will meander excessively with inadequate riparian buffers and amount of stabilizing vegetation.

Management practices and enhancement projects

It is important to identify mass wasting sites in the watershed using aerial photographs and going on-site. The main purpose is to understand the processes of failure, estimate the time scale of the different erosional events, generally estimate the amount of sediment entering the streams and exiting (gaining versus flushing), and develop enhancement or management practices to prevent/slow the erosion. Potential restoration activities include rerouting water, closing roads, eliminating harvest or road building in highly susceptible areas, and re-vegetating areas that require increased root strength, etc.

For potential road failures, a number of management practices are available to reduce the drainage area of the culvert including water bars, cross ditches, and relief culverts. If the road is to remain in place, the culvert could be replaced with a larger sized culvert or bridge, or the amount of fill could be reduced to decrease the amount of soil entering the stream channel during a blow out. Another option would be to put the road to bed (replace fill to original slope, plant road or new slope), pull the culvert, and put the fill back on the hillslopes (or haul off).

Any activity that strips the protective organic layer to the bare mineral surface may allow surface erosion (Road construction and maintenance, skidder/tractor yarding more than cable yarding, burning). Compacted soils also impact the soils ability to

quickly absorb surface water and may result in surface erosion (Skid trails, road and landing construction). Factors that influence delivery to the stream system include: proximity of erosion to the stream system, slope angle, soil particle size (reflects travel distance), areas where overland flow occurs, length and condition of road that drains directly into the stream system, and material used for road surfacing. Management and enhancement techniques involve practices with less impact, water control measures (water bars, good road drainage to decrease impact on cut-fill slopes and skid trails), and vegetating exposed areas.

There are a number of streambank erosion techniques that enhance fish habitat and restore streambank vegetation. Bio-engineered methods have proven highly successful and less costly than rock structures. In addition, there are many different log and/or boulder structures that reduce velocity and erosion at the toe of the streambank and allow for replanting the streambank.

Geomorphology and stream morphology

As mentioned previously, the local geologic processes define the basic structure and a lot of the characteristics of the stream channel. The assessment should entail some analysis of the stream channel conditions, then identify stream enhancement techniques that would improve those conditions.

Assessments and stream restoration techniques

There are a wide variety of stream classification techniques. The most widely adopted technique by public and private agencies was developed by Rosgen (1994). Stream types are characterized by eight morphological features: Channel width, depth, velocity, discharge, channel slope, roughness of channel materials, sediment load, and sediment size. Some applications of stream classification data include: determine the suitability of habitat restoration structures, describe specific stream reaches by channel type and sequence within the basin, and predict a stream's behavior from its appearance, describe the condition of the stream and its ability to transport the sediment yield from the watershed, and provide a consistent and reproducible frame of reference for communication among those working eight river systems. There are manuals available on all kinds of different stream restoration techniques.

Wildlife and wetlands

Assessments generally include summaries of wildlife species that are listed as "sensitive" and need to be addressed through management changes or restoration projects. Local Oregon Department of Fish and Wildlife would provide this information for private land, as well as survey techniques to evaluate populations. Wetland surveys on private land for location and health are usually done by local Oregon Department of Fish and Wildlife, Natural Resources Conservation Service, and sometimes the Division of State Lands. Public agencies would provide wildlife and wetlands information for the respective land they manage.

Management impacts and restoration techniques. These were generally outlined in the Wildlife Management section of the Science Curriculum.

Other important information

Assessments generally include other pertinent information about the watershed to help in developing management and enhancement plans. The most important piece is often the historical perspective on watershed activities and conditions. This can include natural events (floods, fires, disease), big changes in mechanization (ex. change in logging from splash dams to mechanical yarding and hauling), and oral history of natural conditions from long timers.

Sources of information

Resource agencies (USFS, ODFW, BLM, NRCS, etc.) would have information for both private and public land. They probably have completed assessments or at least have detailed information on resource conditions. They also have a lot of local expertise in watershed management and enhancement programs. They usually have hydrologists, fish biologists, wildlife biologists, geologists, and engineers. They would also have aerial photos, road maps, geology maps, etc. that could be used in assessments. (Attach a who's who in resource agencies?)

Prioritize

After the basic assessment is complete for the watershed, prioritize the obvious problem areas, i.e. streamside livestock grazing, fish passage barriers, landslides and/or lack of pool depth or cover. As mentioned previously in section II (Choosing a Watershed), the goal is to protect the prime habitat areas and restore as much of the rest of the watershed as possible. Obviously, you have to prioritize what is restored based on what is feasible (cost, time, etc.). It is most feasible to restore the good areas into prime areas rather than poor areas into prime. Also, areas that link two or more prime habitat areas should take priority.

In order to prioritize projects, it helps to map the prime, good, and poor areas of the watershed as they relate to the resource value being restored (i.e. coho salmon). Be sure the resource values chosen for restoration were present and healthy historically. In other words, don't try to restore something in an area if it was never there.

When prioritizing problem areas, develop a two prong approach. Address up-slope problems at the same time when considering instream improvements. A common mistake is trying to restore fish habitat without addressing the up-slope conditions causing the problems.

As mentioned previously in section II, landowner cooperation is always priority. A project can not succeed in an area without landowner cooperation, no matter how significant the area is to restoring a resource value.

Monitoring

Long term monitoring is necessary to substantiate the effectiveness of watershed restoration or management changes. Therefore, begin long term monitoring before the project or management change is implemented. The types of monitoring plans used de-

pend on the money available and the resource value changes being monitored. If there is only one type of monitoring that could be done once a year, it should be photo documentation. Photos are taken of the same area (same lens setting, exact same photo center) every year to document changes. Start taking pictures before the project begins. A guide explaining photo monitoring can be sent to you from the Governor's Watershed Enhancement Board (1-503-378-3589 ext. 826). Help with monitoring plans on public land can be obtained from the particular agency managing the land. For private land, the Department of Environmental Quality office, Oregon Department of Fish and Wildlife, Natural Resources Conservation Service, and Oregon State University Extension Service for your County or watershed can help.

Education

When dealing with private landowners, its crucial to inform them of the resource values of concern (i.e. life cycles and specific habitat needs of salmonids, the value of sediment reduction and habitat improvement). You will need the landowners cooperation to proceed with the planning process. Let them feel that they have vested interest in the project. Discuss possibilities of tax incentives and cost share programs. Reluctant landowners may take time to educate. "Take it slow!" Let other landowners work on the project's behalf and use other completed projects for examples. Make things plain and simple. "Don't use buzz words!"

When dealing with public land managers, they may not need to be educated on the project. However, public lands are funded by public policy and public votes. In order for the general public to understand and support the management changes and restoration projects on public land (USFS, BLM, etc.), they need to be educated. The newspapers, radios, brochures, and word of mouth can all be used in educating the public.

Project Design

Once the assessment has been completed and some general management changes or restoration projects have been prioritized for an area, the project design can begin. Always design in the field with the appropriate technical personnel (hydrologist, fish biologist, geologist, engineer, etc.) and the person who will supervise or implement the project. Almost all designs require some work inside (maps, drawings, engineered specifications), but these designs must always be field checked.

The project design process usually follows these steps:

1. Map project sites to a reasonable scale
2. Mark the project site boundaries, i.e. fence lines, bank stabilization sites. Determine footage.
3. Draw out plans. Simple is effective.
4. Meet with landowner for ideas and approval. Discuss types of materials to be used. Make sure the plan will meet landowners needs, i.e. access, livestock water-

ing, etc. Write up a landowner access agreement. Make it clear who is responsible for maintenance.

5. List an estimated amount and cost of materials and supplies, i.e. boulders, fencing, seedlings, etc., necessary to complete the entire project.
6. Determine needs and costs for heavy equipment or specialized power equipment.
7. Determine labor force (in-house or contracted) for project supervision and hand crew.
8. Timing: When is the appropriate time to do the job? Winter? Summer? Low Flow? Wet ground?
9. Schedule activities in logical order, i.e. bank stabilization, then fencing, then planting.
10. Inquire about permits and environmental documentation. Determine the turnaround for permits. "Try to keep ahead of the process!" Try to prevent permits from postponing the project.

Typical restoration projects

Riparian area restoration/enhancement

Goal. These projects aim to change the riparian area in order to restore or enhance its essential ecosystem functions. The amount of change the landowner is willing to do varies, but the goal is to restore the native historic vegetation and width of the riparian area. The word riparian area means the actual riparian area along the stream (wetland, lake, etc.) and the riparian area of influence (zone of influence), unless referred to separately (Figure 1). The State Forest Practice Rules specify the minimum riparian buffer width for private forest land, while the public agencies have their own rules for buffer width. Other private land (agriculture) does not have any regulations at this time except for county ordinances.

Planting different species. These projects generally involve tree planting using a number of different species. The forestry management section discussed how conifers and hardwoods are generally planted. Conifers are usually planted as 1 to 3 year old seedlings, while hardwoods may be just clippings (branch at least 2 feet long) or clippings from containers (different sizes and bearing roots). The most important thing to remember is to plant the right tree species in the right proximity to the stream (tolerance to flood) and to larger trees providing shade (tolerance to shade). Always plan to provide maintenance for at least three years. Maintenance includes removing competing vegetation and using protectors for wildlife. Riparian planting often includes removing brush or undesirable species in order to increase conifers and desirable hardwood species. There are several techniques for converting hardwood dominated riparian areas to conifer. The overhead canopy can be removed, thinned, or killed and left standing to fall over time.

Many agricultural riparian areas need to be totally revegetated with trees. Willows are almost always used to help stabilize stream banks and begin the revegetating pro-

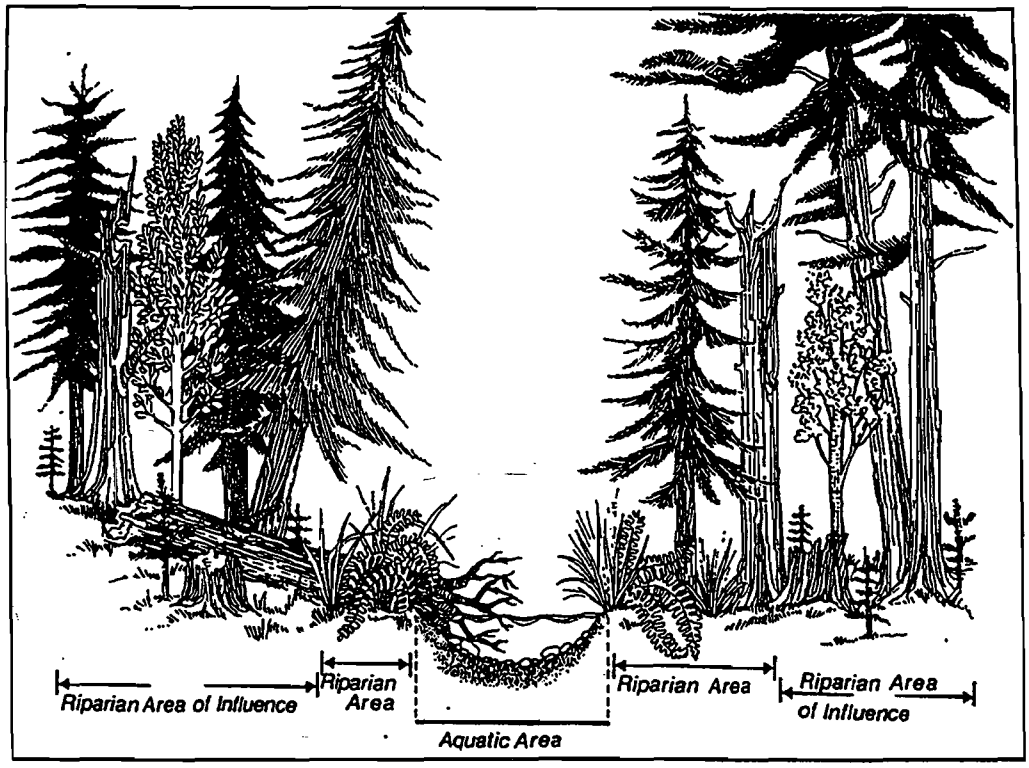


Figure 1. Riparian habitat.

cess. Willows are tolerant to flood but not to light, and they are generally found in the riparian area next to the stream. Willows sprout readily from stumps and clippings, and can be planted using a variety of methods. Willow branches can be cut from a nearby site and planted in the ground with a planting bar or shovel. Other common planting methods include building willow mattresses, planting large stakes, building facines, building willow baffles, and planting willow bundles. Some of these methods are referred to as bioengineering, which is engineering both vegetation and rock to be used as a hard structure that grows and restores vegetation and stability to a site (commonly streambanks, eroding hillsides, and eroding road cuts). There can be a large number of willow species throughout a watershed. However, always try to cut from a nearby site, because they will be most adapted to those conditions. If willows must be cut from a riparian area, do not cut more than 1/3 of the existing group.

Tree spacing. Riparian area planting is usually done at tight spacing (6 x 6 feet and 8 x 8 feet for conifers and most hardwoods, as close as 1 x 1 for willows) because maintenance and wildlife damage can be high. Remember to plant how you would like the area to function in the future. For example, plant a variety of species with a variety of spacing instead of one species in rows. Try to plant in small microhabitats for better competition with vegetation and protection from wildlife (i.e. next to a slow growing bush, old log, or rock).

Stream restoration

Goals and variations. These projects usually focus on changing instream conditions to enhance or restore essential ecological functions for salmonids. Stream restoration techniques vary by location in the watershed, fish species of concern, and

theory of people implementing the techniques. As mentioned previously in the biology section of Chapter 2, each fish species differs in life cycles and critical survival needs. Therefore, restoration techniques will vary depending on the species of concern and the critical need addressed (spawning versus rearing habitat, etc.). Furthermore, location in the watershed must match the critical need being addressed. For example, coho restoration techniques tend to focus on increasing slack-water pools since juveniles rear in tributaries and require slower moving water during high flow events in order to survive to smolt size. Also, stream characteristics (size, hydraulics, shape, slope, etc.) change with location in the watershed. Therefore, restoration techniques and designs change with stream characteristics. For example, log weirs that span the width of a stream are not feasible in larger size streams. Lastly, people have different theories on how stream restoration should be accomplished. All theories view the stream network on a large scale (colluvial tributaries, alluvial flats, valley floors, main-stem, estuaries, etc.) and a small scale (reaches, pools, riffles, etc.). However, theories differ on which scale should be the focus of restoration efforts.

Large scale approach. An example of a large scale approach was discussed in the biology section of Chapter 2. This approach focuses on rebuilding the stream processes that restore food resources, food retention, and food cycling for salmonids. The stream system is analyzed to identify potential "productive flats" for restoration. These are the areas where the stream is connected to its floodplain and is able to restore, hold, and recycle food resources more efficiently. Restoration of these areas includes building log jams, providing enough large woody material in an area to allow log jams and habitat to create itself, and building or restoring critical wetlands, beaver ponds, and backwater areas. The habitat of these flats are also critical for coho rearing, and use by other salmonids.

Other examples of a large scale approach was briefly mentioned in the stream morphology section of the assessment. Several methods have been developed for classifying streams and using this information for restoration planning. Rosgen's classification restoration methods have been the most widely adopted among public agencies. His large scale restoration projects usually include restructuring whole reaches of stream channels to create more stable and natural conditions. The restructuring focuses on recreating natural meanders (size, shape, length, etc.) and stream gradients based on stream characteristics.

Small scale approach. The smaller scale approaches usually focus on restoring critical habitat needs for salmonids in different reaches and sections of the watershed. Small scale approaches involve instream structures using a variety of materials (logs, boulders, rootwads, or combinations). These are more common than large-scale approaches, and there is about ten years of data documenting what works and what doesn't. These techniques have evolved from "let's just try this and see" to requiring similar expertise at the large scale approaches.

Structure design types and configurations are numerous. All of them serve a common purpose: to imitate natural obstructions by disrupting the natural flow of water and sediment. By influencing hydraulic conditions, structures store and sort sediment, en-

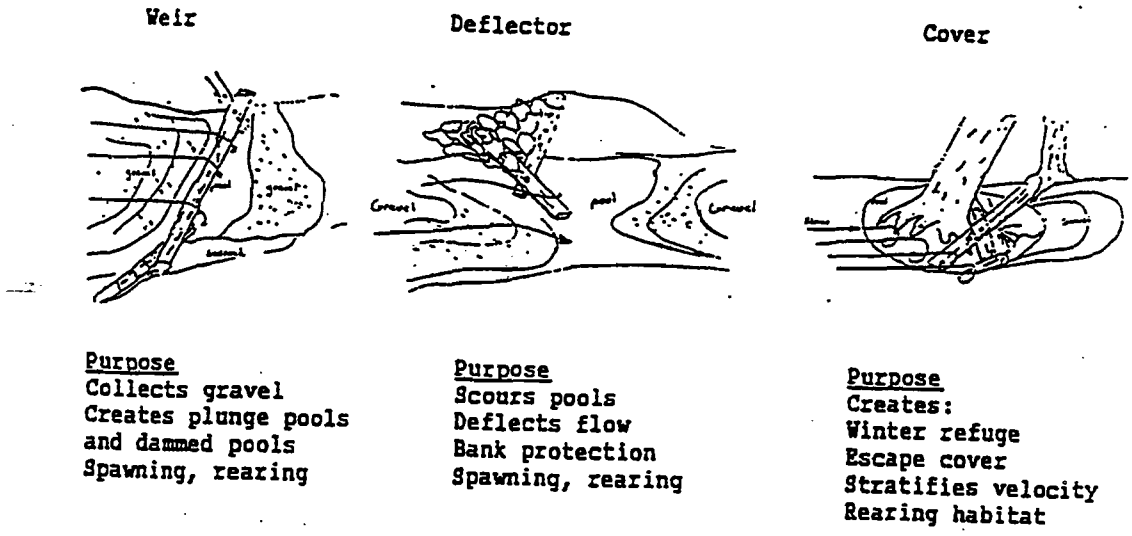


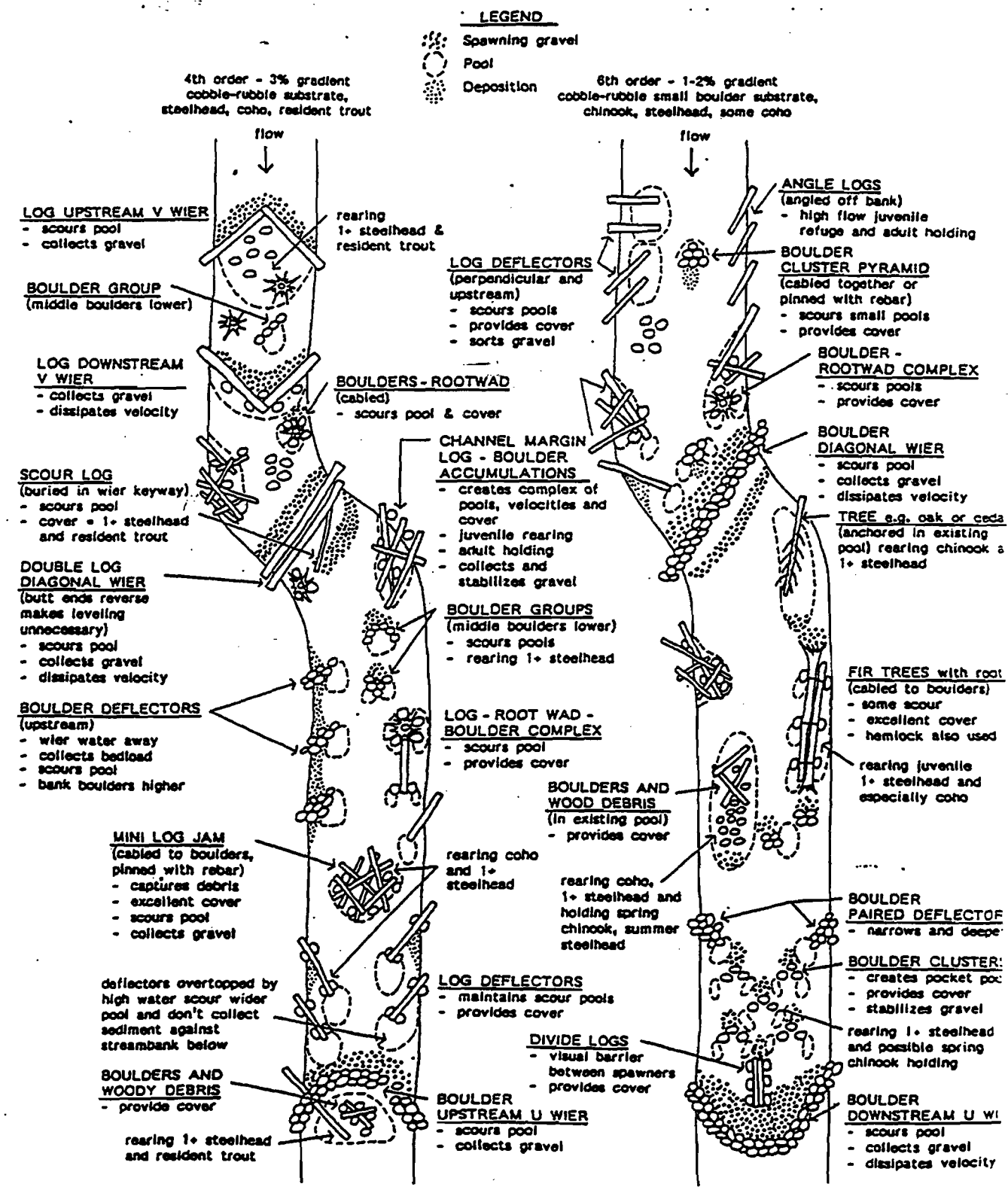
Figure 2. General instream structure types and their purpose.

hance scour, deposit stream bed material, diversify velocity and depth, and fix the position of bars and pools. The substrate is scoured or deposited as water and gravel is forced under, over, around, between, or slowed by the different structures. As a result, structural features are created that may improve fish habitat.

The three general designs for instream structures are deflectors, weirs, and cover structures (Figure 2). Each has several subtypes. For example, some weir configurations consist of "Y-shaped" weirs, "K-shaped" weirs, and "V-shaped" weirs. A combination of structure types are often used to create complex habitats. Multiple structures create a variety of scour and depositional areas for rearing, resting, and hiding. They are formed in conjunction with gravel bars for spawning.

Instream structures may be anchored and built to stay in one place, or they can be strategically placed without anchoring and expected to move with different streamflows into different positions. For either design, the long term maintenance and potential damage downstream has to be discussed and understood with the landowner.

The American Fisheries Society produced a graphic of typical structures used in small and medium size west-side Oregon streams (Figure 3). Structures commonly use boulders, wood, gabion baskets, or a combination of the above. Gabion baskets are not recommended for instream structures because of aesthetics and failures attributed to the basket's wire construction. Material selection depends on availability, site location, logistics, and financial budget. Woody material by itself or combined with boulders is usually the preferred material because of its geometry, its easy to manipulate into shapes or secure to other material, and it usually provides more edges and complexity. Remember when choosing logs for habitat; "the uglier the better." Other



Source:
American Fisheries Society: A Training In

Figure 3. Typical structures used in representative small and medium size (4th and 6th order) west side Oregon streams.

when using woody material are:

1) Conifers generally last longer than hardwoods of the same shape and condition,
2) Submerged wood exists longer than exposed wood, and
3) Do not disturb wood that is already providing instream habitat.

Generalizations exist for site location potential. As a "rule of thumb," structures placed between stream gradients of 0.5% and 3.0% have consistently proven successful. Also, the importance of hydraulic factors need to be stressed, such as angle of the structure and height. Understanding how channel morphology is influenced by these obstructions is vital to constructing stable and effective structures. In other words, each stream is dynamic and has its own conditions that determine how structures are naturally placed. Some general observations include: What is the size of instream wood that is stable at high flows? How is existing habitat reacting to high flows? How far are the logs and other woody debris extending out into the active channel? How are the logs oriented to flow? Are the logs accumulating smaller debris as cover?

Erosion control/prevention

The types of erosion, processes, and general restoration techniques were discussed in the assessment. The main restoration projects relating to erosion include road decommissioning, road maintenance (culvert replacement, water bars, partial fill removals, stabilizing fill material, etc.), treating upland surface erosion sites with vegetation to increase infiltration of runoff, and treating streambank erosion with structures and vegetation.

Road decommissioning basically includes: 1) stabilizing the road surface by ripping, planting, and/or sloping the road-cut back to the normal landscape topography, and 2) removing culverts and fill material in the stream crossing, and sloping the fill material in the stream crossing back to the normal landscape topography. The restoration practices are usually expensive and require engineering for designs. Some past decommissioning efforts have involved removing only part of the fill material above the culvert and leaving the culvert and road alone. The idea is to decrease the volume of sediment that could enter the stream channel if the culvert was plugged and torn out by a debris flow. Furthermore, it greatly reduced the treatment costs allowing more stream crossings to be treated with limited funds. These efforts have since been proven ineffective and should not be considered. By leaving the culvert and fill material in the channel, the stream and debris flows scoured out the culvert, fill material, and eroded far more of the stream bed than if everything had been removed to begin with. When everything is removed, a stream bed is allowed to form and become stable prior to storm events.

Road maintenance includes any efforts that decrease the drainage area of the culvert (water bars, relief ditches, etc.), decrease the potential of the culvert to be plugged (increase culvert size, treat upstream slope failures causing debris flows, build a bridge, etc.), or decreases the amount of sediment washing from the road (vegetate and/or sta-

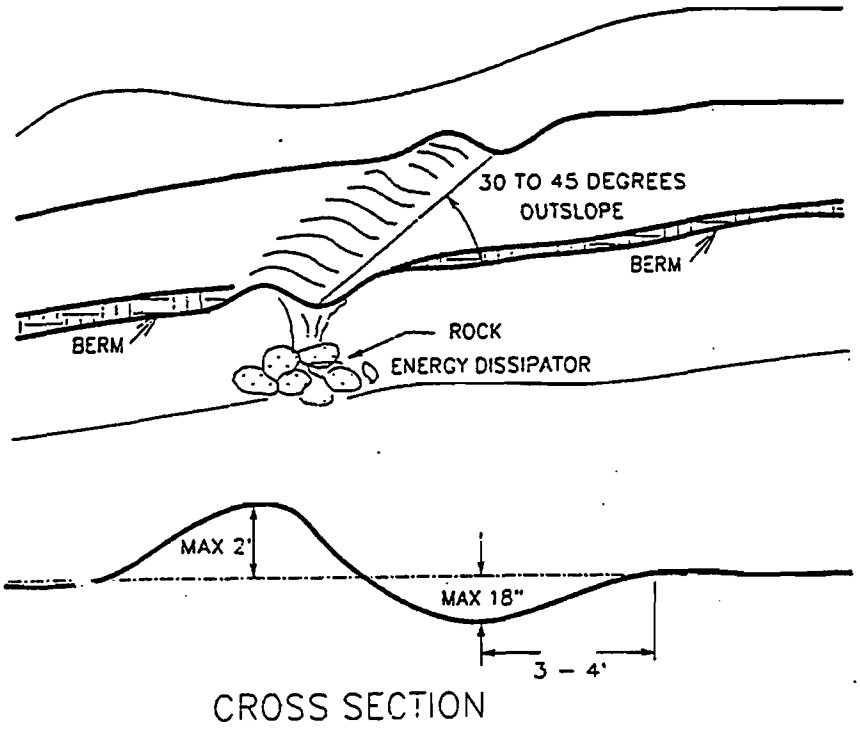


Figure 4. Waterbar

bilize cut and fill slopes, drain water off of road into forested areas, increase frequency of water bars, pave road surfaces, etc.). New culverts in forested areas are now being sized for a 50 year storm event. However, there are a lot of old culverts that are undersized with a high potential for plugging. Waterbars are a temporary means of breaking surface flow over sloped sections of road (Figure 4). They consist of a shallow ditch and rounded berm placed diagonally across the road surface. Often, they must be reconstructed every year because they either wear down during summer or are graded down in the spring for easier driving. They can be made easier to drive by increasing the width and thereby reducing the slope of both the ditch and the berm. Generally, waterbars are spaced by dividing the road grade into 1000 feet (5% road has waterbars every 200 feet). Rolling dips are the same as a wide waterbar. They are installed by gradually ramping the road surface down to a slightly out-sloped low spot built across the roadbed, and then gradually ramping back up to the road grade. They often extend for 100 feet or more.

Cut and fill slopes and exposed upland surface erosion sites cause problems because they generally are steeper than surrounding topography (cut and fill slopes), and they have poor water infiltration. Therefore, once the vegetation is removed, it is difficult to revegetate. These areas can be treated by a number of different techniques that basically stabilize the slopes and increase infiltration, until vegetation can be established. The most common treatment on roads is riprap (Figure 5), but this can be cost prohibitive and doesn't allow for natural infiltration like vegetation. Common restoration treatments include building live crib walls (gabion walls with willows growing out of them), burying willows in the soil perpendicular to the surface, building willow facines,

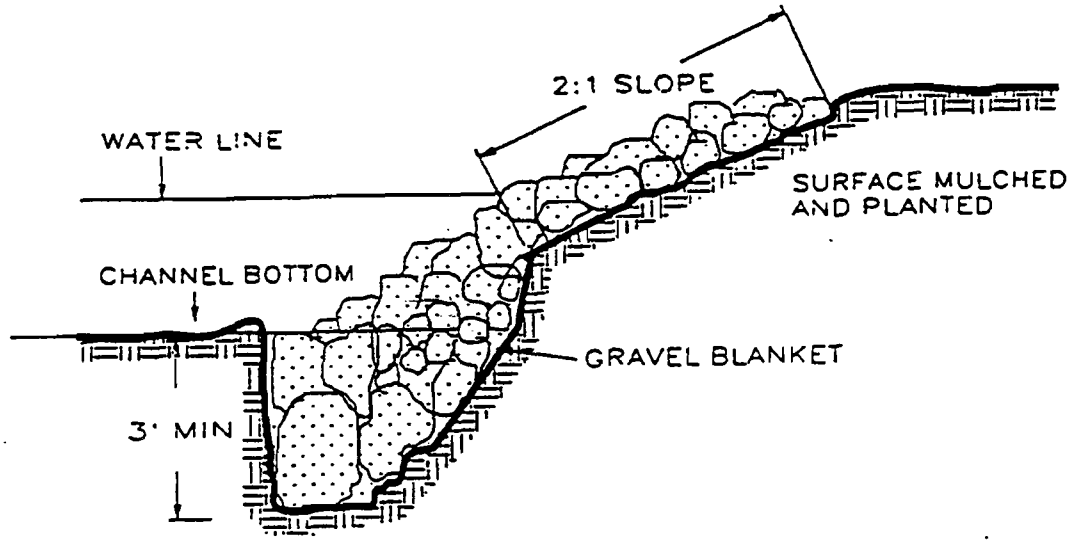


Figure 5. Riprap.

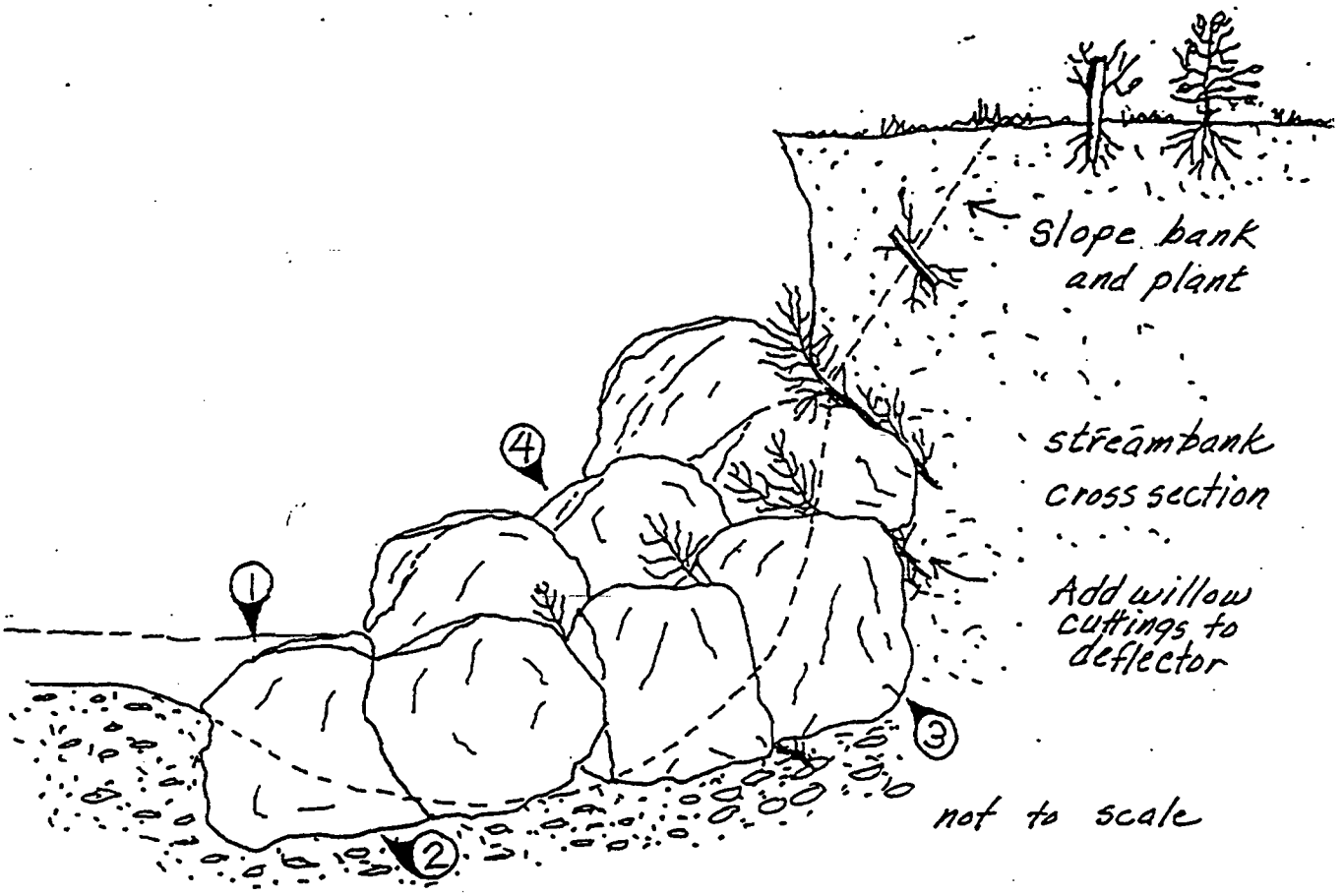
and driving long rebar perpendicular to the surface and using mesh material with grass seed (common road project).

Streambank erosion projects are common restoration activities because an erosion source can be treated while enhancing stream habitat. Streambanks commonly erode when the toe of the slope is scoured by the velocity of the stream channel. Once the toe is gone, the streambank sloughs down to stabilize itself. If the banks are not heavily vegetated with trees (especially a mixture of hardwoods and conifers), an excessive amount of bank can be lost.

There are a number of techniques used to protect streambanks, the most common being riprap (boulders placed at the toe and extending up the bank, see Figure 5). The problems with riprap is that it provides less roughness to the stream channel than vegetation, and less fish habitat along the streambank. Roughness provides friction and hence dissipates the stream's energy causing the water to slow as it passes the streambank, and therefore riprap sends the energy downstream rather than absorbing it.

The goals of streambank restoration projects are to 1) slow the water velocity, causing sediment to deposit and build streambank rather than scour, 2) stabilize the streambank using vegetation, 3) provide some instream fish habitat, and 4) begin to establish a healthy riparian area. All projects entail sloping the streambank to at least a 1.5 to 1 slope, preferably 2 to 1, and planting with willows and other native tree species (1.5 feet horizontal for 1 foot vertical). Some projects entail building boulder and/or log deflectors that are keyed into the bank and extend into the stream channel (Figure 6 and 7). They deflect flow away from the bank, stabilizing the bank and making

Boulder Deflector used for Streambank Stabilization



① Select Large, hard boulders, average size, usually 3/4–1 cubic yard, avoid round boulders, angular material stacks better, and is more stable in the streambed.
② Excavate streambed down below deepest pool 2-3ft.. Excavate a triangle from the bank sloping to deflector tip at a 5°-15° angle. ③ Excavate into the bank a full boulder width to improve structure durability ④ Place boulders in excavated triangle with the biggest boulders at the deflector tip and bank, make sure all boulders have contact with each other, stack boulders to add weight and height toward the bank.

Figure 6.

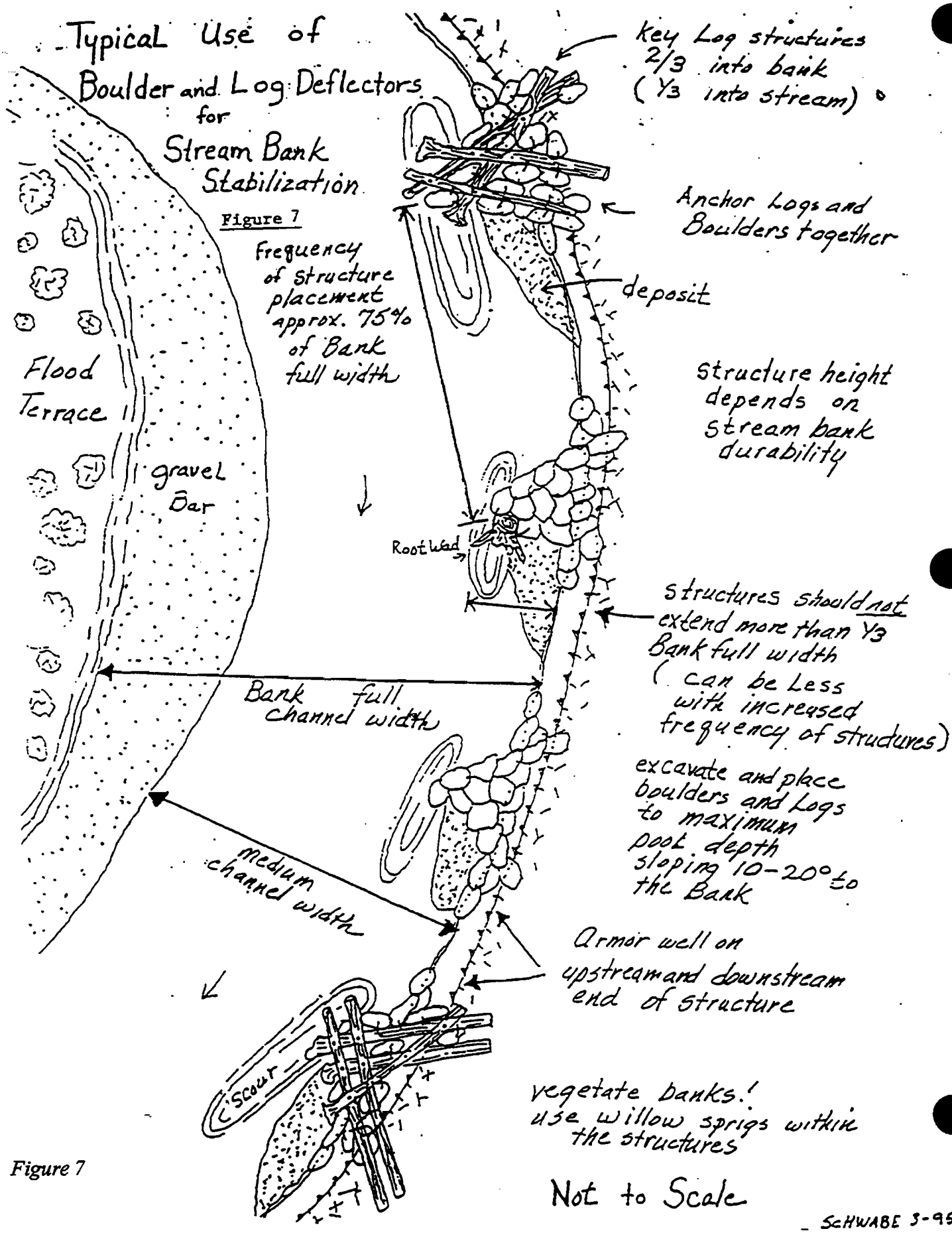

Typical Use of
Boulder and Log Deflectors
for
Stream Bank
Stabilization
Figure 7
Key Log structures
2/3 into bank
(⅓ into stream)
Anchor Logs and
Boulders together
deposit
Frequency
of structure
placement
approx. 75%
of Bank
full width
Structure height
depends on
stream bank
durability
Flood
Terrace
gravel
Bar
Rootwad
Structures Should not
extend more than ⅓
Bank full width
(can be Less
with increased
frequency of structures)
Bank full
Channel width
excavate and place
boulders and Logs
to maximum
pool depth
sloping 10-20° to
the Bank
medium
channel width
Armor well on
upstream and downstream
end of structure
scour
vegetate banks!
use willow sprigs within
the structures
Not to Scale
SCHWABE 3-95

Figure 7

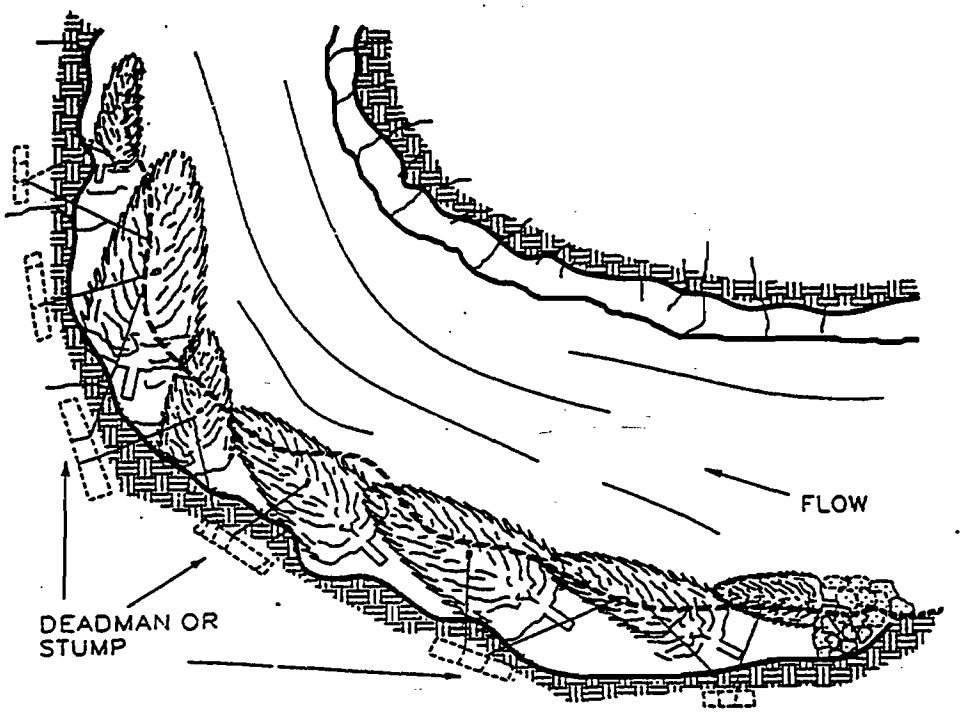


Figure 8. Tree revetment.

revegetating easier. They also increase stream velocity at the tip of the structure and cause a scour pool on the downstream side of the deflector. By creating a scour pool, some of the stream's energy is dissipated, forming for fish habitat. Another design uses large conifer tree tops anchored along the streambank (tree revetment, figure 8). This design decreases velocity along the streambank, causing sediment to deposit, while providing cover for fish.

Other design types were mentioned earlier in the riparian section and included bioengineering methods. These use rock and willows (primarily) to simultaneously decrease velocities, deposit sediment, and grow vegetation. The most common techniques include live stakes (willow branches 2-3" in diameter and 4 feet long, figure 9), willow mattresses (Figure 10), and willow baffles (Figure 11).

Developing fish passage

A common restoration practice is to develop fish passage where a man-made structure is blocking significant upstream habitat. These man-made structures are typically culverts and dams (both large and small). In considering fish passage, make sure both adults and juvenile salmonids are able to pass upstream. Adults need passage to access spawning areas, while juveniles need passage to utilize the best quality habitat for rearing. Culverts can cause blockage by:

- vertical distance from jump pool to the culvert's outlet is too high (need <12 inches for juveniles)
- horizontal distance from jump pool to the culvert's outlet is too far

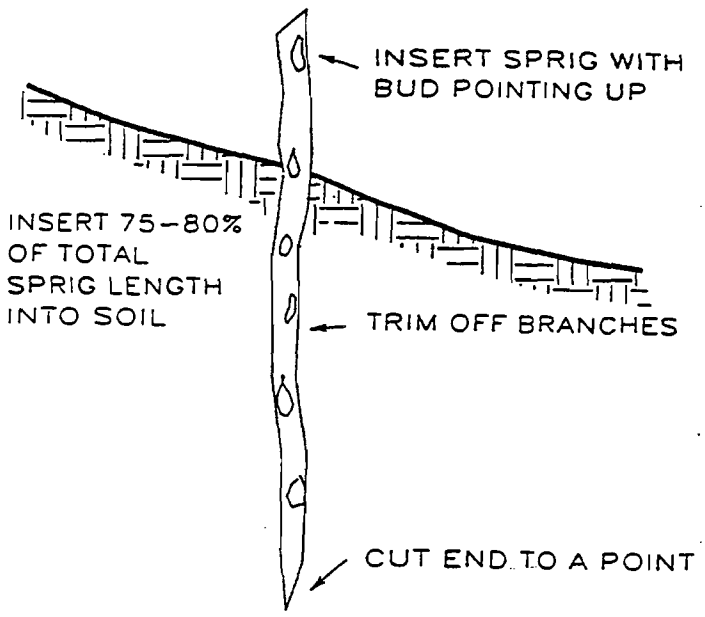


Figure 9. Willow sprigging. (Prunuske, 1987).

- not holding sufficient depth of water (stream flow goes subsurface or bypasses culvert, need >6 inches for passage)
- gradient of culvert is too steep and causes stream velocities to be too high (need < than 7 feet per second)

Restoration projects for culverts include replacement, building a series of jump pools for greater access, back-flooding the culverts with weirs, and building baffles inside culverts to reduce velocities, increase water depth, and decrease gradient. Restoration for dams includes removal (usually cost prohibitive) or building a fish ladder (fishway) for passage. The most common ladder designs are the step-and pool fishway (Figure 12), the Denil fishway (Figure 13), and the Alaskan steeppass (Figure 14). The step-and pool fishway is essentially a series of vertical partitions spaced along a constructed channel or flume. Flow spills over the crests of the partitions creating a series of step like pools that fish can ascend. The Denil fishway and the Alaskan steeppass are essentially flumes with two different baffle designs. They can be installed at steeper slopes than the step-and -pool, however require more maintenance to prevent plugging. The Alaskan steeppass is smaller, lightweight, can be prefabricated, and is more easily installed. However, it requires more maintenance to prevent plugging.

Wildlife and wetland restoration/enhancement

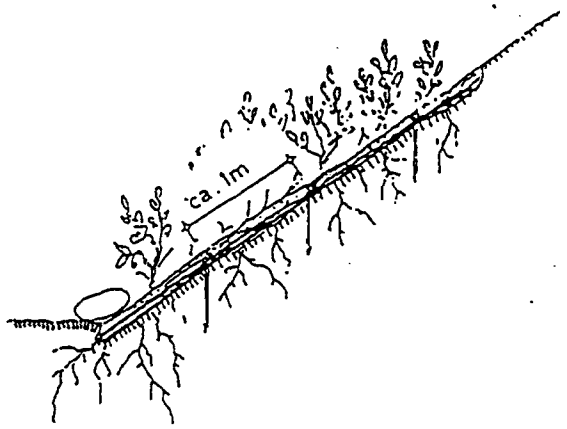
Both wildlife and wetland restoration projects overlap with other projects previously mentioned, especially riparian projects. Wildlife projects typically target sensitive bird, waterfowl, and large game projects. The most common projects for bird and waterfowl include creating nesting habitat by adding large woody material (snags, downed wood)

Construction

Live branches are placed on the ground very close together so that a complete cover is established *(Fig. 135)*. The butt end of the branches must be in the soil. It is essential that the butt ends of the branches be well covered so they can root and not dry out or be washed away. Therefore they are usually protected by fascines, poles, wattle fences, or rock fills *(Figs. 136 and 138)*.

If the length of the branches is not sufficient to cover the entire slope, the branches of the lower layer must overlap the ones in the upper layer by at least 30 cm. The brushmattress is tied to the ground with wire, cross-laid branches, fascines, or wattle fences in rows of 80 to 100 cm apart *(Figs. 136 and 137)*. The simplest method is anchorage with strong wire. Live or dead wooden pegs or steel pegs with hooks are driven into the ground 60 to 80 cm apart and 20 cm deep. The wires are tied to these pegs and the pegs are driven in deeper, so that through the increasing tension of the wire the brushmattress is pressed firmly to the ground. It is better to drive the pegs partially in before the branches are placed.

If fascines or wattle fences are used to fasten the brushmattress the distance between the pegs is generally 100 cm. This is a much more expensive fastening system, but it has no advantage over using wire. In particularly endangered areas (e.g., with heavy rainfall or in wavelap zones) it may be necessary to anchor the brushmattresses more securely with strong wire mesh or something similar. To ensure that the brushmattress will take root and grow, the branching must lie firmly on the ground and have solid contact with the soil. The entire brushmattress must be lightly covered with earth or fill, but topsoil is not necessary.



135
Diagram of a brushmattress construction.

137
Detail of a newly constructed brushmattress.

Materials

Preferably long, straight, branches which root easily and are no shorter than 150 cm should be used. Depending on thickness and number of side branches, approximately 20 to 50 branches are used per running m, provided the length of the branches is the same as the slope length. Weight requirement per square m of smooth branches is at least 5 kg; with bushy branches 5 to 10 kg. If not enough live plants are available, they can partly be substituted by dead woody plants. Live and dead material can be mixed, but mixing must be done thoroughly in order to achieve even growth.

Figure 10. Brushmattress construction (brush matting construction).

from Schiechtl '80

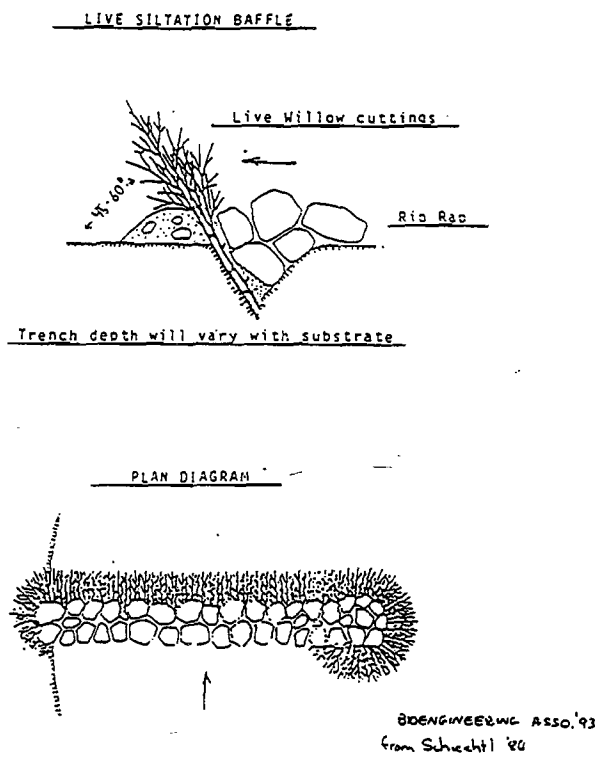


Figure 11. Willow baffles

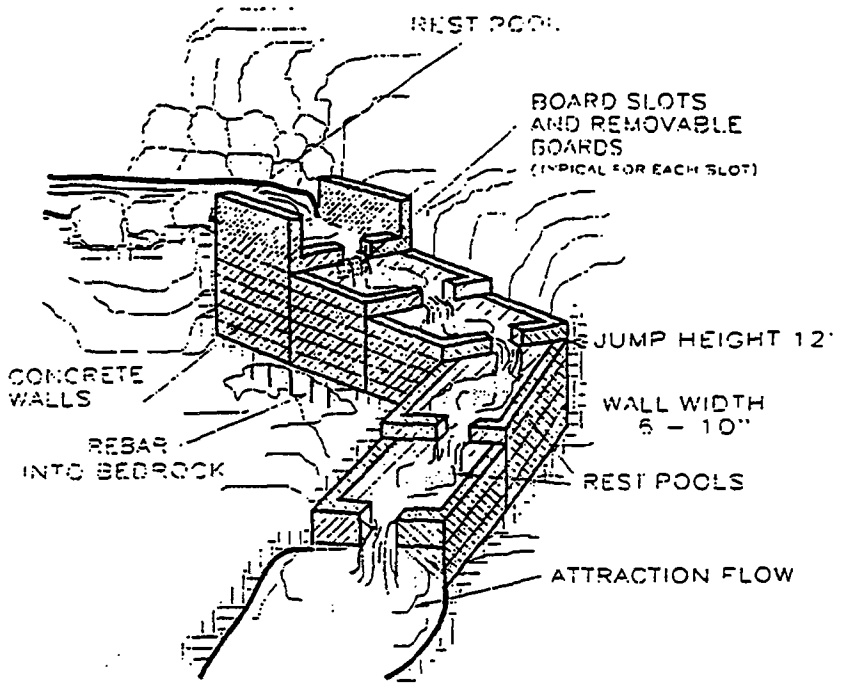
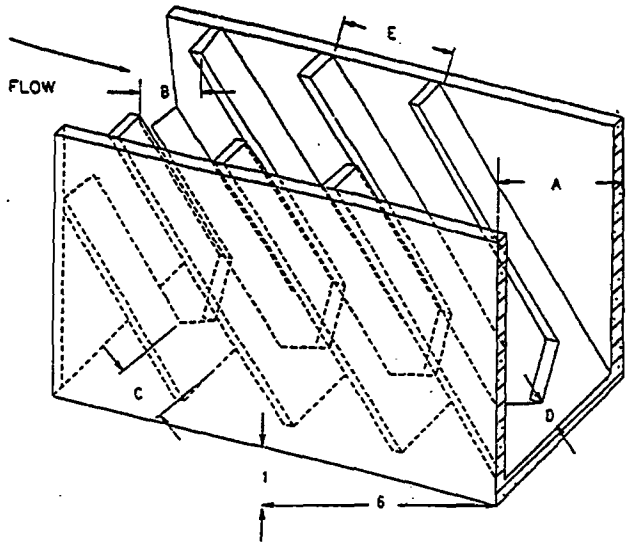


Figure 12. Step-and-pool fishaway.



A	B	C	D	E
4' – 0"	2' – 4"	2' – 0"	1' – 0"	2' – 8"
3' – 6"	2' – 0"	1' – 9"	10.5"	2' – 4"
3' – 0"	1' – 9"	1' – 6"	9"	2' – 0"
2' – 6"	1' – 5.5"	1' – 3"	7.5"	1' – 8"
2' – 0"	1' – 2"	1' – 0"	6"	1' – 4"

Figure 13. Denil fishway.

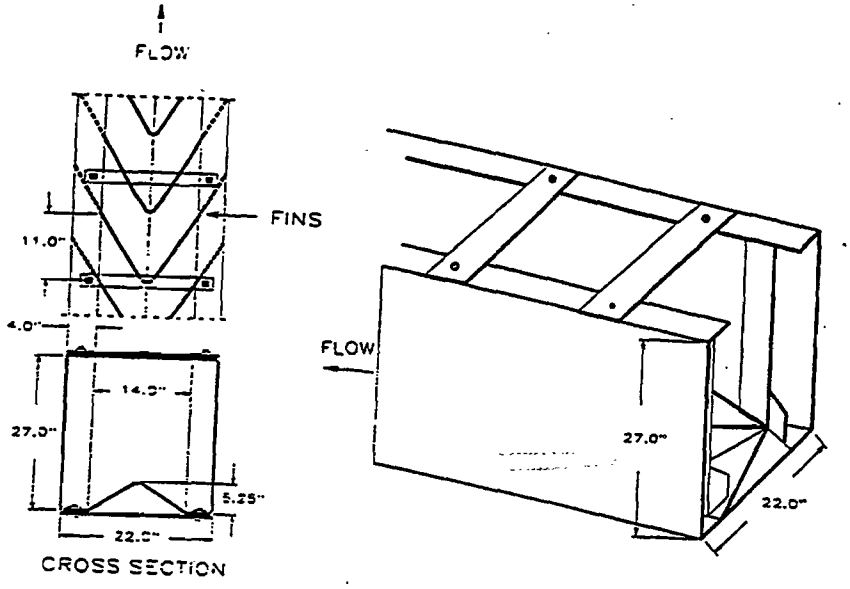


Figure 14. Alaskan steeppass.

to riparian areas, uplands, and wetlands. They also include developing better feed sources in wetlands, converted pasturelands, and reserves. The most common large game projects entail creating or maintaining prairies, and enhancing feed resources in these areas through prescribed burns and plantings.

Wetland restoration projects are usually for wildlife, with the exception of wetlands used by coho salmon. Wetlands are critical for rearing coho in the wintertime. Often restoration projects simply construct off-channel ponds or reestablish wetlands say, for coho. Wetlands are also designed to treat storm runoff, livestock wastes, and other wastewater from a variety of water treatment facilities and manufacturing plants.

Budgeting and Funding Sources

Determine the best funding source that fits the project's needs. Consider cost shares in the form of "in-kind" contributions by the landowner or other involved parties.

The budget must list costs and amounts of the following:

1. Labor (i.e. project supervisor, hand crew)
2. Insurance (i.e. workman's compensation)
3. Equipment and tools
4. Heavy equipment
5. Materials and supplies
6. Consulting fees
7. Documentation
8. Administrative costs
9. Permit fees

Figure at least 10% of total budget as hidden surplus to help offset price increases in materials and labor and to meet unexpected costs. The written proposal and budget always includes a narrative or historical background, current resource assessments, maps, designs, signed landowner access agreements, support letters, and a budget page.

Project Implementation

When funding is secured and contracts are signed, determine if any unknown obligations need to be met, i.e. archaeological surveys. Remember to establish photo points before beginning the job. "Never begin a project without signed contracts. Verbal assurances are not legal contracts." Finally, before the project begins, recontact the landowner and appropriate agencies. Make sure there are no surprises.

Remember mistakes will be made. Be flexible.

Suggested Field Exercises

Visit a number of completed restoration projects and gather the following information if available:

1) Completed assessment of the watershed; Does the project address needs identified in the assessment?
2) Project designs: What is the goal of the project (what resource values is the project restoring/enhancing)? In your opinion, how successful is the project in reaching or working towards the goal (give a % success and the reasons for your answer)? Identify any changes in designs that would make it more successful next time, and changes (or maintenance) that needs to be done now to ensure success.
3) Information on other projects in the watershed with similar goals: Were they considered successful? How do they work with this project to reach the same goal?
4) Identify some types of monitoring that could be done (or are already being done) to measure the success of the project or improvement in resource health.

Visit future restoration project sites that are presently being planned or waiting for implementation.

1) Gather information and develop a restoration plan (with designs, budgets, schedule for implementation, monitoring, etc.) for the site.
2) Compare results among the group and try to come to consensus on one to three different project designs for the site.
3) Have the people who have created the formal plans for the site given a presentation to the group on what is planned? What information was used to develop the plans; compare the crew's plans with the formal plans.

Conduct restoration projects on a variety of ownerships following specifications and goals for the project. Discuss changes that should be made to make the project more successful among the group and with property owners.

Give a brief presentation, tour, or paper to a group of people (interest groups, schools, agency personnel, general public, newspaper, etc.) discussing the types of projects that the group is working on, and the restoration goals they aim to accomplish.

Resources for Further Information, Training/ Certification

Resource agencies that are commonly used for watershed Information

Federal

Natural Resources Conservation Service, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Army Corps of Engineering, and the National Marine Fisheries Service.

State

Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Environmental Quality, Oregon Department of Water Resources, Oregon Division of State Lands, and the Oregon Department of Parks and Recreation.

Oregon State University

Oregon State University has related campus faculty, and extension service specialists on campus and in the Counties. Sea Grant Extension Service is a related group with specialists in counties (mainly coastal) and on campus. Water Resources Research Institute at Oregon State University provides a lot of related information and trainings.

Private

Private organizations specializing in watershed restoration and providing a lot of local support and trainings include; Pacific Rivers Council, Trout Unlimited, California Salmonid Restoration Federation (mainly trainings and certifications), and For the Sake of Salmon.

Frequently used publications

Most publications used for this section have been listed in the other science sections. Here is a short list of publications frequently used.

California Stream Habitat Restoration Manual. Inland Fisheries Division, California Department of Fish and Game. 1994.

Rosgen, D.L., *A Classification of Natural Rivers.* Catena. Elsevier Publications, Amsterdam. 1994.

Rosgen, D.L., and B.L. Fittante. 1986. "Fish habitat structures - a selection guide using stream classification." Pages 163-179 in J.G. Miller, J.A. Arway and R.F. Carline, eds. The 5th trout stream habitat improvement workshop.

The Stream Scene. 1992. An Aquatic Education Program Publication Distributed by Oregon Department of Fish and Wildlife, P.O. Box 59, Portland, OR. 97207.

TECHNICAL AND SAFETY KNOWLEDGE FOR ECOSYSTEM RESTORATION

BASIC FIRE SUPPRESSION AND SAFETY

Flaxen Conway and Dave Degenhardt

Introduction

Many forest/ecosystem workers of the present, and certainly in the future, have found that it is advantageous for them to acquired the skills necessary to work in some type of fire management situation. In the past this has been skills mostly related to wildfire suppression. However, as prescribed burning and other fire-related management tools are becoming part of the toolbox for good forest/range land management, more of the workforce will be expected to have the knowledge, skills, and abilities to work on fire-related projects as well as wildfire suppression. Therefore it seemed appropriate that the topic be addressed in this curriculum.

We are grateful to the assistance of the Oregon Department of Forestry for their help in accessing this information, which was taken directly from a cooperative project between the Oregon Department of Forestry and the Associated Oregon Loggers. There is an accompanying video. During a formal fire training, you would no doubt have the opportunity to watch this video, as well as receive a more in-depth coverage of the topics covered here. Please see the end of this section for resources related to fire training.

Competency Measures

PLEASE NOTE THAT THIS SECTION IS **NOT** FORMAL FIRE TRAINING. Rather, it is intended to provide you with a brief overview of this important topic, to assist you in accessing the resources necessary for you to enroll in a formal fire training program, thereby helping you to develop the needed skills and acquire the formal certification needed to work in this area. You will need this in order to do the best job, to do it safely, and to operate your business or yourself legally and safely. **So before you read this section or attend the training session on this topic, think about what you need to do in order to, in your own words, do the following:**

1) List the five basic core concepts of this topic:
   - What are the components of basic fire behavior?
   - What are the tactics for fire suppression?
   - What are the basics of fire safety?
   - What are the tools, and how are they used safely?
   - What are the training/certification resources out there?
2) Describe basic fire suppression and safety, and what it would look like on a typical forest/ecosystem restoration project.

3) Demonstrate that you understand and know how to safely use equipment related to performing tasks related to a typical fire suppression (as related to forest/ecosystem restoration) project.
4) Say why basic fire suppression and safety are important for ecosystem management and stewardship.,
5) Be able to list three reasons how and why basic fire suppression and safety might be important for land owners/managers.
6) List three sources of support/assistance/reference for basic fire suppression and safety.

Basic Fire Suppression and Safety

The forests of the Pacific Northwest have been the most productive forest region in the world. The public depends upon this natural resource for their lively hood, recreation, wildlife habitat, and many other essentials of life. Each year wildfire is a severe threat to this resource.

In the ten-year period from 1979 through 1988, in Oregon alone 870 logging caused fires on state protected lands resulted in nearly 37 million dollars in fire suppression costs. This does not include the millions of dollars in lost timber resources, logging equipment, habitat, and recreation. Similar numbers of fires and losses occur in other states in the region.

This training program is about safely fighting wild fire. Oregon law requires that a forest operator be prepared to control any wildfire threat to our natural resource. It further requires that forest operators make a reasonable effort to control any fire that is started through their activity.

Oregon OSHA's Forest Activities Code Six Book provides that all employees engaged in forest activities who may be called upon to suppress wild fires are required to receive basic fire suppression training. New employees must receive this training within 60 days of hire. For existing employees, this training should be given before the commencement of fire season. The course is separated into four sections: Basic Fire Behavior; Fire Suppression Tactics; Basic Fire Safety; and the Safe Use of Tools and Equipment.

Not all fires become raging infernos. The most effective firefighting is done by the workers who first respond to the fire. In order to control fire you must learn all you can about it and the factors that influence its spread. For the more you know about fire, the more likely you are to make the decisions and perform the acts that will either prevent fires, or keep them small.

Fire begins with ignition. The match is an example of ignition material. Friction from cables rubbing, sparks from chain saw motors, and vehicle exhaust pipes can ignite a fire just as quickly as a match will.

Fire Triangle

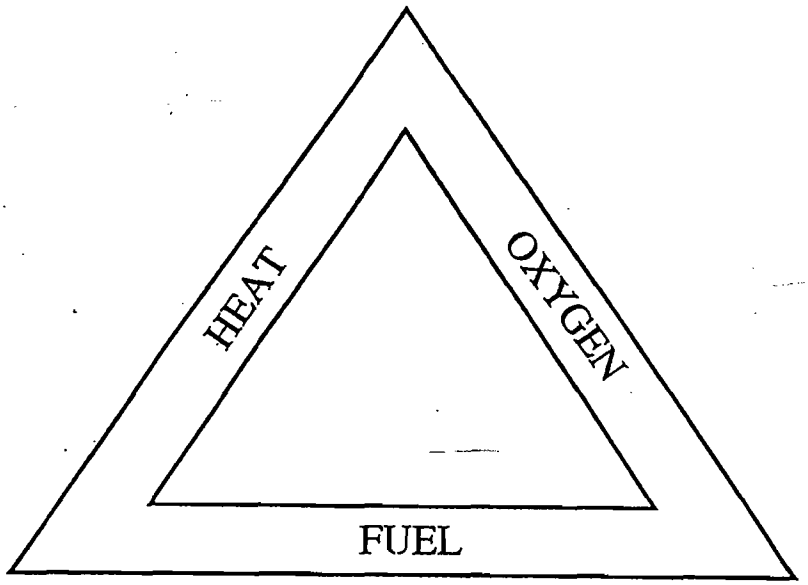


Figure 1

Fire triangle

The three ingredients necessary for combustion are heat, oxygen and fuel. Heat, oxygen and fuel create fire. If any of these ingredients are missing, there can be no fire.

Here are all the ingredients necessary for fire. Heat from a match. Fuel in the candle, and oxygen from the air. But, remove one of the ingredients... in this case the oxygen and the fire goes out. The same principle is used in fighting forest fires. We stop fires by removing heat; by removing oxygen; by removing fuel.

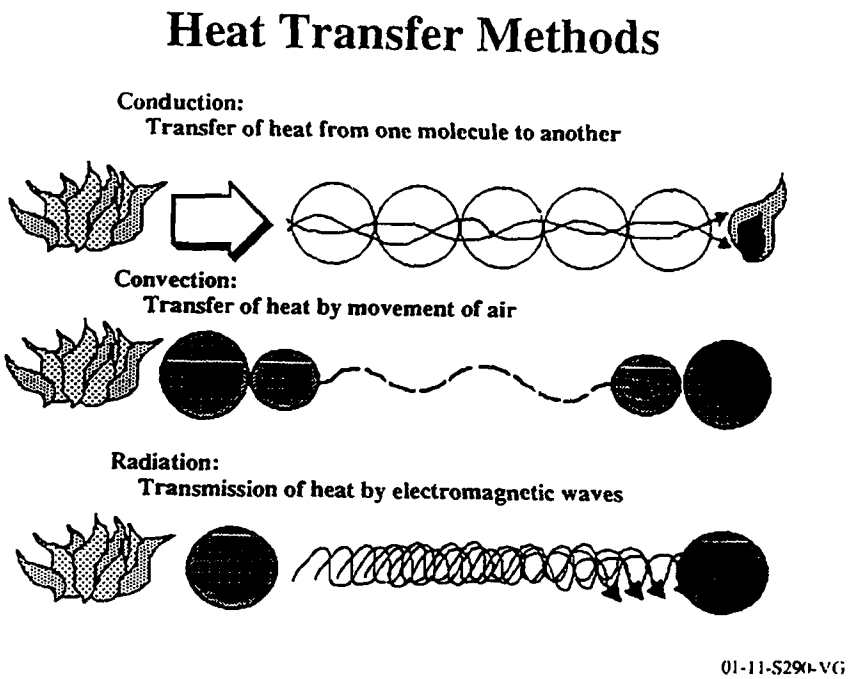


Figure 2

Means of heat transfer

In forest fires, heat sufficient to cause combustion is transferred to new sources of fuel in three different ways. By conduction, by convection, and by radiation. Conduction is transfer of heat within the material itself. Most metals are good heat conductors, but wood is a poor conductor and transmits heat slowly. Conduction is not an important factor in the spread of forest fires.

Convection is transfer of heat by flow of liquids or gases. In the case of forest fires, convection is well illustrated by the air and gases which rise above the fire. If the heated mixture is confined to a column, the convection current is strong. Perhaps strong enough to reach 15,000 feet or more into the air carrying embers ahead of the fire to cause spot fires. Convection may cause dry snags to burn rapidly.

Another method of transferring heat is by radiation. The earth, for instance, is heated from the sun by radiation through space. In forest fires, the fuel ahead may be dried by radiation and sometimes ignited.

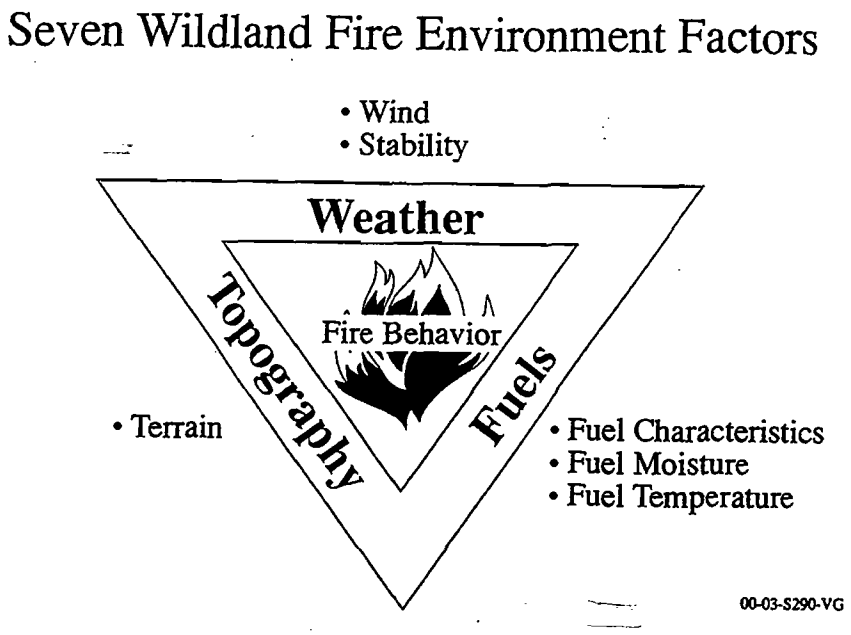


Figure 3

Principle influences on fire behavior

The principle influences acting on fire behavior are fuel, weather and topography.

Fire behavior is effected by the amount of moisture in the fuel. Dry fuel burns faster than wet fuel. Size and character of fuel is a factor. Fine fuels burn faster than coarse fuels. Fine fuels are more quickly heated and ignited as they are surrounded by plenty of oxygen.

Fires in fine fuels spread rapidly, but burn out quickly. Heavy fuels warm more slowly and interiors are exposed to oxygen only after the outside is burned off.

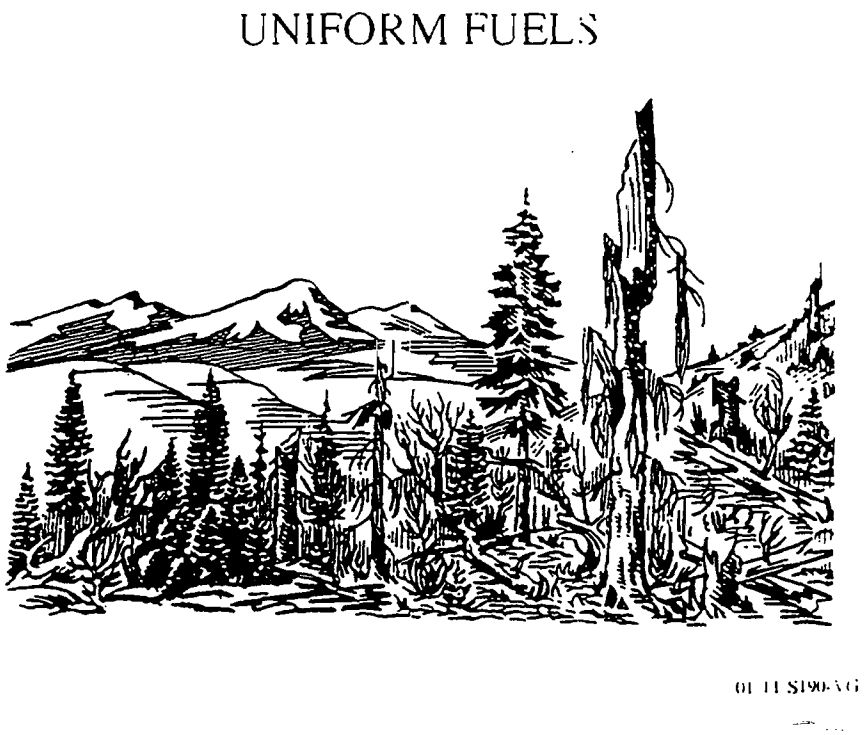


Figure 4

Volume or quantity of fuel in an area is a factor. The more fuel the more total heat output. The greater the volume of fuel readily available for burning, the more intense the fire will be.

The fuels may be spread evenly over the ground, or they may be patchy and broken up. There may be little of the fuel standing in the air as snags, or there may be a lot of snags. All these will effect the behavior of a fire.

Along with fuel, another important influence on fire behavior is weather. Temperature of the air influences fire most indirectly. There may be fifty degrees difference between fuel temperatures in the sun and in the shade. Temperature of the fuel determines how fast it will ignite and burn.

One of the most important, and least predictable influences effecting fire behavior is wind. Wind makes fire burn faster by increasing the supply of oxygen and by driving convection heat into new fuel. Wind encourages combustion and spread of the fire in one direction, or it can cause it to spread erratically.

PATCHY FUELS

01-12-S190-VG

Figure 5

Wind carries sparks and fire brands ahead of the main fire starting spot fires. Wind increases evaporation from damp surfaces by carrying away moist air and bring in dryer air. Evaporation effects moisture in the forest fuels.

The amount of fuel moisture affects the rate of combustion. This has a great influence on fire behavior. When fuel is moist, combustion is slow because part of the heat required for ignition is used to evaporate the moisture. As fuels become dryer, more heat is available to heat the fuel itself.

Relative humidity is an important factor effecting fire behavior. It does this indirectly. Dead forest fuels and the air are always exchanging moisture. As relative humidity increases, fuel moisture increases. As relative humidity decreases, fuel moisture decreases. Light flashy fuels gain or lose moisture quickly with changes in relative humidity. Fine dead grass, for example, readily shows the difference due to humidity. All these factors of weather will effect the behavior of a fire.

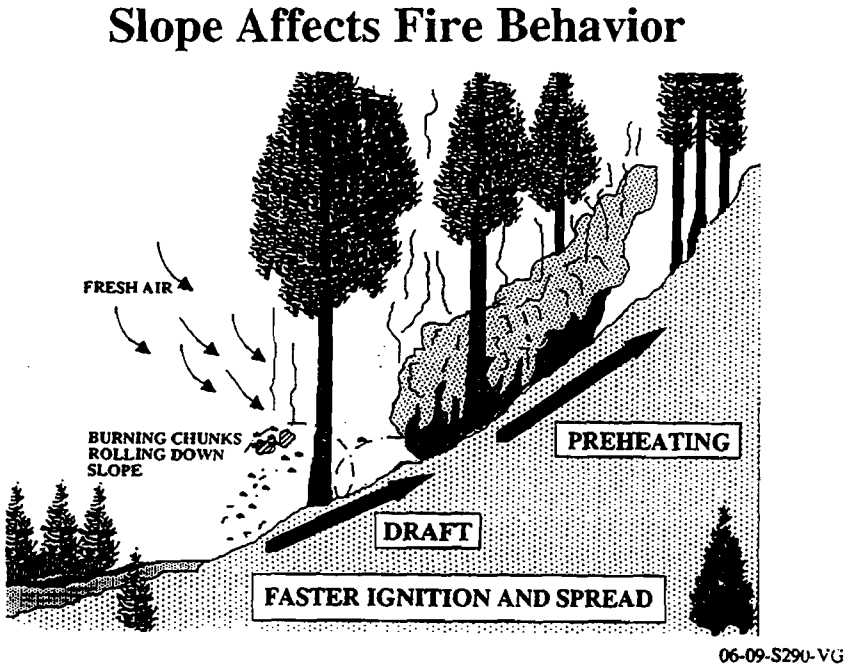


Figure 6

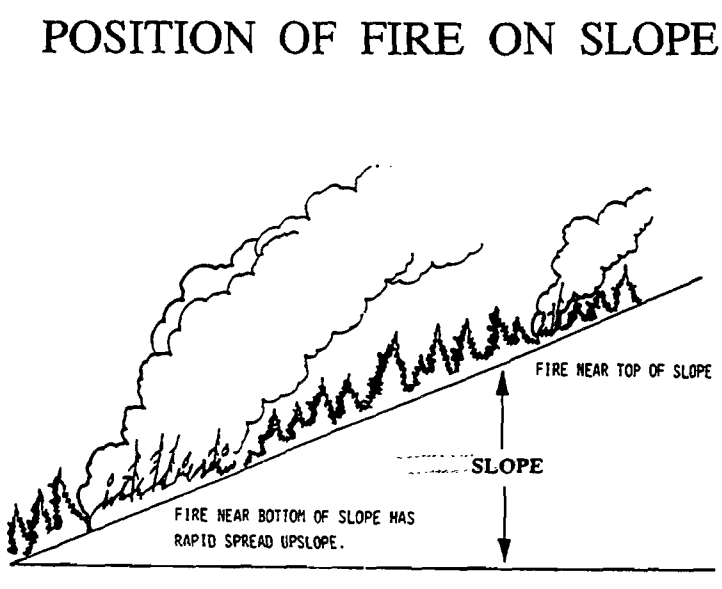


Figure 7

Along with fuel and weather, topography completes the influences on fire behavior. Aspect or direction in which a slope faces determines how much heating it gets from the sun and of course heated fuels ignite and burn more rapidly.

Slope is another factor of topography. The steeper the slope the faster the fire burns. On a slope the unignited fuels above the fire are closer to the flame and catch fire quickly. The position of the fire, whether near the bottom of the top of a ridge, is a topographic factor. The shape of the country is an important factor when a fire is burning in rugged topography. For example, when the canyon is narrow, fire will easily cross. Heat transfer by adjacent radiation drys out the unburned slope.

Another effect of topography is shown in the influence of elevation. This is shown by the earlier drying out of the low country in early spring and in other ways.

These are all ways in which topography influences fire behavior. The behavior of the fire after it becomes established is governed by fuel, weather and topography, all acting together. When all three are favorable for the spread of the fire, anything can happen. That is anything can happen unless you as a firefighter intervene.

Fire suppression tactics

One way to keep destructive fires from developing is for you to decide firefighting strategy from knowledge of how a fire will behave in its changing environment, rather than to shape strategy to fit what the fire has already done. In a formal fire training, at the completion of this block you would know how to: 1) Safely take direct attack action of small smoldering, creeping, and running type fires and spot fires, and 2) Recognize when spotting and crowning conditions require indirect attack actions.

Smoldering fires usually occur in ground fuels such as rotten logs, duff, loose nettles and leaves. The fire smolders because the fuels are too compact, too wet, or the humidity is too high to allow it to burn freely. The heat given off is usually of low intensity, and does not radiate away from the fire very far. The fire will have little or no open flame. This allows you to work directly on the edge of the fire with a water hose, back pumps, or hand tools. A fog spray setting on your nozzle is best. A straight stream may throw burning material outside the fire line. Also, if you hit a very hot spot with a straight stream, you will get a geyser like reaction, with hot steam and debris blasted back towards the person using the hose. Goggles should be worn when using a fire hose.

Creeping fires usually have active flame, but are not moving fast due to light fuel loading, lack of wind, high humidity, or the fire is moving downhill, against the wind. This kind of fire can usually be attacked directly with hand tools, back pumps or water hoses. A creeping fire has low intensity, and does not radiate heat more than a few feet ahead of the flame. Flames may be a few inches to a couple of feet high. Since a creeping fire is more active than a smoldering fire, more care should be taken in your attack. Start your attack at the lowest, coolest part of the fire, and build line along the flanks or sides, working towards the head or top of the fire.

Running fires are generally found in light to medium fuels, such as grass, brush, and on moderate to steep slopes. They may also be the result of moderate to strong winds.

Flames at the head, or leading edge will be leaning in the direction it's moving and be from a couple of feet, to twenty feet or more in height. Stay away from the head.

Temperatures on the head and sides near the head are usually too intense to allow a safe direct attach. An indirect attack with dozers or aircraft is usually necessary on this part of the fire.

Direct attacks should only be attempted on the coolest part of the fire line. Control action should move from the coolest part around both flanks, toward the head. This reduces the heat flowing into the head. This can also cool and slow down the head enough to allow further attack. Personnel with little or no experience should attack a running fire only under the direction of a supervisor with firefighting experience. Never attack a running fire without establishing escape routes, safety zones, and a safe starting or anchor point.

Spotting is not a type of fire. Rather, it's a fire behavior that can happen on any fire and will effect your control actions. Spot fire is a term used to describe small fires outside the main fires perimeter. They can occur anywhere along the perimeter, depending on the conditions that caused them. Spot fires occur when burning material, called embers or brands are lifted or roll across the fire line and ignite unburned fuels. Several conditions may cause a fire to spot. Convection columns can pick up burning embers that are carried across the fire line by the wind. Wind speed and size of the fire brand determine how far across a fire line a spot fire will occur.

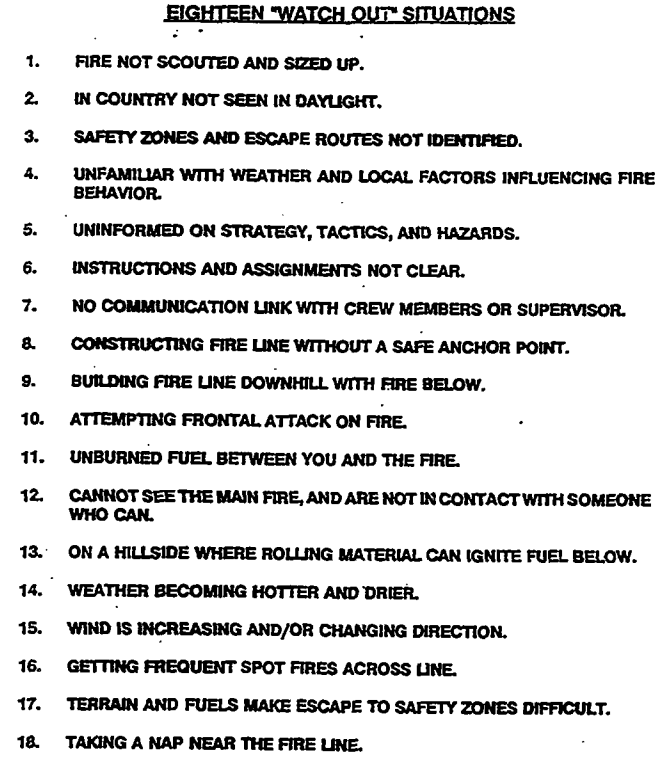
Dust devils can carry burning embers across the line. Dust devils can occur when winds are gentle, and may happen on any part of the fire line.

Burning material can roll down steep slopes and cross the fire line. The fire trail on the down hill side of a fire should be trenched, or cupped to catch this rolling material. Increasing frequency and number of spot fires are indicators of worsening fire conditions. If this occurs immediately alert your supervisor and others working around you.

A fire with frequent spotting should be approached from the coolest side, and with extreme caution. Lookouts and/or patrols with communications to personnel on the main fire should be posted anytime spotting is occurring.

Direct action can be taken at the base and lower flanks of fires that are spotting. It's very important to know your escape routes and safety zones, and avoid being in the areas between the main fire and spot fires. Suppression of fires with wind driven spotting is seldom successful without dozer and aircraft support.

A crown fire is characterized by flames burning and being carried through the crowns, or tops of the trees or brush. It's often accompanied by frequent and long-range spotting. Flames can extend several hundred feet into the air. Temperatures are so intense that personnel and equipment must stay well away from the head and hotter flanks. These are frequently moderate to fast moving fires. Speeds from one mile per hour to speeds in excess of twenty miles per hour are possible. Direct attacks on the leading edges of a crowning fire should never be attempted by ground attack. After the fire has burned through an area and cools, direct attack can be taken, like a creeping or running type fire.



EIGHTEEN "WATCH OUT" SITUATIONS

1. FIRE NOT SCOUTED AND SIZED UP.
2. IN COUNTRY NOT SEEN IN DAYLIGHT.
3. SAFETY ZONES AND ESCAPE ROUTES NOT IDENTIFIED.
4. UNFAMILIAR WITH WEATHER AND LOCAL FACTORS INFLUENCING FIRE BEHAVIOR.
5. UNINFORMED ON STRATEGY, TACTICS, AND HAZARDS.
6. INSTRUCTIONS AND ASSIGNMENTS NOT CLEAR.
7. NO COMMUNICATION LINK WITH CREW MEMBERS OR SUPERVISOR.
8. CONSTRUCTING FIRE LINE WITHOUT A SAFE ANCHOR POINT.
9. BUILDING FIRE LINE DOWNHILL WITH FIRE BELOW.
10. ATTEMPTING FRONTAL ATTACK ON FIRE.
11. UNBURNED FUEL BETWEEN YOU AND THE FIRE.
12. CANNOT SEE THE MAIN FIRE, AND ARE NOT IN CONTACT WITH SOMEONE WHO CAN.
13. ON A HILLSIDE WHERE ROLLING MATERIAL CAN IGNITE FUEL BELOW.
14. WEATHER BECOMING HOTTER AND DRIER.
15. WIND IS INCREASING AND/OR CHANGING DIRECTION.
16. GETTING FREQUENT SPOT FIRES ACROSS LINE.
17. TERRAIN AND FUELS MAKE ESCAPE TO SAFETY ZONES DIFFICULT.
18. TAKING A NAP NEAR THE FIRE LINE.

Figure 8

If you arrive at a fire that is crowning, or are working on a fire that starts to crown, immediately notify your supervisor and the personnel working around you. This kind of fire should only be initially attached by qualified, trained firefighters.

You have now seen five types of fire. You have seen which fires are safe to take direct attack action on, which require indirect action, and special equipment or aircraft, and which you need to stay away from until conditions change to permit a more direct attack.

Basic Fire Safety

Firefighters have died in most geographic areas and fuel types, not just in widely publicized California brush types, but in the hardwoods of the East, the conifers of the West, the palmetto of the Southeast, the grasslands of the Great Basin. All fires, including prescribed fires, under the right conditions and circumstances have the potential to take your life.

Anticipating, recognizing and responding in time to these situations makes the difference between an orderly escape and a fatality. From past tragedies and near misses, we have developed reliable, time tested rules and principles to guide us in this hostile environment.

Eighteen situations that mean watch out!

The first step in learning the standards for survival is to be able to recognize the watch out situations. Let's review the watch out situations.

The first five are as follows. One, the fire has not been scouted or sized up. Two, you are in country you have not seen in daylight. Three, the safety zones and escape routes

have not been identified. Four, you are unfamiliar with the local weather patterns and the local factors that are influencing the fire's behavior. Five, you have not been informed on existing hazards or the strategies and tactics that are to be used.

The next five are as follows. Six, you have not been given clear instructions and assignments. Seven, you are not in communication with your supervisor or other crew members. Eight, you are building a fire line without insuring a safe anchor point. Nine, you find yourself building a fire line downhill with the fire below you. Ten, you are attempting a frontal assault on the fire.

The last eight are as follows. Eleven, you have a lot of unburned or flashy fuel between you and the fire. Twelve, you cannot see the main fire, or you are not in contact with someone who can. Thirteen, you are on a hillside where rolling material can ignite fuel below you. Fourteen, you notice the weather is getting hotter and dryer. Fifteen, you notice the wind increasing or changing direction, or both. Sixteen, you find you are getting frequent spot fires across the fire line. Seventeen, you notice the terrain and fuels would make an escape to safety zones difficult. Eighteen, you find yourself tired and considering taking a nap near the fire line.

Any of these watch out situations have the potential for causing serious injury or death. They are as fundamental for survival as looking both ways before you leave a stop sign. When one or more of these situations exist, you must know the appropriate actions in order to safely proceed.

Ten Fire Fighting Orders

The appropriate actions to take are called fire orders. By taking the first letter from each order you will see it spells fire orders. Let's look at each fire order more closely.

The first order is fight fire aggressively, but provide for safety first. Aggressive action is essential but should not override firefighter safety. No property or resource is more valuable than a human life. Don't let adrenalin and excitement dictate your actions.

Order number two is initiate all actions based on current and expected fire behavior. In determining what actions you should or should not take, you must consider the basic fire behavior elements, weather, topography and fuels. Observe the intensity of the fire and anticipate how it might change in the next few hours. Expect fire behavior to become more active and dangerous from midmorning until late afternoon. Gauge suppression actions with a margin for safety. Expect the unexpected and be prepared with an alternative plan.

Order number three is recognize current weather conditions and obtain forecasts. Three weather factors that greatly effect fire behavior are temperature, relative humidity, and wind. On the fire line, firefighters must be alert to changing weather conditions. Your personal observations are important. Weather information can be obtained from several sources.

Order number four is to ensure instructions are given and understood. It is the responsibility of your supervisor to be specific, clear and precise. However, this may not always happen. Never assume. If in doubt ask questions, and get clear answers.

Order number five is obtain current information of fire status. You need to know such information as the location of the fire perimeter or edge and how fast it is spreading. Is it spotting and what direction is it currently heading? This information can be obtained through your own observations and from the people you are in contact with.

Order number six is remaining in communication with crew members, your supervisor and adjoining forces. Remaining in communication at all times is vital to your ability to receive instructions, warnings, retain control and keep informed of status changes.

Order number seven is determine safety zones and escape routes. A safety zone could be a lake or swamp. It could also be a natural break in the vegetation, a rock slide, or even the burned over area. Choose the safety zone wisely. It could save your life. An escape route is a travel route to a safety zone. It should be the quickest, shortest and easiest route to the safety zone. If a portion of a route needs cleared for easy travel, clear it before you need it.

Order number eight is establish lookouts in potentially hazardous situations. Persons chosen to be lookouts must be fire wise, dependable, and alert. They must be aware of changes in fire behavior and weather. Lookouts serve as your eyes and ears when you are out of sight of the fire and, must be able to recognize hazardous situations such as crowning and spotting.

Order number nine is retain control at all times. All the fire orders support retaining control, however, the primary elements in retaining control at all times are. Assure assignments and instructions are understood, a communication link is established and maintained, and the locations of all the crew members are known.

Order number ten is stay alert, keep calm, think clearly, act decisively. Fatigue, heat stress and smoky and stressful situations adversely effect mental alertness, and physical capabilities. Don't drop your guard when you et tired. If an emergency situation occurs, remember to stop and evaluate your planned actions before initiating them. Good decisions and actions can only be accomplished when you are under control. Once a decision is made, then act decisively. Fatalities have occurred on prescribed fires. Under the right conditions, any fire has the potential to kill. Inexperienced firefighters as well as the most highly trained hot shots have died in fires. In each case a common theme prevailed. A disregard for, or failure to recognize the life threatening watch out situation and the failure to follow basic rules or orders when a watch out situation was recognized. If you are able to recognize and act on the watch out situations, your next fire will be a safe one. Review the checklist routinely on every fire regardless of fire size of complexity. Carry your wallet card. Know the survival checklist and fire orders. They are your standards for survival.

Safe Use of Tools and Equipment

Dozers, plows and engines are all effective fire fighting tools and are commonly used in fire fighting operations. But in the final analysis individual fire fighters with the right hand tools, training and experience have to control and extinguish the fire.

Choose your hand tool carefully. See that the handle is straight. Make sure there are no splinters. A loose head can cause serious injury. See that the cutting edge is sharp. Keep at least ten feet apart when walking or working to avoid injuring others.

The polaski can be used to begin fire line construction. The hoe end is used to grub out clumps of grass and small brush. Its full length can be used to scrape and improve the fire line. The hoe end is used for trenching fire line on steep slopes to catch rolling material. The ax blade is used for chopping.

The most popular hoe is the Osborn Adz hoe or hazel hoe used where mineral soil lies buried under thick layers of duff. It's designed for heavy grubbing or trenching. It's ideal for trenching fire lines on steep slopes.

Single bit axes are popular with timber cutters. Double bit axes are also popular. Both tools are effective falling tools and are commonly used to support the falling operations.

The shovel is used to scrape the line to mineral soil. The knee is used as added leverage to save upper body strength. The sharp edges cut small trees, brush and roots. The shovel is used to cool hot spots. Throwing dirt with a hard side arm swing is effective on ground fires. For fire burning off the ground, the overhand throw knocks the fire down and cools it.

The metal or the newer collapsible rubber version of the backpack pump is a universally popular tool. It is used in conjunction with hand tools to fight fire and to mop up. It can effectively knock down hot spots and spot fires. The backpack pump is generally used in combination with other tools, or to cool a fire to allow other tools to work.

Water is the single most effective firefighting tool available. It efficiently cools fuels and stops the fire. Use water to attack and cool down a hot moving fire. Use water in combination with hand tools for best effect. The most commonly used nozzle for general firefighting needs is the forester nozzle. It has a combination fog and straight stream for most general purposes. Use either fog or straight stream to support other tools.

The chain saw is a highly effective line clearing tool. A faller and swamper fall and buck trees and heavy brush, clearing the fire line for follow up by hand tools. Timber falling is extremely dangerous and should only be done by experienced personnel.

Wear your safety equipment at all times. Any injury is made worse by fire line conditions. Your hard hat protects your head. Gloves prevent burns, blisters, slivers and cuts. Leather lace up boots at least eight inches high protect against snake bites, burns, rocks and other hazards. Cork boots are sometimes used for traction. Rubber lug soles are also used.

Protect and cover exposed flesh as much as possible. Long sleeve shirts and long pants are important protection from heat and embers. A loose fit keeps the heat away from your skin.

Cotton underwear prevents chafing and helps wick perspiration from the body. Avoid clothing, such as athletic jerseys of poly blend, nylon or other man-made materials. Not only do they flame more easily, but they melt to your skin when exposed to fire. Of the non-flame resistant fabrics, cotton or wool are best.

Remember, safety first. No tree is so important that you should risk your life to stop a wild fire. It's easy to get caught up in the emotions of the moment. When you feel pressed to take action. That's when you should stop and think of the watch out situations. Do they apply here?

Besides the obvious hazards of the fire itself, the dangers created by the fire are complicated by many other hazards. The use of sharp hand tools, fast cutting power tools, heavy equipment, rugged and steep terrain, loosened rocks, rolling logs, and weakened snags and trees. These all have played a role in serious injury accidents, even during the mop up stage of fire suppression.

Fire agencies have fire suppression supervisors, trained in the complex aspects of attacking and controlling a wild fire. With this training comes the responsibility of safely fighting a fire with the resources they have available. They need your full cooperation. Stay informed at all times. If you are unclear of your instructions, ask questions, don't assume.

Always have an escape plan when on the fire line. Don't get caught without escape options.

Only operate equipment you are trained to operate. The fire line is no place for on the job training, on the high risk operations of tree falling or pumper operation for example. If you are not trained, say so. Leave these jobs to those who are trained and skilled.

If you are called upon to fight a wild fire, recall the principles you have learned here. Apply them at all times to avoid injury, and to fight fire most effectively.

Resources for Further Information/Training

At the present there are the two associations in Oregon that provide fire suppression training to the private sector. Also listed are the Community Colleges that are or have expressed an interest in regularly scheduling NWCG courses.

Associations

National Wildfire Suppression Association, Inc.
P.O. Box 7788
Klamath Falls, OR 97602

Oregon Firefighting Contractor's Association
P.O. Box 418
Merrill, OR 97633

Community colleges

Rogue Community College in Grants Pass

Southwest Oregon Community College in Coos Bay

Treasure Valley Community College in Vale

Central Oregon Community College in Bend

Chemeketa Community College in Salem

Oregon Institute of Technology in Klamath Falls

LAND MEASUREMENT AND SURVEY

Phil Gremaud

Introduction

Quick overview and short glossary

The land measurement and survey module of the ecosystem demonstration project is designed as a two day course with the first day in the class room and the second in the field. The entire outline will be covered in class the first day, with review and practical application of course material in the field the second day. The final product, produced by trainees, will be a map of an area drawn to scale on graph paper, showing predominant land features and other attributes appropriate for the site.

Glossary

Azimuth: Angles measured clockwise from any reference meridian. In plane surveying, azimuths are measured from north. Azimuths range from 0 to 360 degrees.

Baseline: For public lands surveying, a baseline is a line from the initial point extending east and/or west as a parallel of latitude to the limits of the area to be covered.

Bearing: Bearings are a system of designating directions of lines. The bearing of a line is the acute horizontal angle between a reference meridian and the line. The angle is measured either from the north or the south. Toward the east or west, to give a reading less than 90 degrees.

Crab: The condition caused by incorrect orientation of the camera with respect to the track of the airplane, indicated in vertical photography by the sides of the photographs not being parallel to the principal-point base line.

Declination: The horizontal angle between the magnetic meridian and the true geographic meridian.

Drift: Sometimes used to indicate a special condition of crab in which the photographer has continued to make exposures oriented to the predetermined line of flight while the airplane had drifted from that line.

Effective area: For any aerial photograph that is one of a series in a flight strip, that central part of the photograph delimited by the bisectors of overlaps with adjacent photographs. On a vertical photograph, all images within the effective area have less displacement than their conjugate images on adjacent photographs.

Local attraction: A change in the magnetic field caused by metallic objects and direct-current electricity.

Orienteering: The art of map interpretation to travel between and locate points on the map.

Principal meridian: For public land surveying, from each initial point, a true north-south line to the limits of the area to be covered.

Topographic maps: A large-scale representation of a portion of the earth's surface, showing the culture, relief, hydrology, and vegetation. Man made features i.e. roads, buildings, bridges, etc. are considered culture.

How this topic fits into other topics

Land measurement and survey are essential tools in all fields of natural resource management. A timber manager may want to know how many acres of harvestable timber exists on an ownership. A fisheries biologist may want to know how many miles of spawning habitat exists. A wildlife biologist may want to know how many acres of winter range exists for big game species. A private landowner may want to know how many acres are in pasture and how many are in timber. A forester may want to know the status of a reforestation unit concentrating on mortality of planted seedlings, to aid in prescribing follow up treatments. Everyone wants to know where their property lines are.

Competency measures

This education module will give trainees the skills required to:

- locate themselves on the ground,
- find individual operational units,
- determine the size of those units, and
- map information for monitoring and forest development purposes.

Land surveying

Definition of land surveying

The art of determining relative positions of points above, on, or beneath the surface of the earth, or establishing such points. Generally, surveying is the gathering and processing of information about the physical earth.

Methods range from aerial and satellite systems to conventional ground methods. Surveyor work can be divided into five parts:

1. Decision making (survey method, equipment, etc.).
2. Field work or data acquisition (making measurements and recording data).
3. Computing or data processing (calculations for locations, areas, volumes, etc.).
4. Mapping or data representation (plotting measurements and attributes).
5. Establishment (setting monuments, stakes, flagging to delineate boundaries or guide construction.

Types of surveys

There are many types of surveys. For this demonstration project we will consider "plane surveying." In plane surveying, the reference base is assumed to be a flat horizontal surface (plane). Except in surveys covering extensive areas, the earth's surface can be approximated as a plane. When large areas are surveyed, calculations to compensate for the curvature of the earth's surface must be made. With the rectangular system of surveys, that will be discussed shortly, forestry does not need the level of accuracy greater than plan surveys produce.

When putting in a new road or logging forty acres, whether we are on the line or one ten thousandth of a foot off is not going to effect what we do. With plane surveying, algebra, plane and analytical geometry and trigonometry are easily applied, simplifying calculations.

In geodetic surveying, which is the technique to determine relative positions of widely spaced points, there is consideration for the size and shape of the earth.

Other survey types include photogrammetric surveying, which uses data obtained by camera and other sensors. Photogrammetry has had forestry applications for decades, with aerial photography a must for planning purposes today. Remote sensing, or use of satellite data is a newer tool in land management, with many forests finding new applications every day. Both will be discussed latter.

Other survey types include:

1) Control surveys, which serve as a reference framework for other surveys.
2) Construction surveys, which provide reference for civil engineering projects.
3) Property surveys, which establish property corners, lines and areas of parcels.
   The Federal Government's property survey system is termed Cadastral Surveys, which have their own protocol specific to Federal Lands. Familiarity with the methods of marking these (Federal) property lines is valuable in locating yourself in the field. Often when lines cross roads, reference tags are placed indicating the location of the line and road intersect. Corners, 1/4 corners and 1/16 corners are often monumented in the forest, with blazed, flagged or posted lines between them.
4) Topographic surveys result in the topographic maps we commonly use in forest development work.
5) Route surveys are usually required prior to construction of highways, railroads, pipelines, power lines, etc.
6) Hydrographic surveys look at water, and result in navigational charts and other maps of water bodies. In Southeast Alaska, foresters use marine charts like we use transportation maps to get to work.

Remember that all survey systems are required to produce the maps land managers need for ecosystem based management. Through the technical expertise of survey professionals, maps are produced that are easy for us to use as tools in land management. If we concentrate on Plane surveying, we simplify our lives, and achieve the accuracy necessary for our purposes.

Rectangular system of surveys (public lands survey, cadastral survey)

[**Note:** Cadastral comes from the term "cadastre," which means a tax inventory and assessment of real property. Source: *Black's Law Dictionary*]

Most of the US has been surveyed using the rectangular system of surveys. (See Exhibit A) Discuss the Exhibit. Note the Eastern states used an older system called "metes and bounds". Most of this survey work was done prior to establishing protocol for disposal of public lands in 1785. The Federal survey system is based on two principals that provide the legal background for stabilizing land lines. The first is, "boundaries of public lands established and returned by duly appointed surveyors are unchangeable." That means if you are an adjoining landowner to Federal lands, the survey line they establish if done correctly will not change, no matter what your licensed surveyor may say.

The second principal is, "original township and section corners established by surveyors must stand as the true corners which they were intended to represent, whether in the place shown by the field notes or not".

This principal required since once section lines are established, and interior lines are established off the section lines, if the original section line is not correct all other lines are not correct.

The rectangular system sets up a grid system with the objective of obtaining approximately square sections of one square mile (one mile on a side). The procedure begins with dividing the land into quadrangles or tracts approximately 24 miles on a side. Further division into townships (16) approximately 6 miles on a side. Further division of townships into sections (36) approximately 1 mile square. With further division of the sections, which reflects local ownership or other objectives. The process in Oregon and Washington began with establishing a point through which a "Principal Meridian" and "Baseline" intersect. (See Exhibit A)

This point was permanently establish and located through astronomical observations. As with anything dealing with the Government, there is a manual discussing how, where, what, why and when each of the thirty seven initial point was established in the United States. The principal meridian (Willamette meridian for Oregon and Washington) runs true north-south and the baseline runs true east-west. From that intersect, a grid of townships are established north and south of the intersect.

The townships further range east and west of the principal meridian, so on the grid, a township two grid locations south of the baseline and three grid locations west of the principal meridian would be T2S, R3W. Within that township are 36 sections. All townships use the same system for numbering the 36 section within them. Sections are numbered beginning in the northeast corner with number 1, going west to number 6 then south to 7, east to 12 and so on (see Exhibit B).

Sections can further be divided by quarters and halves. With a line drawn north-south or east-west through the center of a section, the section is divided into halves, identified by their location in the section (north half, south half, east half, west half). With lines drawn north-south and east-west through the center of a section the section is divided into quarters, identified by their location in the section (northeast quarter, southeast quarter, northwest quarter, southwest quarter). Halves and quarters can fur-

ther be divided and divided, such that a 40 acre block is identified as SW1/4 NW1/4, Sec.14, T2S, R3W, (legal description). The legal description for small ownerships often includes a block identification that may not follow the quartering of a section. Every section has 4 section corners, that may or may not be shared with the adjoining section. Although there are 640 acres in one square mile, not all sections have 640 acres. With surveys begun on different townships at different times, edge matching adjoining townships becomes a problem at some times. Often we have offset corners that are a kind of fudge factor to avoid overlapping ownership, which results in a variation of the 640 acres. Every section has 4 quarter corners, the points that divide the section into halves.

Table 1. Section Division

Portion of section	Legal description	Size estimate *(acres)
1 section	T2S, R3W, Sec 14	640
1/2 section	T2S, R3W, Sec 14 N1/2	320
1/4 section	T2S, R3W, Sec 14 NW1/4	160
1/8 section	T2S, R3W, Sec 14 S1/2 of NW1/4	80
1/16 section	T2S, R3W, Sec 14 SW1/4 of NW 1/4	40
1/32 section	T2S, R3W, Sec 14 S1/2 of SW1/4 of NW1/4	20
1/64 section	T2S, R3W, Sec 14 SW1/4 of SW1/4 of NW1/4	10

They are called quarter corners because they divide the section into quarters. Every section can further be divided by 1/16 corners. See Table 1 for acre estimates by divisions.

* Remember these are only acre estimates as each section may or may not actually contain 640 acres.

Maps

This section is designed to provide trainees with skills required to use maps to locate on the ground features at a scale typical of forest development projects. Most project work done today requires a variety of map types. In ecosystem based management, the project development process begins with landscape level plans (watershed analysis) using large scale planning maps.

The Northern Spotted Owl was the outcry that resulted in the FEMAT plan or ecosystem based management, which used maps to look at a landscape level of the range of the species to develop a plan which covers the Federal lands west of the Cascade Divide from Northern California to the US Canada Border. Each National Forest and BLM District started with those maps and developed management plans consistent with

the information portrayed on those maps. As those plans are implemented on the ground the resolution becomes clearer and for each acre of land we begin to see a designated function. As the scale of operation approaches the ground, we change the maps we use to match our needs. For the purpose of this training program we will concentrate on stand level maps, or maps appropriate for management of individual projects.

Transportation maps

After the planning process determines the need for a project and the project is situated in the landscape consistent with the overall plan, we move to the stand or project level with stand level maps. Although a transportation map typically covers an entire National Forest, we consider it a stand level tool since we use it to locate areas where project work occurs. Transportation maps vary in design usually based on ownership. There is consistency within agencies, but not much across agencies, and very little consistency between private and public lands.

Typically Forest Service maps concentrate on road systems on national forest lands and do not show other connecting roads. BLM maps do the same for BLM lands. This can be a problem for anyone working in areas with checkerboard ownership, especially when working with ecosystem based management, which is designed to look at landscapes, regardless of ownership.

Compare map attributes of a Forest Service transportation map and a BLM transportation map (see Exhibits C and D). Discuss the features on each map, be sure to look at Township Range and Section. Look for the date the map was made and any updates. This may help when you find a road that is not on the map. Perhaps it is a new road built since the map was made.

Topographic maps

Topographic (topo) maps can be used as transportation maps since topo maps show roads. However, most topo maps were produced many years ago and are not updated like transportation maps are. Topo maps show many of the same features as transportation maps, although each puts more detail into elements required by design (see Exhibit E). When comparing Exhibit E and D, we see topographic features on each. On the transportation map, it is more of an interpretation to see ridges and valleys, where on the topo map, the ridges and valleys are well defined. Discuss attributes of topo maps and compare to transportation maps.

Azimuth and bearing

Using transportation maps is a fairly simple task. From town we travel north on I-5 and look for the exit for highway 140, travel along it to forest road number 37-4-33 go up that to spur road 5 down that to the work site. What happens when we find ourselves at the four way intersection of 37-4-33 and 39-5-2 and we have to decide which way to go on 37-4-33 We need to know the direction (azimuth or bearing) of travel. Maps are made with direction in mind with the top of the map oriented to north. If spur road 5 is east of this junction, we turn to travel east on 37-4-33 The

same is true of topo maps, in that direction between points on the map can be measured and followed to locate any point from any other point.

The measure is a compass reading of either an azimuth or bearing. A compass contains a magnetized steel needle mounted on a pivot at the center of a circle graduated in degrees (360 degrees). The needle points to magnetic north. Remembering that the rectangular survey system uses a principal meridian and base line oriented to true north-south and true east-west respectively. So compasses need to calculate the difference between true north and magnetic north. This adjustment or declination is either a mathematic calculation applied to bearings and azimuths or a compass will have an internal mechanisms for adjustment. Declination varies by location and changes over time (see Exhibit F). Check the Exhibit for the appropriate declination for your location

Changes over time can effect reconstructing old surveys for the purpose of reestablishing monuments, with a swing of 8 degrees in 175 years recorded for Baltimore, Maryland. For work done in our lifetime, Exhibit F should suffice. This magnetic measure of direction can be recorded as an azimuth or bearing. azimuths are based on the 360 degrees of the compass, read from north (360 degrees) clockwise with east being 90 degrees, south 180 degrees, and west 270 degrees. Bearing read one of four 90 degree quadrants, reading from north either east or west up to 90 degrees or reading from south either east or west 90 degrees (see Exhibit G).

With the help of Exhibit G convert between azimuths and bearings. Select two points on each map Exhibit and calculate the azimuth and bearing from point to point, using the 360 degree protractor (Exhibit H). Draw a line true north-south through one of the points and a line between the two points. Lay the protractor oriented north-south on the north-south line with the center of the protractor on the point. Where the line crosses the edge of the protractor read the true azimuth from point to point.

Map scales and distances

Maps are made to a scale that is suited for the purpose of the map. To large or to small of a scale may result in a map that will not function for the user.

Azimuths and bearings between points taken from maps are only accurate if the maps are drawn to scale. The same is true with distances measured from maps. Azimuths and bearings are independent of map scale, where distances are dependent on scale for computation. That is the azimuth between two points on a map can be measured without knowing the map scale, but the distance between two points requires using the map scale to convert map distance to ground distance. Map scales are either written as a ratio (1:12,000) or a representation (1" represents 1 mile).

In the first case (1:12,000) 1 inch on the map represents 12,000 inches on the ground, or 1 foot on the map represents 12,000 feet on the ground. In the second case 1 inch on the map represents 1 mile on the ground. In either case, the distance between two points on the map can be measured with a ruler and the map scale multiplier applied to calculate ground distance. Select two points on the topo map Exhibit, measure the map distance using the aerial photo chain scale, inches and tenths of inches (Exhibit I) and calculate the ground distance from point to point.

Measure the distance in inches and tenths of inches between the two points. Multiply

the measured distance by the map ration. Convert inches to feet. That is the horizontal distance between the two points.

Orienteering

Orienteering could be considered the art of map interpretation. In the practical sense it is the ability to determine travel routes from point to point. Orienteering might be considered a dying art in the foresters world since most work areas are roaded and often a fairly straight forward approach to locating the job site is all that is required. However, there are occasions where you may have to hike in a fair distance to reach the unit. In this case you may not want to walk a straight line up and down and up and down hills. So the route from point A to point B may go through C, D, and E. On the topo map, mark two points and find the easier route from point to point.

Aerial photographs

Aerial photographs function as detailed maps that are used by all types of forest workers, from timber sale layout personnel to wildlife biologists. The are used to form the base line data for GIS by dividing the land base into stand level units through delineation of vegetation communities, visible on the photographs. Originally photos were black and white, but as technology advanced, land managers demanded it's application. Now color photos of high resolution can tell us species composition, density, tree height, and many other attributes of the forest, stream, and landscape. Satellite imagery is used for broad based planning efforts that look at the largest landscape scales.

Combined with GIS, plans at the scale of the Presidents Forest Plan are possible. The present day industry standard for stand level photo coverage is a 1:12,000 scale color photograph. With the aid of a hand lens, we are able to recognize brush clumps as small as two feet in diameter. Photos allow us to locate an individual tree in the forest. Continuous forest inventories, which establish permanent plots throughout the forest are usually photo referenced by a pinprick on the photo that is found on the ground. This ability is only limited by good eyes. People with poor eye sight or colorblind, will have difficulty with aerial photograph interpretation. Interpretation is not impossible, but will require additional efforts to recognize what they are looking at. Most photographs are oriented with the top of the photo to north. The top of the photo has information about the flight line number, photo number, date of flight, and ownership identification. When ownership is more or less a rectangular block, with the long axis oriented east-west, the flight lines may be oriented east-west, in which case the photos would be oriented east-west. There are three basic camera angles for aerial photography (verticil, high oblique and low oblique). For this training course we will discuss vertical photography (see Exhibit J).

Stereoscope

A unique feature of aerial photography, is the ability to see three dimensional images of the land base. With the aid of a stereoscope, the topography of the land will be visible. This is an extremely useful tool not only for planning purposes, but for locating on the ground features. Overlapping images (photos) and a stereoscope are needed to

make three-dimensional visible to most people. People with normal eye vision and eyes of equal strength can often see three dimensional images without the aid of a stereoscope.

Overlapping images are obtained by flowing a flight line across the land base and taking pictures at predetermined intervals (see Exhibit K). View the stereo pair with the stereoscope. Discuss objects visible, color, texture, and resolution. If in areas of hardwoods, what would the effects of a fall photograph date be?

Azimuth and bearing

As stated above, aerial photographs are detailed maps. Azimuths and bearings can be obtained from photos the same as from maps. Be aware of crab and drift, which will cause the photo orientation to be skewed from true north (see Exhibit L). Select two points on a photo and calculate the azimuth and bearing from point to point, using the 360 degree protractor (Exhibit H). Draw a line true north-south through one of the points and a line between the two points.

Assume the photo is oriented north-south and the edge of the photo is a true north-south baseline. Use parallel lines to transfer the edge of the photo baseline to intersect one of the points on the photo. Lay the protractor oriented north-south on the north-south line with the center of the protractor on the point. Where the line crosses the edge of the protractor read the true azimuth from point to point. Most photos have some crab or drift that skews the orientation of the photo from true north-south or east-west. A true baseline can be determined for each photo by finding a straight stretch of road and sighting down the road with a compass and comparing that to the measured photo bearing or azimuth of the same stretch of road.

Photo scales and distances

As stated above, aerial photographs are detailed maps. The principals of scale and distances are the similar. As with azimuths and the problems created by crab and drift, photos given their nature have pitfalls relative to scale and distance measures. Most scale variation is due to changes in elevation of the grounds surface. When the planes altitude is determined, it is based on the average elevation of the ground to achieve the desired scale (1:12,000). The plane maintains that elevation for all flight lines in a photo series. As the ground comes closer to the camera or gets farther away, the photo scale changes.

Adjustments for each photo can be obtained in the same manner we adjust photo orientation (azimuths). When on the baseline straight stretch of road, pin prick one end of the road and measure the ground distance to a pinprick on the other end of the road.

Measure the photo distance and using the ground distance, determine the ratio and true photo scale. Be sure to compare apples and apples, that is either convert both measurements to feet or both to inches. Select two points on one photo, measure the map distance using the aerial photo chain scale, be sure to use the appropriate scale (Exhibit I) and calculate the ground distance from point to point. Measure the distance in inches and tenths of inches between the two points. Multiply the measured distance by the

photo scale. Compare the two calculations. Did you get the same distance between the two points?

Orienteering

Orienteering with the aid of aerial photography is easier than working from a topographic map. Remember photos are topographic maps with that show the vegetation on the landscape. It will take time to get used to working with photos. The best practice is to look at an object on the ground and the same object on the photo. In time you will be able to recognize what you see in the photo. When working in a new area with a different set of photos, you will have to adjust color variations from film development, scale variations and variations in the vegetation that will require you to adjust.

Field measurements

Azimuth and bearing

Azimuths and bearings measured in the field are usually done with a compass. For our purposes we will discuss the common hand compass. This is the tool of choice by foresters for daily use. It is not accurate enough for property line location, but it serves virtually all other functions for field work for foresters, biologists and anyone looking to get around in the forest. Care must be used when compassing, as it is easy to err.

Earlier we discussed how to calculate the bearing or azimuth between points on a map or aerial photograph. The next step is to apply that to the ground, using a hand compass. Starting from a known point on the ground that corresponds to the map point, set the compass dial to the desired azimuth or bearing. Be sure to use the same compass measure as the map calculation relative to true north or magnetic north. Do not calculate true north on the map and use magnetic north on the ground. Holding the compass level, align the compass needle in the outline of a needle in the compass housing. Sight along the edge of the compass or use the compass's sighting mirror to locate a point ahead of you in the direction of travel. Select an object that is easily recognizable as a point for the next compass reading. Continue moving from point to point until you reach your destination, either a certain distance or another mapped location.

It will take time to learn how to hold and use a hand compass. Some of the more common errors are listed: Not holding the compass level will cause the compass needle to miss align in the outline, which could throw you 2 to 6 degrees off course. Sighting to an object that you can not easily find after beginning travel, will cause you to double back or if the previous point is not marked on the ground will cause a guess at the next point. Not properly using the compass's sighting device will cause an inaccurate reading of the next point. Wearing some watches and/or rings will cause local attraction that will throw the needle off, giving a false reading of true or magnetic north. Parking the vehicle at the beginning point may also cause local attraction at least for the first compass sighting. Take time to check and recheck your compass-

ing protocol, as bad habits will waste valuable time and energy trying to locate yourself or points in the forest.

Horizontal distance (pace and tape)

When traveling through the forest, knowing direction is not enough to get from point to point. We need to know the distance traveled. From the map (above exercise) we calculated the distance to travel, now we can pace the distance by counting our steps. To count one pace, begin with both feet together, take one step with the left foot and one step with the right foot, that equals one pace. Every individuals has their own pace which may or may not differ between individuals.

To determine your pace, lay a two hundred foot tape on flat ground and beginning at one end, walk with normal steps to the other end. How many paces did you take? Convert that to chains (66 feet = 1 chain). Some people like to pace in chains and others like to pace in 100 foot increments. I find that pacing is chains is useful for acre determination since there are 10 square chains per acre. We will discuss this latter. The pace is a rough measure of distance (horizontal), and results in rough estimates only.

Depending on you purpose for pacing, rough estimates may be appropriate, since it is the least costly way to measure distance in the field. Chaining, or measuring distance using a steel or plastic tape is another method of determining horizontal distance. This method requires two people, a head chainman and a rear chainman. The head chainman holds the zero end of the tape and movers from point one to point two. When arriving at point two, he/she holds the tape at the point an yells mark. The rear chainman pulls the tape tight and reads the tape at point one. The rear chainman records the measurement. On gentle slopes, the two using plumb bobs, can hold a level tape (breaking chain) to measure horizontal distance. In this case the slope of the line is zero. When the slope is to steep to break chain, a slope distance measure is required.

Slope distance

Once we determine our pace on flat ground we are able to measure horizontal distance. Often in the forest we find steep slopes and need to measure slope distance, to convert to horizontal distance or vise versa. When we scale the distance off a map between points, we actually measure the horizontal distance. When pacing up or down hill from point to point we travel slope, which is always farther than horizontal distance.

If we travel 100 feet up a up or down or down a 60 percent slope, we actually traveled 86 horizontal feet. If we want to travel 100 feet up or down a 60 percent slope, we need to travel 116.6 feet slope distance. Remember all acre measurements are on the horizontal plane (horizontal distance). To convert slope distance to horizontal distance and vise versa, determine the percent slope (using clinometer, to be done in field exercises) and use the table in Exhibit M.

Making maps

All projects begin with a planning process that requires a map. Maps serve many functions, from a means of locating objects, to a system of monitoring. If a 40 acre clearcut is reforested, and stocking survey plots are taken across the entire site, the plot data can

be mapped and we see where reforestation success and failure occur. Other map attributes may lead us to conclude that the north aspect had good survival and the south aspect had high mortality. This type of monitoring tool is very valuable in planning addition reforestation efforts, not only by helping us target specific acres for replanting, but also in determining the appropriate species to plant.

Information required (project objectives)

The first thing we need to know to make a map is the purpose of the map. What information do we need to make the map function for it's intended purpose. In the above example of reforestation, the map attributes we might want include roads, topography, competing brush, conifer species planted, stocking levels, geographic features i.e. rock outcrops and wet areas, unit identification information, and any other information that will help in decision making. A fisheries biologist would need other types of information such as length of pools and riffles, water depth temperature and chemistry, location of spawning gravel, fish passage barriers, and other information for his/her decision making process.

Data collected

Prior to going to the field, make a list of the data to be collected. To keep costs down, be sure the data is necessary and it is collected at an accuracy level to be usable. Determine what you need to do to collect each data field and design a plan for collecting the information. If unit boundaries are required, a traverse around the edge of the unit is necessary (traverse will be discussed latter). If stocking levels are required, some type of walk through the entire unit is required. Be sure to maintain consistency in data collection so when analyzing the data you are comparing apples and apples and not apples and oranges.

An example of a bad sample would be to only walk through the north aspect and assume the south aspect is the same, or have two people walk through and one person puts in two 1/100 acre plots per acre on a grid system and the other person just meanders through the other half of the unit. It would be difficult to calculate trees per acre with this data set. Once your plan is determined, pick a nice day and try to have fun with the project.

Draw/copy maps and transfer data

Making maps is a simple task, but not having the right drawing tools can make it difficult or look unprofessional. If you are a part of the computer generation, there are many draw programs, ranging from inexpensive and simple to very sophisticated (autocad) engineering design tools that require extensive training to operate. Both combined with a good printer can produce professional looking and useful maps. If you have not entered the computer age, you can still produce professional looking maps using simple mechanical drafting tools. There are even lettering templates that help those with the worst handwriting.

For the example of reforestation mapping, use graph paper to draw the unit boundaries to a functional scale, number the plots where they were located on the ground and treat the data collected as attributes of each plot. First look at stocking levels by

placing a S for stocked and a N for nonstocked next to each plot number. For competing vegetation, map the type and amount of brush for each plot. Map the other plot attributes from the data set collected. Clear plastic (mylar) overlay material might help by having different layers for different attributes. Does the data tell you anything about the unit?

Area determination

Consider a piece of paper to equal an acre. With the paper flat the horizontal distance and the slope distance are equal. Crease a second piece of paper down the center to form a "V." Hold second piece of paper horizontal over the first, we see that slope distances produce a horizontal plane area much smaller than the flat piece of paper. Area (acres) are measured on the horizontal flat plane. This is why we need to use horizontal distance or slope distance with a multiplier for correction to calculate area. Area can be determined in a number of ways. In this training program we will consider two ways, use of a dot grid and traversing.

Dot grid

Using a dot grid is probably the easiest method for estimating area taken from a flat surface (map or aerial photograph). A dot grid is a clear plastic sheet with uniformly spaced dots. A dot grid is randomly placed on the area to be computed with dots covering the entire area. The number of dots within the area is counted, with every other dot falling on the boundary counted. The total dot count is multiplied by the correct conversion factor for the scale you are using (see Exhibit N). Try calculating the area three or four times to see if you get different estimates. Remember dot grids are only an estimate. If the map scale is not accurate due to photocopying and scale changing, the area estimated by the dot count method will not be accurate. Delineate a logical logging unit on the topographic map and use dot grid to calculate area.

Traverse

Traversing is the most accurate method of determining area. Depending on the equipment used, accuracy varies. Electronic surveying equipment is very accurate, but requires a two or three man crew to operate and takes the most amount of time to set up and read. Staff compass and steel or plastic tape require a two man crew and are a little faster. For forest development work, one man can use a hand compass and string box to achieve adequate accuracy (1:100).

Traversing requires recording azimuth or bearings, distances and slope between points on the ground. Azimuths seem to be preferred over bearings, with foresights and backsights being recorded. A foresight is the compass reading from point A (station) to point B (station) as we go around the unit. A backsight is the reading from B to A, looking back from where we came.

We use foresights and backsights to check for local attraction. If the foresight is not 180 degrees different than the backsight, we know either point A or point B has some magnetic force throwing the compass needle off of the true magnetic north. By checking the points on either side of A and B, we can determine which azimuth is correct.

Distance is a required data field for traversing and is usually recorded as slope distance. The percent slope of the line that the distance was measured is recorded so a slope multiplier can be used to convert to horizontal distance. This data when fed into computer traversing programs, will produce a scale drawing of the unit, determine area, and calculate the error of closure (a measure of accuracy).

This course is not designed to give you computer skills, so an alternative method is to use the data to draw a map to scale on graph paper and use a dot grid to calculate area.

GIS and GPS

What is GIS?

GIS is an acronym that stands for "Geographic Information System." GIS is a relatively new tool being used in a variety of fields. City planners use GIS when developing long and short range plans. Police and fire departments use GIS to look at crime density to allocate resources to specific geographic areas. Land managers began using GIS this past decade, and as the technology advances, the applications for GIS expand to other natural resource fields. Today, GIS is essential in ecosystem based management. The only tool suitable for landscape level planning, GIS offers many questions. Ability to quickly evaluate large areas asking specific questions. The Northwest Forest Plan (FEMAT) made extensive use of GIS to allocate lands for specific functions.

Landscape level planning

A function of ecosystem based management is landscape level planning. Ecological processes occur at different landscape scales and over time. This spatial distribution of ecosystem elements is complex enough to understand and map, it is further complicated by the changes over time that occur. Landscape level planning looks at both the spatial and temporal distribution of elements in ecosystems and with the aid of GIS, managers are able to manage and manipulate vast data banks

What is GPS?

GPS is an acronym that stands for Global Positioning System. A GPS utilizes satellite technology to locate a handheld unit on the ground. The GPS is a constellation of satellites orbiting the earth, transmitting very precise time and position data, received by the handheld unit. The receiver receives signals from three or more satellites to determine the user's position on the earth. Handheld units range in accuracy and thus cost, from as little as $400.00 to as much as $4,000.00.

Early systems had blind spots or times when satellites were not above the user. Over time these problems are being solved as new satellites are put into the system. Some limitations still exist where steep and deep canyons prevent three or more satellite signals reaching the receiver. GPS is rapidly changing and updating geographic information systems, with some handheld GPS units feeding data directly into GIS. As a botanist finds an endangered plant species, he/she can enter that position into GIS using the GPS. A forester can use GPS to traverse a timber sale unit and feed that

information directly into GIS. New applications are born daily in the GIS world.

Suggested Field Exercise

Use maps and photos to find a small identifiable reforestation unit to traverse and survey. Map and determine acres, plot reforestation survey data on map.

Resources for Further Information

Forestry suppliers

See Exhibit O

Textbooks

Elementary Surveying, sixth edition, Russell C. Brinker and Paul R. Wolf
Interpretation of Aerial Photographs, third edition, Thomas Eugene Avery

Internet (USGS)

See Exhibit P

Map and photo sources

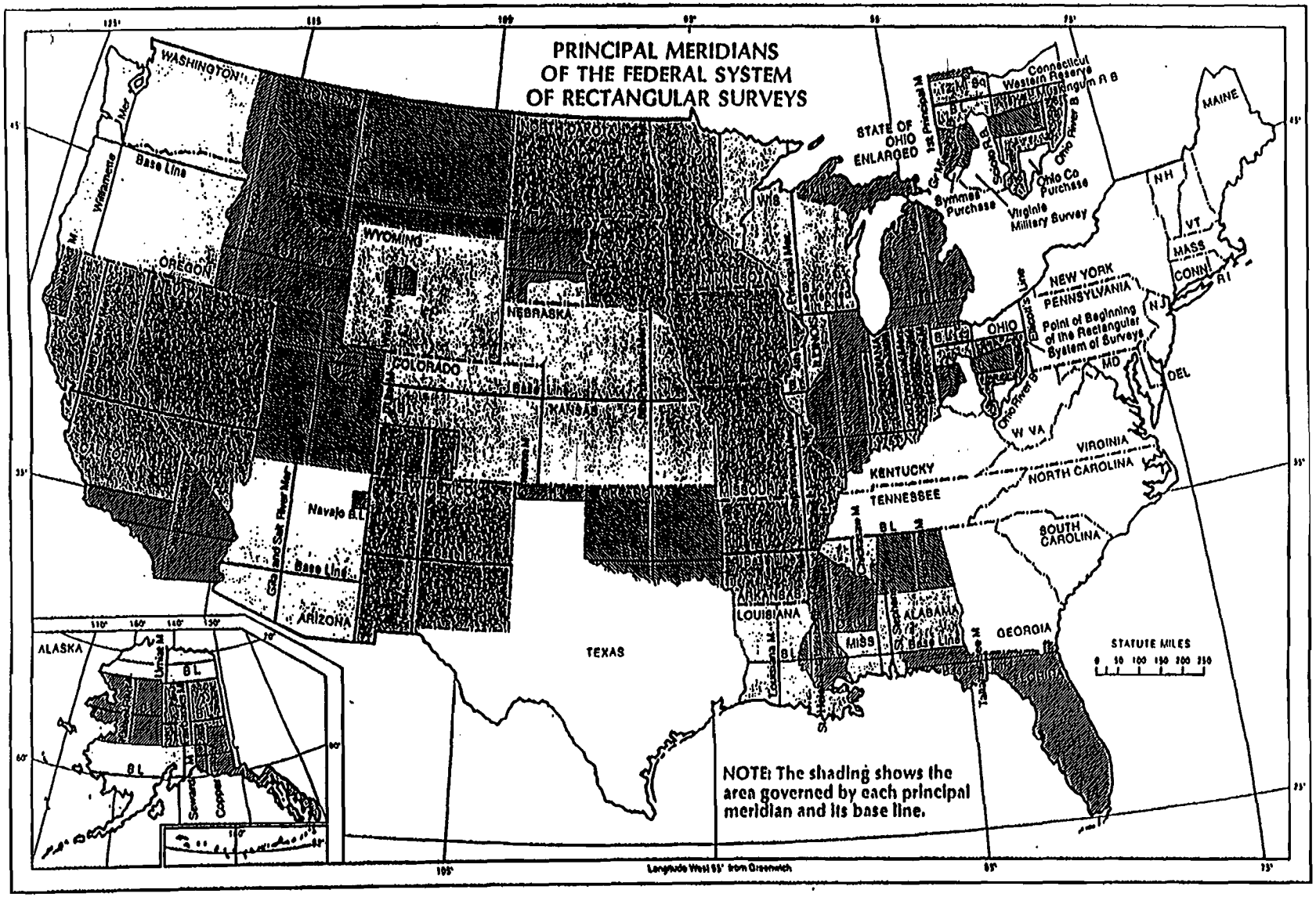
Local Forest Service, Bureau of Land Management, and State Department of Forestry Offices have transportation and topographic maps which show private and public ownership. However, large blocks of private ownership may not be available from Federal sources, as large blocks are usually not adjoining lands.

Limited GIS maps may be obtainable through these agencies for cooperatively developed projects. Most Forest Service and BLM offices have aerial photo coverage of their lands, which often have adjoining private lands covered as well. These photos may be available to check out and have color copies made for you field use. Again large blocks of private lands would not be available. Copies usually cost about $5.00 each and can be obtained at high end copy shops. Every county court house has maps showing ownership of each tax lot. These maps usually do not show roads, and are a large scale not appropriate for stand level planning. USGS topographic maps are sold at various speciality and outdoor stores throughout the Northwest and are available directly from the Branch of Distribution, USGS, Federal Center, Denver, Colorado 80225 (see above).

Equipment needs

Maps
Photos (stereo pair)
Hand compass
200' tape
Clinometer with percent scale
Aerial photo chain scale
Dot grid
Protractor
Graph paper
Stereoscope

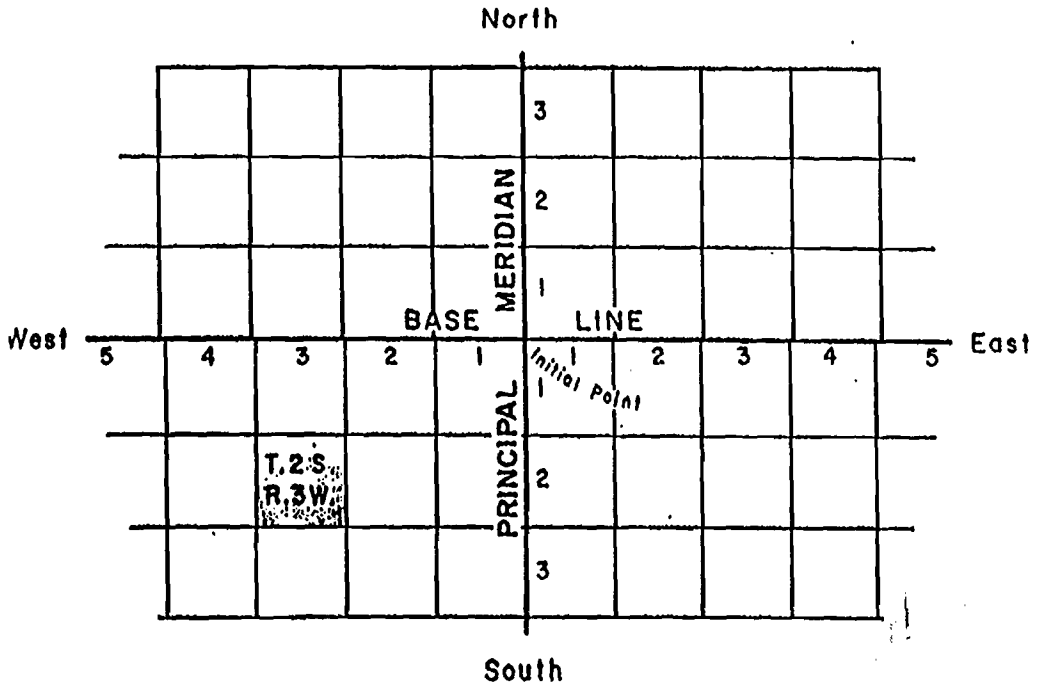
Exhibit A


PRINCIPAL MERIDIANS
OF THE FEDERAL SYSTEM
OF RECTANGULAR SURVEYS
WASHINGTON
OREGON
Base Line
Willamette Mer.
WYOMING
COLORADO
NEBRASKA
KANSAS
Navajo B.L.
Gila and Salt River Mer.
Base Line
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
LOUISIANA
ARKANSAS
MISSOURI
IOWA
MINNESOTA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISS
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W VA
PENNSYLVANIA
NEW YORK
MD
DEL
NJ
CONN
RI
MASS
VT
NH
MAINE
STATE OF OHIO ENLARGED
Connecticut Western Reserve
Symmes Purchase
Ohio Co Purchase
Virginia Military Survey
Point of Beginning of the Rectangular System of Surveys
ALASKA
Umiat
Seward
Copper
STATUTE MILES
NOTE: The shading shows the area governed by each principal meridian and its base line.
Longitude West 81° from Greenwich

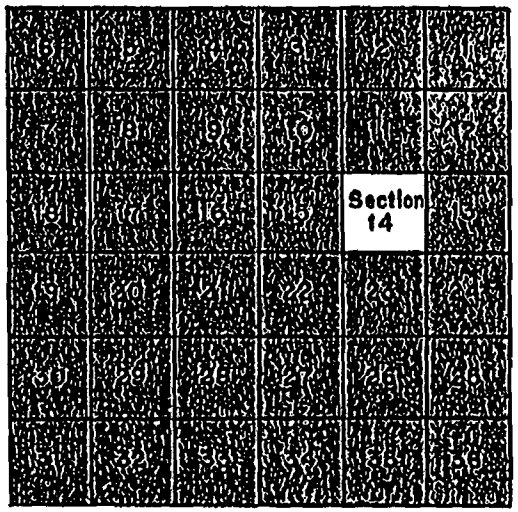
GENERALIZED DIAGRAM OF THE RECTANGULAR SYSTEM OF SURVEYS

Exhibit B

TOWNSHIP GRID



TOWNSHIP 2 SOUTH, RANGE 3 WEST



SECTION 14

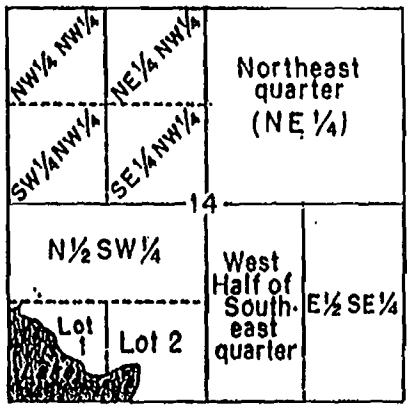


Exhibit C

A transportation map from the local Forest Service office.
Trainees can become familiar with maps they will be working with.

Exhibit D

A transportation map from the local BLM office.
Trainees can become familiar with maps they will be working with.

Exhibit E

A topographic map of the local area.
Trainees can become familiar with maps they will be working with.

Exhibit F

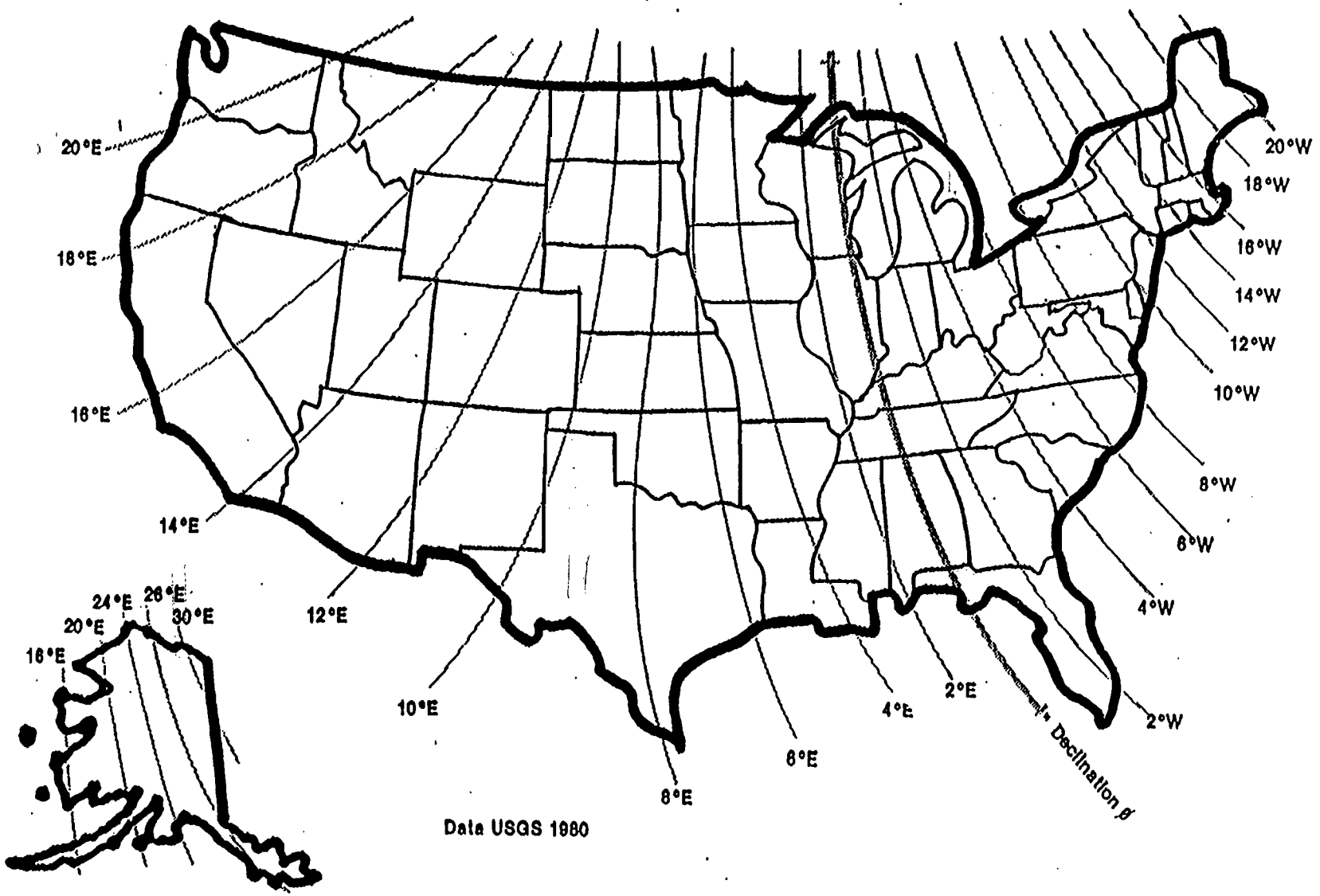


Fig. 12. Above map shows declination of the compass in North America. East of zero line, declination is "Westerly". West of the zero line, declination is "Easterly".

REFERENCE: USGS 1980

Exhibit G

[1]Some organizations, notably military agencies, measure azimuth angles clockwise from due south instead of due north.

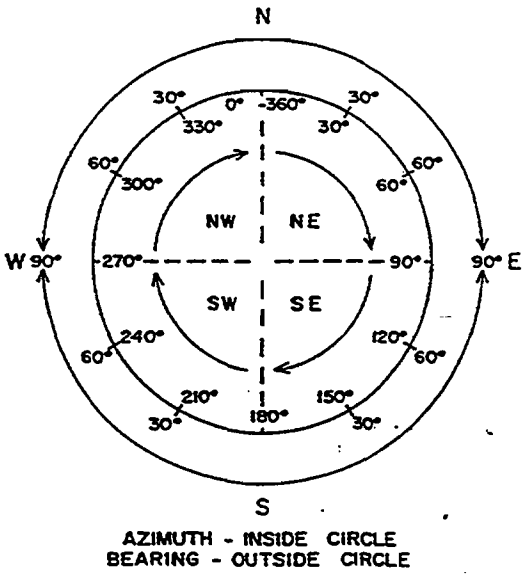


Figure 3-1 Relationship of compass bearings and azimuths.

Exhibit H

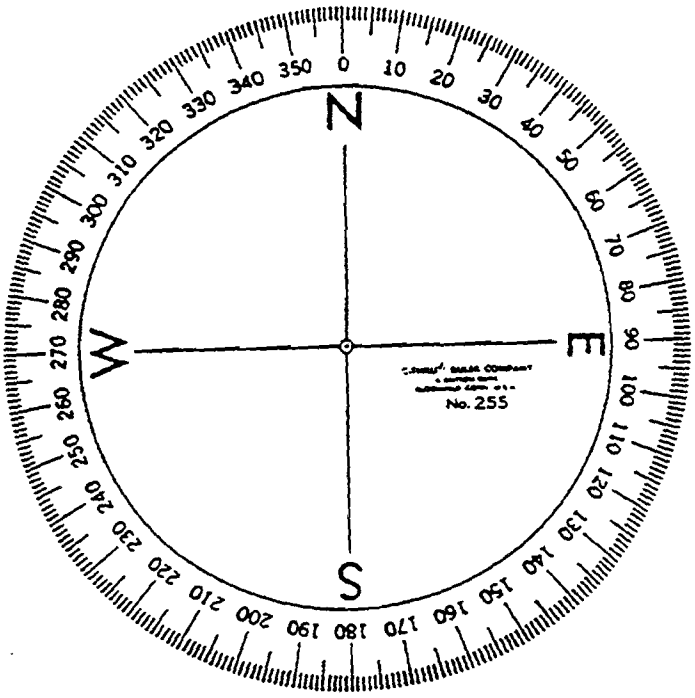


Exhibit I

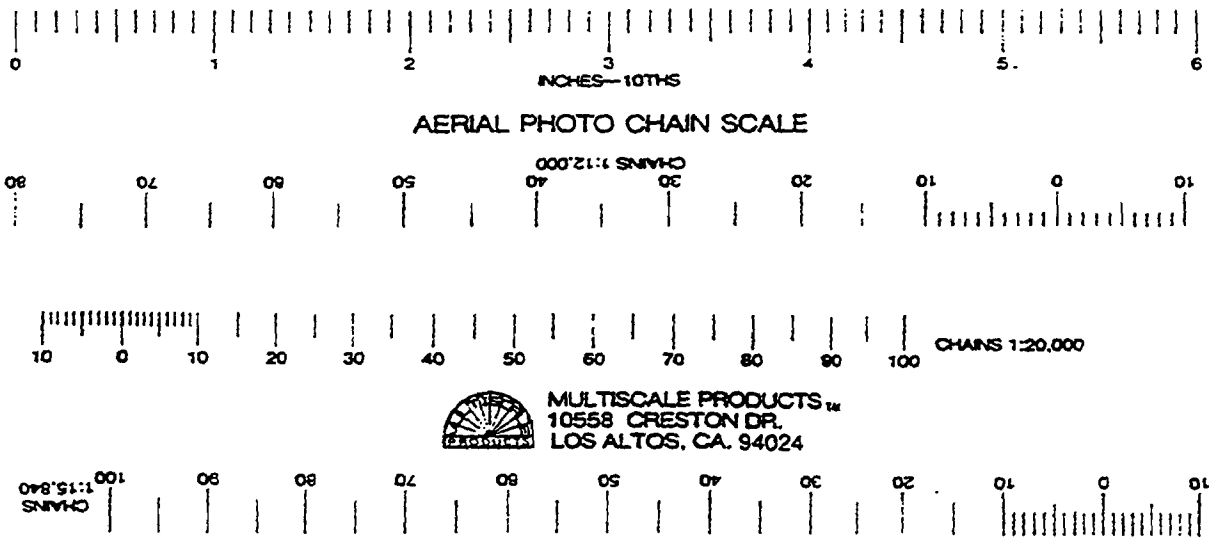


Exhibit J

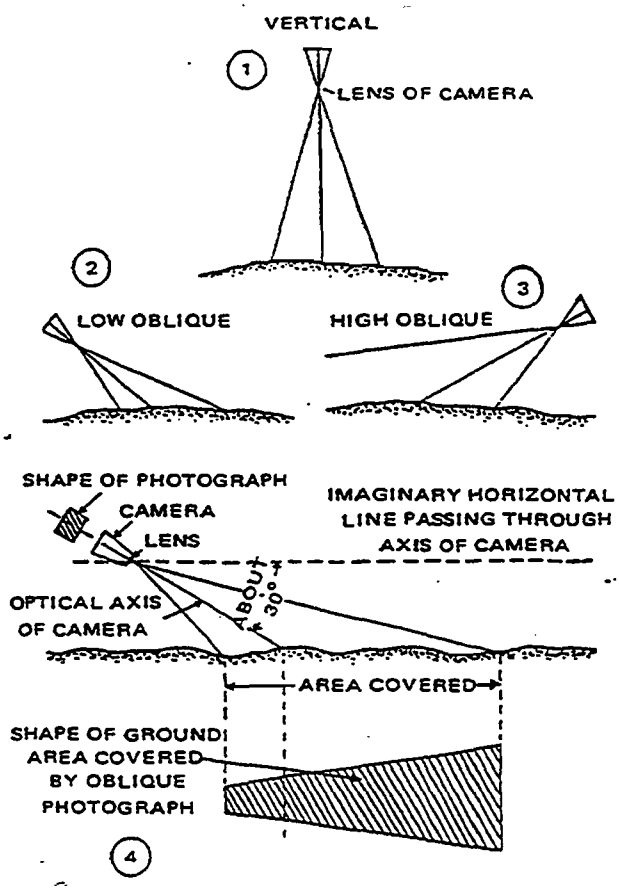
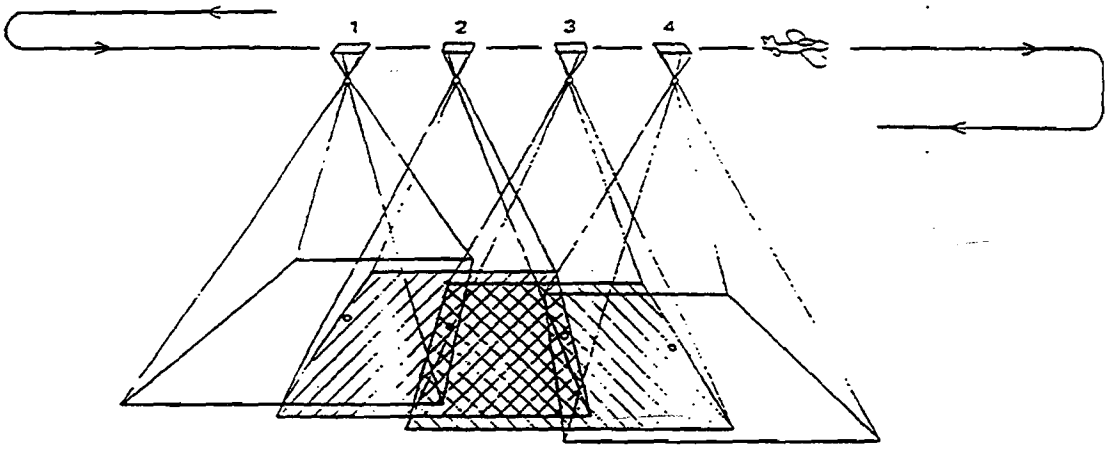


Figure 1-9. Orientation of aerial camera for vertical and oblique photography. Courtesy U.S. Department of the Army.

Exhibit K



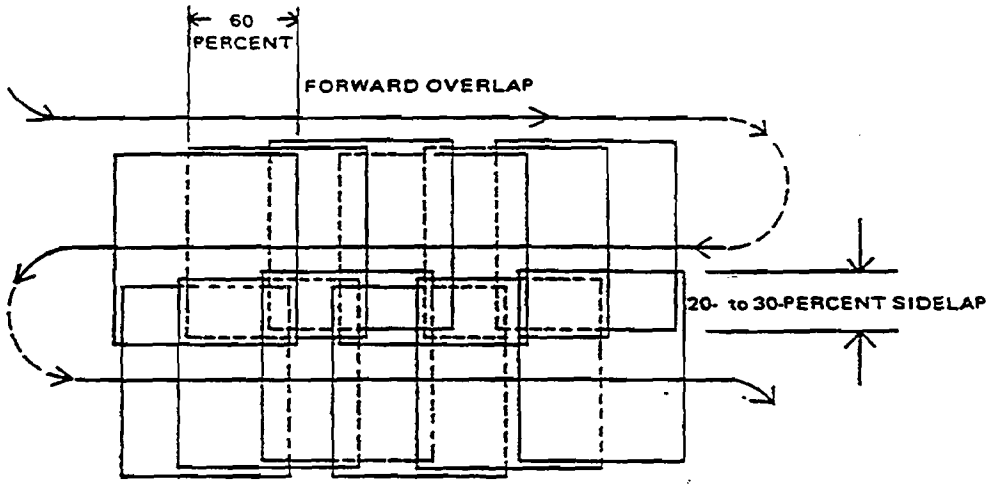


Figure 2–6. Aerial camera stations are spaced to provide for a 60-percent forward overlap of aerial photographs along each flight line and a 20- to 30-percent sidelap for adjacent lines.

Exhibit L

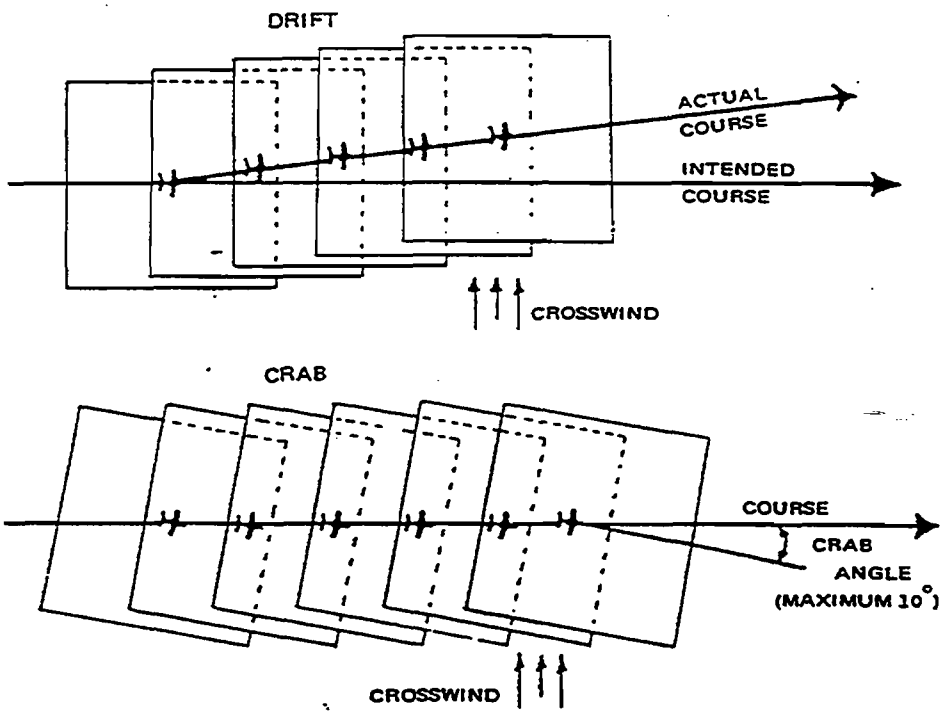


Figure 2–12. If crosswinds are encountered during flight, the photographic airplane may be blown off course, causing an alignment defect known as drift. The pilot can avoid this by heading the airplane slightly into the wind. If the photographer does not adjust the camera to counteract this condition, a skewed or crabbed photograph results. Excessive drift or crab may reduce overlap to an undesirable level. Courtesy U.S. Army Engineer School.

Exhibit M

Slope	Expansion Factor	Expansion Factor Reciprocal	Slope	Expansion Factor	Expansion Factor Reciprocal
83	1.300	.768	124	1.593	.624
84	1.306	.764	125	1.601	.620
85	1.312	.760	126	1.609	.618
86	1.319	.756	127	1.617	.616
87	1.325	.752	128	1.624	.614
88	1.332	.748	129	1.621	.612
89	1.338	.744	130	1.640	.610
90	1.345	.740	131	1.648	.608
91	1.352	.736	132	1.656	.606
92	1.359	.732	133	1.664	.604
93	1.365	.728	134	1.672	.602
94	1.372	.724	135	1.680	.600
95	1.379	.720	136	1.688	.596
96	1.386	.716	137	1.696	.592
97	1.393	.712	138	1.704	.588
98	1.400	.708	139	1.712	.584
99	1.407	.704	140	1.720	.580
100	1.414	.700	141	1.728	.578
101	1.421	.698	142	1.736	.576
102	1.428	.696	143	1.745	.574
103	1.436	.694	144	1.753	.572
104	1.443	.692	145	1.761	.570
105	1.450	.690	146	1.769	.566
106	1.457	.686	147	1.778	.562
107	1.464	.682	148	1.786	.558
108	1.472	.678	149	1.795	.554
109	1.479	.674	150	1.803	.550
110	1.486	.670			
111	1.494	.668			
112	1.501	.666			
113	1.509	.664			
114	1.516	.662			
115	1.524	.660			
116	1.532	.656			
117	1.539	.652			
118	1.547	.648			
119	1.554	.644			
120	1.562	.640			
121	1.567	.636			
122	1.578	.632			
123	1.585	.628			

DISTANCE CORRECTION

a. Slope dist. x % slope exp. factor = adj. slope dist.

b. Slope dist. x exp. factor recip. = Hor. dist.

c. Slope dist. x Cos. of vert. angle = Hor. dist.

TREE HEIGHT CALCULATION

a. Hor. dist. x (Upper % ± Lower %) = Total Height

b. Tan 1 ± Tan 2 x hor. dist. = Total Height

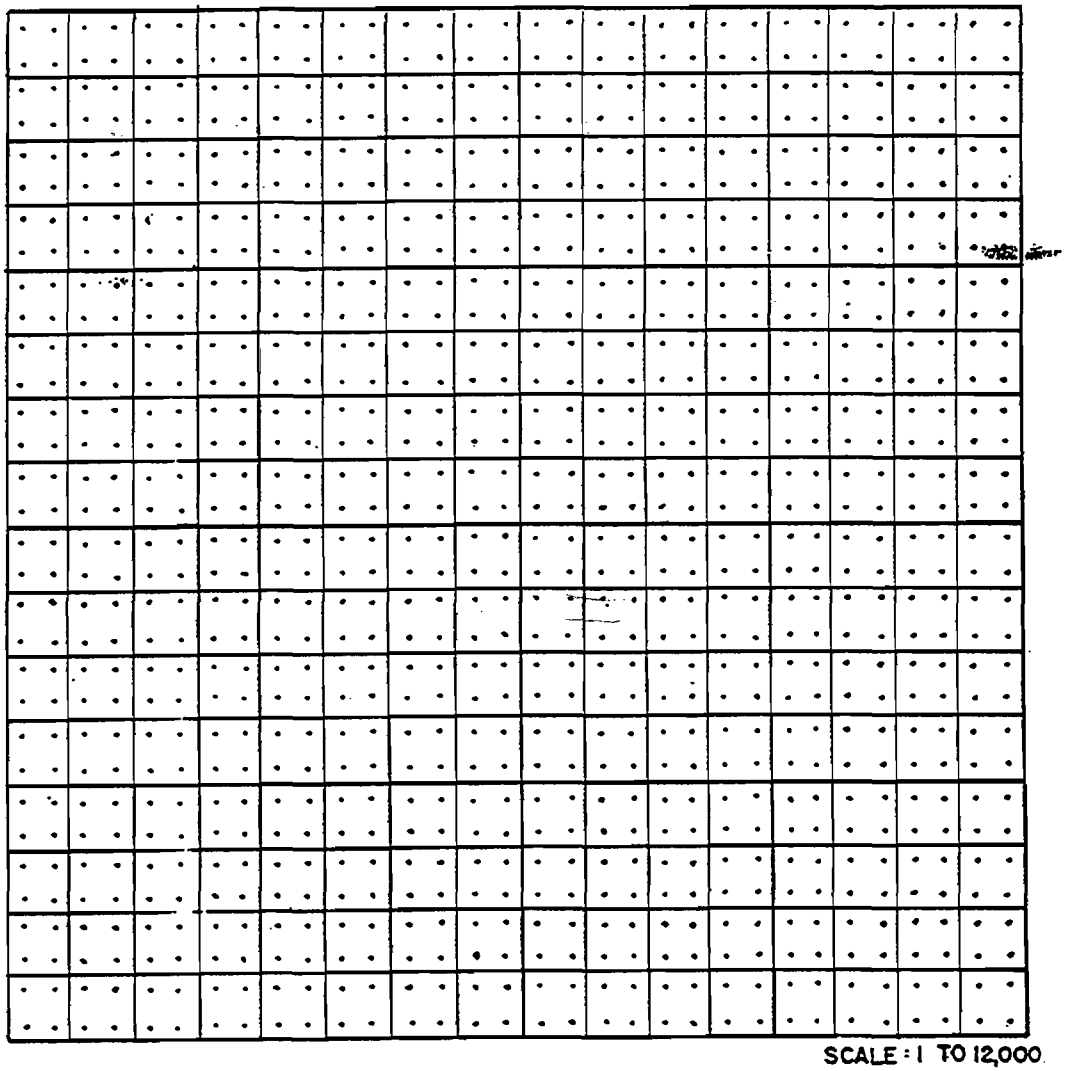
Horizontal Limiting Distance from plot center to the center of the bole at the point of diameter measurement.

BAF 10				BAF 20			
	Distance		Distance		Distance		Distance
Dia.	Feet	Dia.	Feet	Dia.	Feet	Dia.	Feet
0.1	0.3	27	74.3	0.1	0.2	27	52.5
.2	.6	28	77.0	.2	.4	28	54.4
.3	.8	29	79.8	.3	.6	29	56.4
.4	1.1	30	82.5	.4	.8	30	58.3
.5	1.4	31	85.3	.5	1.0	31	60.3
.6	1.7	32	88.0	.6	1.2	32	62.2
.7	1.9	33	90.8	.7	1.4	33	64.2
.8	2.2	34	93.5	.8	1.6	34	66.1
.9	2.5	35	96.3	.9	1.8	35	68.1
1	2.8	36	99.0	1	1.9	36	70.0
2	5.5	37	101.8	2	3.9	37	71.9
3	8.3	38	104.5	3	5.8	38	73.9
4	11.0	39	107.3	4	7.8	39	75.8
5	13.8	40	110.0	5	9.7	40	77.8
6	16.5			6	11.7	41	79.7
7	19.3			7	13.6	42	81.7
8	22.0			8	15.6	43	83.6
9	24.8			9	17.5	44	85.6
10	27.5			10	19.4	45	87.5
11	30.3			11	21.4	46	89.4
12	33.0			12	23.3	47	91.4
13	35.8			13	25.3	48	93.3
14	38.5			14	27.2	49	95.3
15	41.3			15	29.2	50	97.2
16	44.0			16	31.1	51	99.2
17	46.7			17	33.1	52	101.1
18	49.5			18	35.0	53	103.1
19	52.3			19	36.9	54	105.0
20	55.0			20	38.9	55	106.9
21	57.8			21	40.8	56	108.9
22	60.5			22	42.8	57	110.8
23	63.3			23	44.7	58	112.8
24	66.0			24	46.7	59	114.7
25	68.8			25	48.6	60	116.7
26	71.5			26	50.6		
Plot Radius Factor = 2.75				Plot Radius Factor = 1.9445			
Limiting Distance = PRF X Dia.				Limiting Distance = PRF X Dia.			

Exhibit N

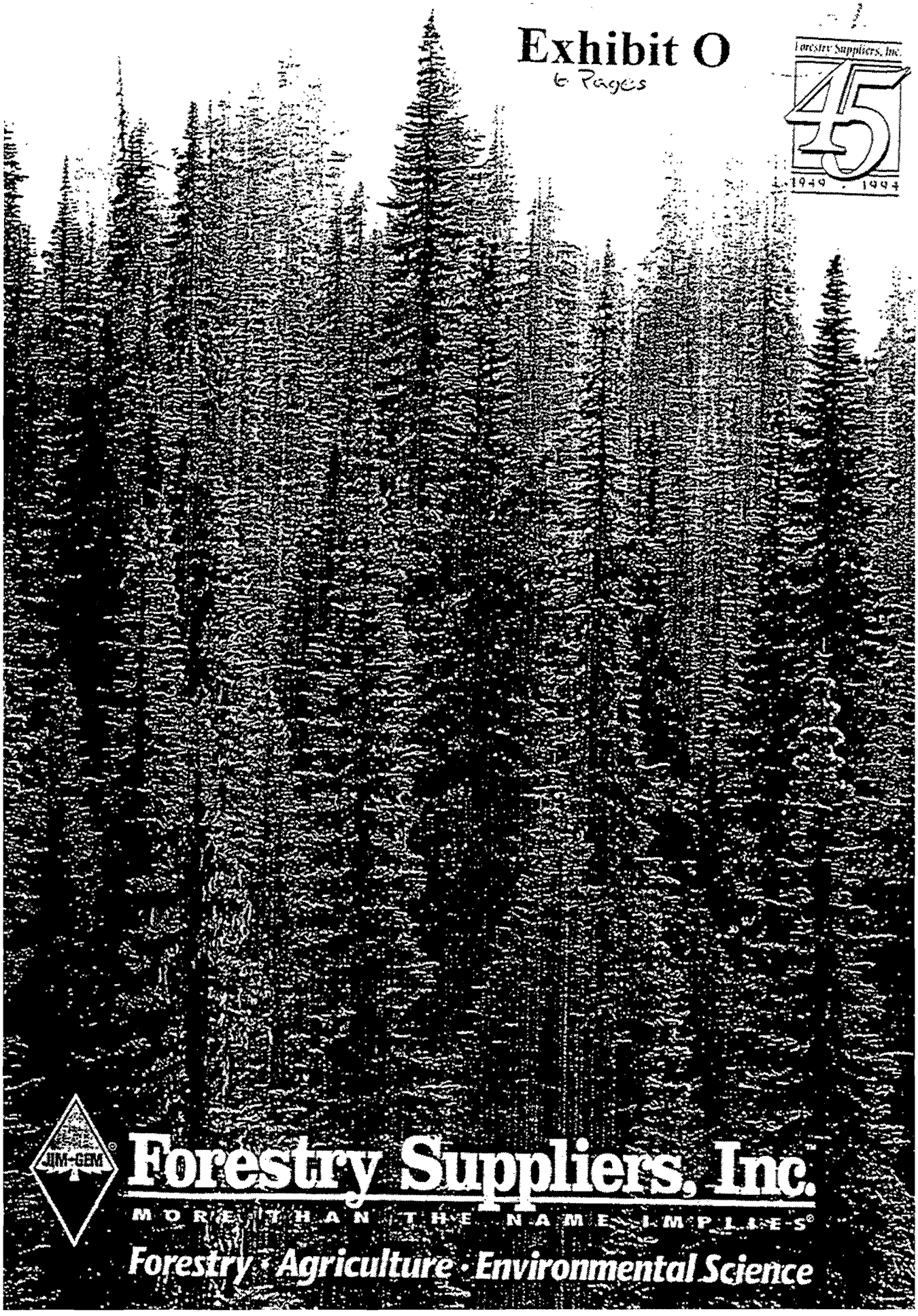
DOT GRID

AREA PER DOT — 0.625 ACRES



SCALE : 1 TO 12,000

Exhibit O
6 Pages



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This set of three filmstrips and three cassettes is based on the popular workbook "Your Way With Map & Compass," by John Disley. The three-part program consists of instructing the viewer in basic principles of the map, the compass and combining the two into Orienteering. Instructional guide included.

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D. Orienteering/Educational Package

For Secondary Level

Contains: Silva Type 7 Polaris Compass, "Teaching Orienteering" book, Map Memory Relay Game, Map Symbol Relay Game, Competitive Compass Game and Sheet of Schoolground Adhesive Markers. Order demonstration compass (36994 below) separately.

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E. Orienteering/Educational Package

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Kit contains: Silva Type III Explorer Compass, "Be Expert with Map & Compass," "Teaching Orienteering," Map Memory Relay Game, Map Symbol Relay Game, Competitive Compass Game, "Trim Orienteering" and Sheet of Schoolground Adhesive Markers. Order demonstration compass (36994 below) separately.

36999 (3 lbs.) $43.25

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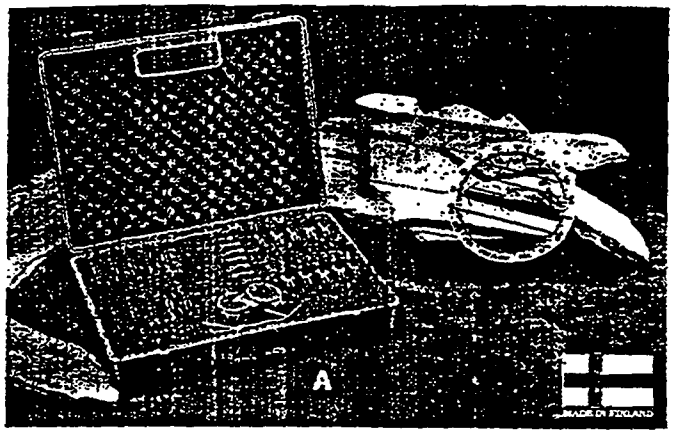
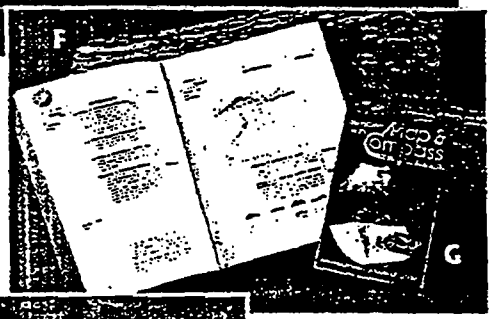
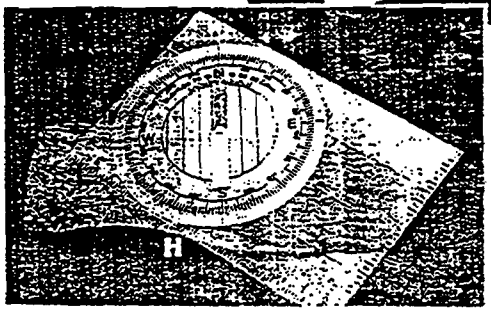
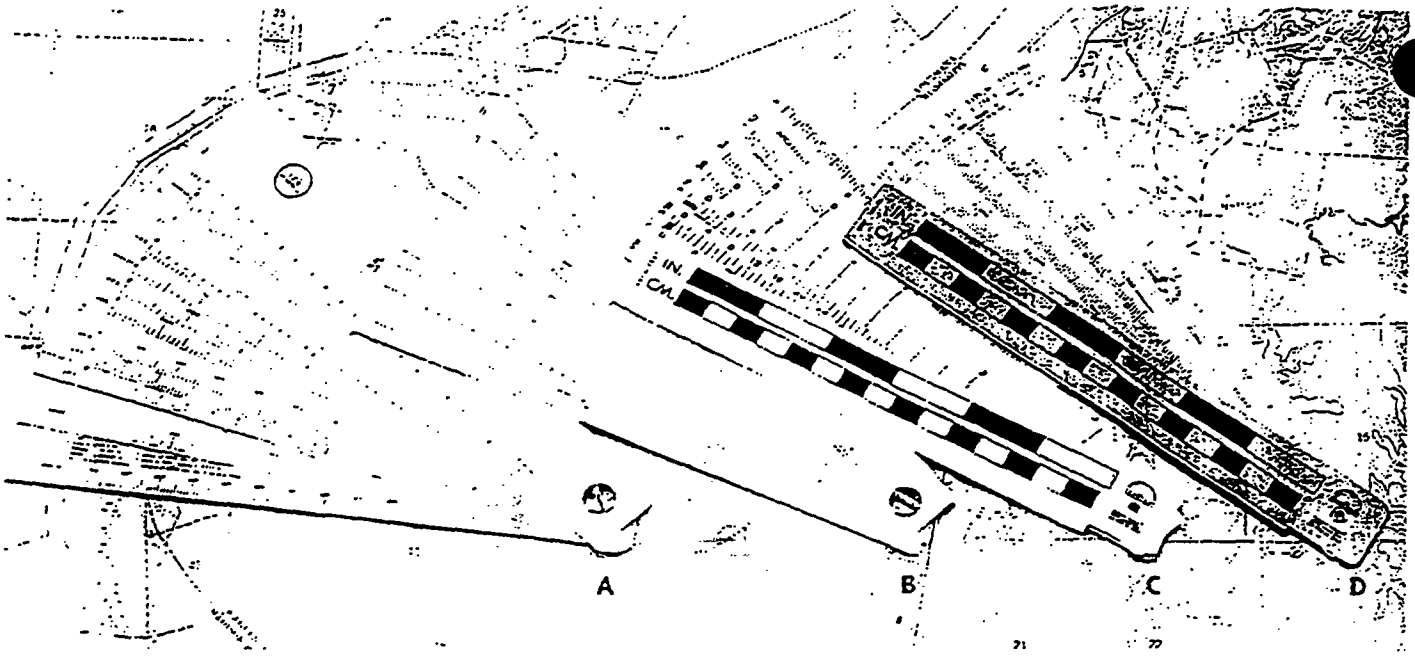






Fan Type Mapping Scales



A. Allen Engineering Scales

For use on maps in posting oil wells, towers, buildings, and tracts of land. White plastic leaves hinged at one end. Contains 23 leaves with 48 scales. 1" x 7-7/8" x 1/4" folded. Complete with case.

Leaf	Inch Scale	Reads directly in:
1	1"=1000 Ft.	Feet/Varas
2	1"=1000 Ft.	Chains/Arpents
3	1"=1000 Ft.	Rods/Feet
4	1"=2000 Ft.	Feet/Varas
5	1"=2000 Ft	Chains/Arpents
6	1"=3000 Ft.	Feet/Varas
7	1"=4000 Ft.	Feet/Varas
8	1"=500 Ft.	Feet/Varas
9	1"=600 Ft.	Feet/Varas
10	1"=8000 Ft.	Feet/Varas
11	1"=1 Mile	Feet/Varas
12	2"=1 Mile	Feet/Varas
13	3"=1 Mile	Feet/Chains
14	4"=1 Mile	Feet/Varas
15	1"=1000 Varas	Feet/Varas
16	1"=2000 Varas	Feet/Varas
17	1"=300 Varas	Feet/Varas
18	1"=400 Varas	Feet/Varas
19	1"=500 Varas	Feet/Varas
20	1"=600 Varas	Feet/Varas
21	1"=800 Varas	Feet/Varas
10A	5"=1Mile	Feet/Varas
11A	1"=1200 Ft.	Feet/Varas
	1"=660 Ft.	Feet/Varas

47204 (3 oz.) $15.15

B. Allen Miscellaneous Scales

Same size, construction and weight as the 47204, but featuring the following scales. Complete with case.

Leaf	Proportion	Inch Scale	Reads directly in:
A	1:1000	1"=83.3 Ft.	Ft./Mi
B	1:2000	1"=166.6 Ft.	Ft./Mi
C	1:3000	1"=250 Ft.	Ft./Mi
D	1:4000	1"=333.3 Ft.	Ft./Mi
E	1:5000	1"=416.6 Ft.	Ft./Mi
F	1:6000	1"=500 Ft.	Ft./Mi
G	1:7000	1"=583 Ft.	Ft./Mi
H	1:7500	1"=625 Ft.	Ft./Mi
I	1:1,900,800	1"=30 Miles	Mi/Km
J	1:380,160	1"=6 Miles	Ft./Mi
K	1:190,080	1"=3 Miles	Ft./Mi
L	1:1,520,640	1"=24 Miles	Ft./Mi
M	1:8000	1"=666 Ft.	Ft./Mi
N	1:9000	1"=750 Ft.	Ft./Mi
O	1:125,000	1"=2 Miles	Mi/Km
P	1:150,000	1"=2.37 Miles	Mi/Km
Q	1:250,000	1"=3.95 Miles	Mi/Km
R	1:500,000	1"=7.89 Miles	Mi/Km
S	1:1,000,000	1"=15.8 Miles	Mi/Km
T	1:62,500	1"=1 Mile	Ft./Mi
U	1:31,680	2"=1 Mile	Ft./Mi
JJ	1:20,000	1"=1667 Ft.	Ch/Var
KK	1:7920	1"=660 Ft.	Ft./Var

47206 (3 oz.) $15.15

C. Multiscale "Scaler"

Unique pocket-sized set that includes all 24 standard architect and English/metric engineer scale ratios. The equivalent of three triangular scales in one package. Consists of six leaves, precision printed both sides on white laminated vinyl. Yellow vinyl jacket. Scale ratios: Architect: 3, 1-1/2, 1, 3/4, 1/2, 3/8, 1/4, 3/16, 1/8, 3/32, 1/16, 1/32 inches/foot. Engineer English: 10, 20, 30, 40, 50, 60 parts/inch. English metric: 20, 33-1/3, 40, 50, 80, 100 parts/meter.

47213 (2 oz.) $10.50

D. Multiscale "Quadrangle"

Ultimate pocket-sized set of map scales. Includes the 12 commonly used map scales for measurement of distances on topographic quadrangle maps and aerial photographs used worldwide. Consists of six leaves, precision printed both sides on white laminated vinyl. Silver gray vinyl jacket. Each scale reads directly in feet, miles, meters, and chains. Scale ratios: 1:10,000 (10cm = 1km), 1:12,000 (1" = 1,000'), 1:15,840 (4" = 1 mile), 1:24,000 (1" = 2,000'), 1:25,000 (4cm = 1km), 1:50,000 (2cm = 1km), 1:62,500 (1" = 1 mile), 1:63,360 (1" = 1 mile), 1:100,000 (1cm = 1km), 1:125,000 (1" = 2 miles), 1:250,000 (1cm = 2.5km, 1" = 4 miles), 1:500,000 (1cm = 5km, 1" = 8 miles).

47208 (2 oz.) $10.50

Aerial Photo Chain Scale

Excellent for foresters, surveyors and others wishing to read aerial photos and maps in chains. White vinyl. Measures 6-1/4"L x 1"W. Graduated on both sides with the following scales:

Scale	Reads directly in:
1: 12,000 (1" = 15 chains)	Chains
1: 15,840 (1" = 20 chains)	Chains
1: 20,000 (1" = 25 chains)	Chains
Inches	Inches to 10ths

47215 (1 oz.) $1.50

English Area Grid

Use to determine the area of any flat surface in English measure- r units. Scales and ratios include the following:

1 in.: 1 in.
1 in.: 1 ft.
1 in.: 1 yd.
1 in.: 500 ft. = 10.56 ins.: mi. = 1:6,000
1 in.: 1,000 ft. = 5.28 ins.: mi. = 1:12,000
1 in.: 1,320 ft. = 4.0 ins.: mi. = 1:15,840
1 in.: 1,667 ft. = 3.167 ins.: mi. = 1:20,000
1 in.: 2,000 ft. = 2.64 ins.: mi. = 1:24,000
1 in.: 3,334 ft. = 1.58 ins.: mi. = 1:40,000
1 in.: 5,280 ft. = 1 in.: mi. = 1:63,360

Two edge scales (inches to tenths and inches to 16ths) are included. It may also be used with any other map scale, but first you must figure the conversion factor (see "How To" Box on the right). Available in standard size or super size.

45008 Standard Size 7" x 9" with 4" x 4" work area (3 oz.) $3.50
45009 Super Size 9" x 12" with 8" x 8" work area (3 oz.) $4.60

How To Use the English Area Grid

To use, randomly place grid over area to be computed and count the dots falling within that area. Count every other dot that falls on the boundary of the area. Multiply the number of dots counted by the proper conversion factor for the scale you are using to obtain total area.

Example: Using a map scale of 1"= 1,320 ft.

1,320² = 1,742,400 sq. ft./sq. in. of area grid

1,742,400 ÷ 43,560 sq. ft. per acre = 40 acres/sq. in. of area grid

40 acres ÷ 64 dots per sq. in. of area grid = 0.625 acres per dot conversion factor

Each dot represents .625 acres. If the dot total of an area is 50 dots, multiply 50 by the conversion factor. 50 x 0.625 = 31.25 acres within area.

This can be done using any map scale.

A. Coordinate Ruler

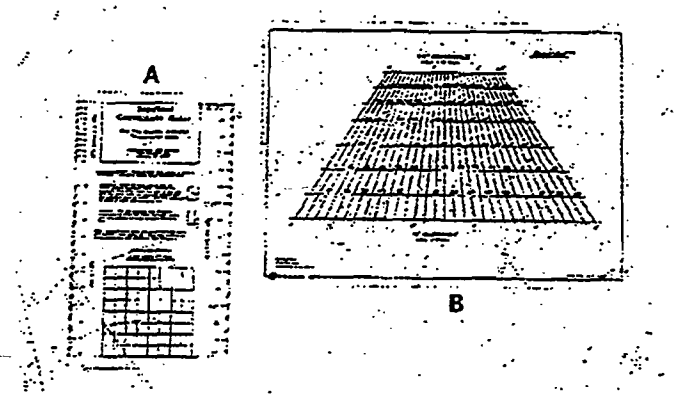
Used on 7.5-minute, 1:24,000 topographic maps to find and plot coordinates. All common systems used on maps are included. Can also be used to measure distances in feet, estimate surface area in acres, and aid in finding slope. 9-1/4" x 11-1/4".

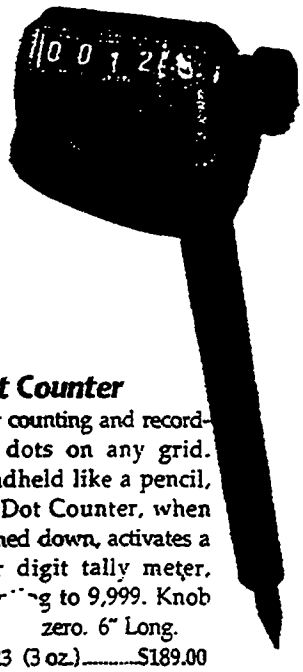
45676 (3 oz.) $10.95

B. Topo Aid

Helps you quickly determine longitude and latitude of any point on USGS 7.5 and 15-Minute Topographic Maps. Accurate to the nearest se- d on 7.5-minute maps and 5 seconds on 15-minute maps. C ucted of heavy 40-mil plastic for holding maps down and flat. 8" x 11".

45675 (4 oz.) $16.50

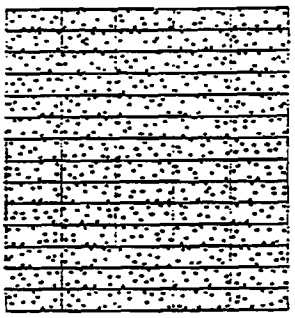




Dot Counter

For counting and record- ng dots on any grid. landheld like a pencil, he Dot Counter, when ushed down, activates a our digit tally meter, u- -g to 9,999. Knob se zero. 6" Long.

5023 (3 oz.) $189.00



Planogrid Measuring Overlay

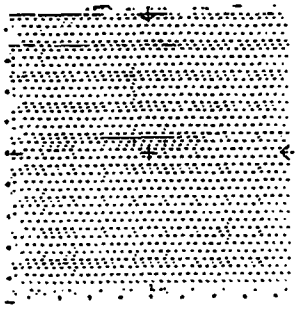
The inexpensive alternative to a planimeter! Simply lay this clear plastic 8-1/2" x 12" grid over any map, plan, or drawing you need to measure. Instructions and conversion scales printed on sheet.

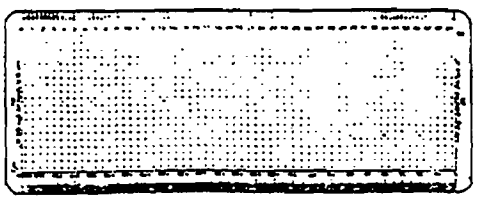
45011 (3 oz.) $19.95

Acreage and Photo-Coordinate Grid

Use to locate and describe any area on any aerial photograph. Also use to calculate acreage by dot count on any map or photo, regardless of the scale. Detailed instructions included with each grid. Mylar, 9-3/8" square; fits into Aerial Photo Carriers sold on page 328.

45026 (3 oz.) $4.20



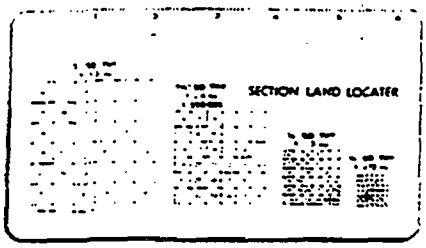


Area Scale (A-29)

Easy to read scale with the following calibrations: 1" = 660' = 1/8 mile; 1" = 40 rods; 1" = 440' = 1/12 mile; 1" = 10/tenths. Equal dotted squares – 1 Dot = 0.1 acre at 660 scale. 1 dot = .044 acre at 440 scale. 2-1/2" x 6-3/8".

45285 (1 oz.) $3.10

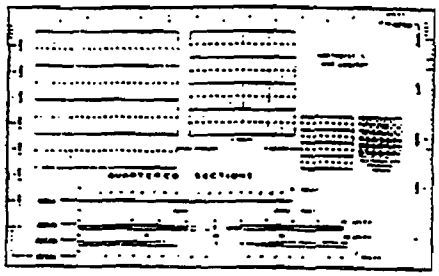
Section Land ator



Time-saving method for locating specific sections of land on Federal topographic, state mineral, oil and gas, county, blackburn and other maps drawn to any of the eight most commonly used scales from 1" = 16 miles to 1" = 2 miles. By placing locator on map with corresponding scale on township lines, exact location of all 36 sections is immediately visible. Consists of two templates, each 3-3/4" x 6-3/4". Frosted plastic.

45662 (1 oz.) $9.20

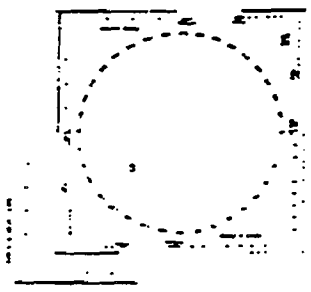
Geologist's Land Locator



Features Quarter Section Grids in map scales of 1:24,000, 1:31,680, 1:62,500, and sectionalized Township Grid in map scale of 1:500,000.

Linear scales – two 1:24,000 scales – one in tenths and twentieths of a mile, the other in 100' intervals. Two 1:31,680 scales – one in tenths and twentieths of a mile, the other in 500' intervals. Two 1:62,500 scales – one in tenths and halves of a mile, the other in 500' intervals. One 1:125,000 scale – in 1/4 mile intervals. One 1:500,000 scale – in one mile intervals. 8-1/2" x 6". Transparent plastic.

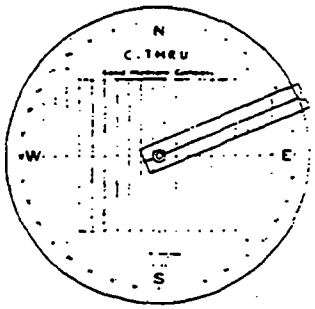
45674 (1 oz.) $2.50



UTM Coordinate Grid (USGS Type)

For determining positions of points on maps which have a metric grid. Designed for use on maps with scales of 1:24,000, 1:62,500, 1:63,360, 1:125,000 and 1:250,000. USGS maps, in general, have Universal Transverse Mercator (UTM) grid ticks around the map margin, and a full grid can be constructed by drawing lines connecting the ticks. With a full grid carefully drawn, metric coordinates of map points can be measured directly with the reader. [illegible]" x 11". Transparent plastic.

[illegible] (1 oz.) $4.60



C-Thru Land Measure Compass

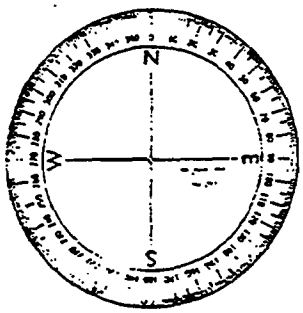
Land measure compass with cursor arm enables you to lay out a property description. 360° Divided into four 0-90° quadrants. 5" Diameter. Transparent plastic.

47922 (1 oz.) $4.25

Compass Protractor Azimuth

Helpful in map reading and navigation. Made of clear plastic, 3-1/2" in diameter graduated 0-360° in 1° increments. 3-1/2" Diameter. Transparent plastic.

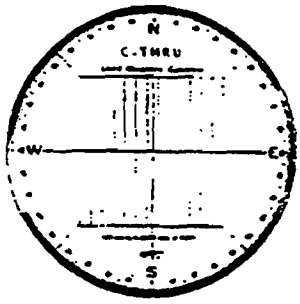
7954 (1 oz.) $1.00

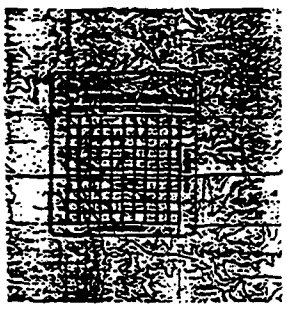


Land Measure Compass

Based on the principle of a surveying compass, this device has precision-graduated edges in four 90° quadrants, with 1° graduations, commencing with zero at N and S. 5" Diameter. Transparent plastic.

45283 (1 oz.) $2.95

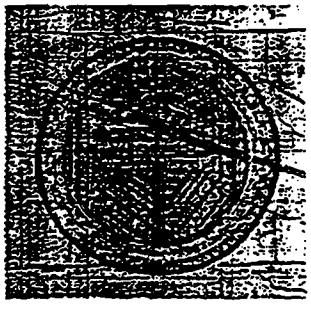




Grid Reader

Transparent template containing ten vertical parallel lines, and ten horizontal parallel lines that converge at 90° forming a grid. Used to find and plot coordinates, measure distances in feet, estimate surface area in acres, and aid in finding slope on a topographic map. The land area of this square grid on a 24,000 Scale USGS topographic map is 1,000 square meters. Each small square within its grid is 10 meters square. Made of two pieces [illegible]ged, laminated vinyl measuring .040" in total thickness. 3" x 4-[illegible]. Transparent plastic.

[illegible]677 (1 oz.) $5.95



Declitractor

Transposes map direction into compass degree values. Simply read the magnetic declination diagram printed on the bottom of the topographic map you are using, "dial-in" the exact declination angle on the tool and use it in the same fashion as a common protractor. All readings either plotted or read from the map will be in magnetic compass values. Made of durable plastic. 5" Diameter. Transparent plastic.

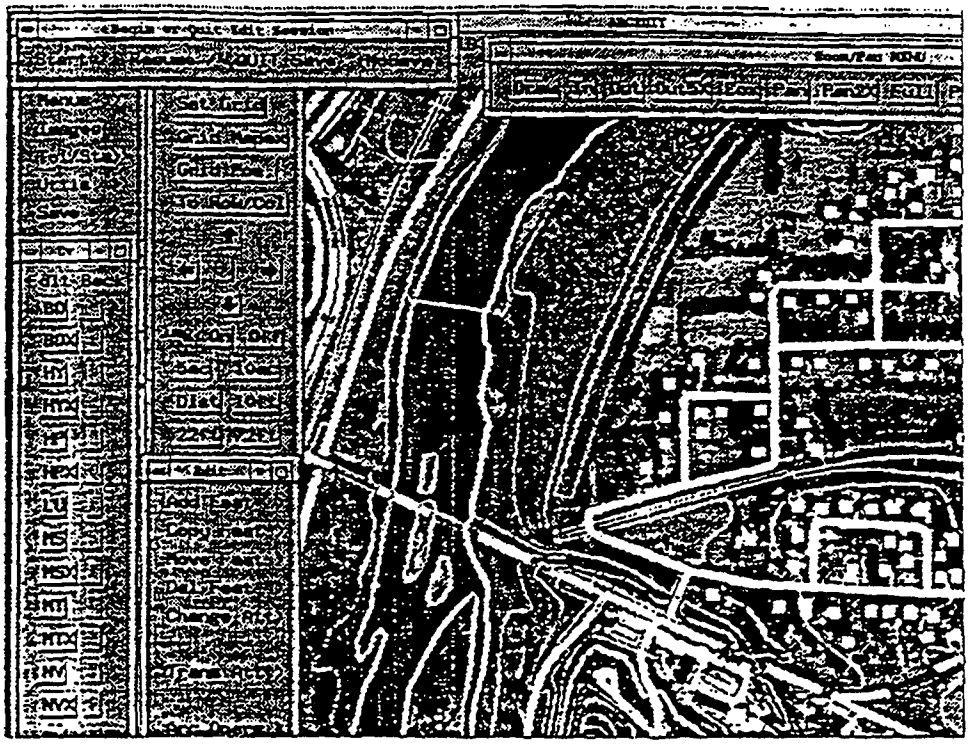
47916 (3 oz.) $12.95

U.S. Department of the Interior
U.S. Geological Survey

Revision and Product Generation Software

Fact Sheet

The U.S. Geological Survey (USGS) developed revision and product generation (RevPG) software for updating digital line graph (DLG) data and producing maps from such data. This software is based on ARC/INFO, a geographic information system from Environmental Systems Resource Institute (ESRI). RevPG consists of ARC/INFO Arc Macro Language (AML) programs, C routines, and interface menus that permit operators to collect vector data using aerial images, to symbolize the data on-screen, and to produce plots and color-separated files for use in printing maps.



Background

The USGS mission includes meeting the mapping requirements of various Federal, State, and public users. Through the National Mapping Program, the USGS has developed digital tools and techniques to accomplish this mission. In the 1970's, USGS began to digitally capture graphics as points, lines, and polygons, using numeric codes to represent their attributes. The files generated in this manner are called DLG's. Recently, a means was sought to update these and other vector data sets using digital orthophoto quadrangle (DOQ) images. DOQ's are high-altitude aerial photographs that have been scanned and geographically corrected. The USGS developed RevPG software to collect and revise DLG data using a DOQ image as an on-screen backdrop, and to make updated maps from these data.

Capabilities

RevPG has the following primary capabilities:

- loading and registration of DLG and DOQ images;
- tools to edit DLG data to reflect changes observed in the DOQ;
- symbolization of elements derived from their numeric attributes;
- query functions and queued edit functions;
- feature conflict detection and resolution; and
- options for electrostatic plots and film plots.

Availability

Under a Cooperative Research and Development Agreement, the USGS and ESRI have recently completed porting RevPG to several Unix environments. The system requirements are ARC/INFO 6.1.1, 7.0.2, or later versions; DG/UX, SunOS/Solaris, HP/UX, AIX, IRIX, or Ultrix/OSF operating systems; a minimum of 28 megabytes of RAM and 21 megabytes of disk space, along with 100 megabytes of swap space.

A limited number of CD-ROM's containing RevPG will be made available on request.

Information

Complimentary copies of RevPG on CD-ROM are available. To request a copy, contact:

USGS Information Services
Box 25286, Denver Federal Center
Denver, CO 80225
303-236-7477; Fax 303-236-1972

RevPG can also be retrieved on Internet through:
<URL:http://www-nmd.usgs.gov/>

For more information about RevPG, contact:

USGS Mid-Continent Mapping Center
RevPG System Manager
1400 Independence Road, MS 315
Rolla, MO 65401
Fax 314-341-0812

Form 9035

Exhibit P

U.S. Department of the Interior
U.S. Geological Survey

US GeoData Available Through the Internet

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The U.S. Geological Survey (USGS) offers select US GeoData data bases through the Internet. They can be retrieved using anonymous File Transfer Protocol (FTP) or World Wide Web. The data bases and their directory paths are:

- 1:2,000,000-scale digital line graph data (/pub/data/DLG/2M)
- 1:100,000-scale digital line graph data, hydrography and transportation layers only (/pub/data/DLG/100K)
- 1:100,000-scale land use and land cover data (/pub/data/LULC/100K)
- 1:250,000-scale land use and land cover data (/pub/data/LULC/250K)
- 1-degree digital elevation model data (/pub/data/DEM/250)

FTP Access

To download files from the above data bases using standard anonymous FTP:

- The Internet address is: edcftp.cr.usgs.gov
- At the user name enter *anonymous*
- At the password enter your e-mail address.
- The files are listed by area name, generally in an alphabetical list where, for example, the Austin, Tex., quadrangle would be found under the directory "A."
- When the desired quadrangle has been located, set the file transfer mode to binary by entering *binary* at the prompt. Then enter *get* and the quadrangle name.

World Wide Web Access

US GeoData

US GeoData files can also be retrieved through a USGS World Wide Web server using browse tools, such as Mosaic. The address for the USGS EROS Data Center home page is:

<URL:http://edcwww.cr.usgs.gov/eros-home.html>

README Files

README files can be downloaded from the data base directories for information concerning the US GeoData files. It is recommended that users download and read the README file for their desired data base before changing the transfer mode and downloading the quadrangle files.

File Formats

Data files retrieved using FTP may need to be translated from one format to another to make them usable with different application programs. The US GeoData files, for example, have been compressed with the GNU public domain "gzip" utility. Users without access to gzip may uncompress the file as it is retrieved by leaving off the ".gz" extension.

The gzip program is available for a variety of platforms via anonymous FTP at the following sites:

- prep.ai.mit.edu
- enterprise.nwi.fws.gov

Uncompressed files for these data are typically five times larger than compressed versions and, therefore, will take longer to transfer.

National Geospatial Data Clearinghouse

Metadata describing the data sets are available in electronic form through the USGS node of the National Geospatial Data Clearinghouse (NGDC). The Internet address for the USGS node is:

<URL:http://nsdi.usgs.gov/nsdi/>

The USGS continues to add data and metadata to this node in support of the National Spatial Data Infrastructure. See the NGDC fact sheet for a complete list of data sets.

Information

For specific information concerning the data bases, US GeoData users guides are available via anonymous FTP at the following Internet address:

nmdpow9.er.usgs.gov

Read the file "readme" in the public directory to find the directory location for the word processing or plain text versions of the appropriate US GeoData users guide. It is recommended that users download and read these files before transferring detailed information.

To purchase a hard copy of any users guide or for further information about Internet access to US GeoData files, call 1-800-USA-MAPS, Fax 703-648-5548, E-mail: esicmail@usgs.gov, or contact:

U.S. Geological Survey
EROS Data Center Customer Services
Sioux Falls, SD 57198
605-594-6151; Fax 605-594-6589
E-mail: custserv@edcserver1.cr.usgs.gov

SOME WESTERN REGION CENTER PHONE NUMBERS OF INTEREST

There's an earthquake geology and geophysics telephone for people who want to talk about topics relating to earthquakes: that number is (415) 329-4085.

If you are only interested in hearing about the magnitudes and the locations of recent local quakes, a daily California quake update recording is available at (415) 329-4025.

If you have a computer with a modem, you can dial up our Quick Epicenters Determination List by having your modem call 1 800 358-2663. You'll get info about quakes worldwide.

For information about California landslides and rainy season geologic hazards, please call (415) 329-5099 and for audio text of landslide warnings call (415) 329-5540.

For DLG, DRG, or orthophoto digital map sales call (415) 329-4309 and for general information about paper maps and books call (415) 329-4390.

Help with our Library can be had from (415) 329-5027. For Library aerial photos, photographs, and videotapes, call (415) 329-5009.

For operator's help to other USGS telephones, call (415) 853-8300. The private contractor operators are on duty Monday through Friday, 7:45 a.m. to 4:15 p.m. only.

SOME INTERNET GEOSCIENCE ADDRESSES FOR USGS AND OTHERS

Note: There were some address misspellings in previous lists, this new list corrects some errors.

http://xroads.wr.usgs.gov/url.html is an excellent jump off point for finding USGS on-line resources (and earth info from other sources such as NOAA and NASA).

http://xroads/calendar.html gets the new experimental on-line schedule of events.

http://www.usgs.gov/data/geologic/nelc/qed/index.shtml gets you directly to our worldwide Preliminary Determination of Epicenters List, a must see for quake followers.

http://quake.wr.usgs.gov/QUAKES/HOT/hot/html gets data and maps of big quakes.

http://quake.wr.usgs.gov/QUAKES/CURRENT/current.html gets current seismicity.

file://garlock.wr.usgs.gov/pub/CURRENT/current.html for California quake maps.

http://walrus.wr.usgs.gov gets Pacific Marine Geology and coastal program research.

http://copper.whoi.edu gets you to the Ridge Interdisciplinary Global Experiment.

http://vulcan.wr.usgs.gov gets our Cascade Volcano Observatory in Vancouver, WA.

http://www.soest.hawaii.edu/hvo/ gets our Hawaii Volcano Observatory.

http://nmnhgoph.si.edu/gvn.html gets the Smithsonian global volcanism network.

http://www.geo.mtu.edu/eos/ gets NASA's Earth Observing System.

http://www.ca/ gets the Geological Survey of Canada.

http://info.er.usgs.gov gets the USGS Headquarters page.

http://wings.buffalo.edu/geogw gets a geographic names catalogue and lat-long database.

http://www.usgs.gov/special/collections/crada/index.html gets CRADA info. to those interested in cooperative research and development agreements with USGS.

http://h2o.er.usgs.gov/public/wrd011.html gets Water Resources Division Offices.

http://www.oes.ca.gov:8001/html/cuicc/html gets you to the California Office of Emergency Services (operated by the state of California) and links to USGS on-line resources.

ask-a-geologist@octopus.wr.usgs.gov is an SMPT e-mail address where kids can ask general questions about geologic topics. Kids, be sure to include your computer's E-mail (SMTP) return address to get a brief electronic reply from the geologist of the day!

oppen@alum.wr.usgs.gov is Dave Oppenheimer's e-mail address, he has developed a computer program which can run on a home or school computer, that plots earthquakes. For more information, you can contact him or educational distributor Alan Jones at (607) 786-5866.

http://www2.infoseek.com/Titles?qt=Federal+Jobs will get you to a good jumpoff point for net searching for a new job. It will link you to many sources of infomation on employment.

United States Geological Survey
Earth Science Information Center
Menlo Park, California

Earth Science Information Available Through the World Wide Web

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URL Assistance & Launch Sites

Title	URL Address
USGS URL Directory	http://xroads.wr.usgs.gov/url.html
United States Geological Survey	http://www.usgs.gov/
USGS Data Available Online	http://www.usgs.gov/data/index.html
Related Information Provided by Other Organizations	http://www.geo.mtu.edu/eos/otherlinks.html
Yahoo	http://www.yahoo.com/
Hooked.Net launch point	http://www.hooked.net/
University at Buffalo Wings Home Page	http://wings.buffalo.edu/

Mapping Related Locations

Title	URL Address
USGS Mapping Information	http://www-nmd.usgs.gov/
USGS Mapping Information: Products, Information, and Services	http://www-nmd.usgs.gov/www/html/1product.html
USGS National Geospatial Data Clearinghouse	http://nsdi.usgs.gov/nsdi/
EROS Data Center	http://sun1.cr.usgs.gov/
Global Land Information System	http://edcwww.cr.usgs.gov/glis/glis.html
USBoC: TIGER Mapping Service	http://tiger.census.gov/
NASA - JSC Digital Image Collection	http://images.jsc.nasa.gov/html/home.htm
NASA Spacelink	http://spacelink.msfc.nasa.gov/
Space Telescope Electronic Information Service	http://www.stsci.edu/
Declassified Satellite Photography	http://edcwww.cr.usgs.gov/dclass/dclass.html
Bay Area Regional Database	http://bard/
DMA GEOnet Names Server	http://toponym.dma.gov/

...ology Related Locations

Title	URL Address
USGS Geologic Data	http://www.usgs.gov/data/geologic/index.html
National Earthquake Information Center Online Data	http://www.usgs.gov/data/geologic/neic/index.html
NEIC Quick Epicenter Determination Report	http://www.usgs.gov/data/geologic/neic/qed/index.shtml
USGS Earthquake Info at Menlo Park	http://quake.wr.usgs.gov/
Current Seismicity	file://garlock.wr.usgs.gov/pub/CURRENT/current.html
Pacific Marine Geology	http://walrus.wr.usgs.gov/
Cascades Volcano Observatory	http://vulcan.wr.usgs.gov/
Association of Bay Area Governments; Earthquake Hazard Maps	http://www.abag.ca.gov/bayarea/eqmaps/eqmaps.html

Water Related Locations

Title	URL Address
USGS Water Resources Information	http://h2o.usgs.gov/
National Water Conditions	http://nwcwww.er.usgs.gov:8080/
US F&WS: National Wetlands Inventory	http://www.nwi.fws.gov/

Other Related Locations

Title	URL Address
Natural Hazards	http://www.usgs.gov/research/environment/hazards/index.html
CERES: California Environmental Resources Evaluation System	http://resources.agency.ca.gov/
School of Ocean & Earth Science & Technology, Hawai'i	http://www.soest.hawaii.edu/
Montana Natural Resource Information System	http://nris.msl.mt.gov/
The Nine Planets	http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html

U.S. Department of the Interior
U.S. Geological Survey

Earth Science Information from the U.S. Geological Survey

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Since 1879, the U.S. Geological Survey (USGS) has served the public and Federal, State, and local governments by collecting, analyzing, and publishing information about the Nation's mineral, land, and water resources. This earth science information is available in a variety of books, maps, and other formats. Major information and sales offices are listed below.

Earth Science Information and Sales

Earth Science Information Centers (ESIC) offer nationwide information and sales service for USGS map products and earth science publications. These ESIC's provide information about geologic, hydrologic, topographic, and land use maps, books, and reports; aerial, satellite, and radar images and related products; earth science and map data in digital format and related applications software; and geodetic data. A separate address list is available for State ESIC's.

ESIC's can fill orders for custom products such as aerial photographs and orthophotoquads, digital cartographic data, and geographic names data.

ESIC's can also provide information about earth science materials from many public and private producers in the United States using automated catalog systems for information retrieval and research services.

For further information contact or visit any of the following ESIC's or call 1-800-USA-MAPS.

Anchorage-ESIC
4230 University Drive, Rm. 101
Anchorage, AK 99508-4664
907-786-7011; Fax 907-786-7050

Lakewood-ESIC
Box 25046, Building 25, Rm. 1813
Denver Federal Center, MS 504
Denver, CO 80225-0046
303-236-5829; Fax 303-236-8654

Lakewood Open Files-ESIC
Box 25286, Building 810
Denver Federal Center, MS 517
Denver, CO 80225
303-236-7476; Fax 303-236-4031

Menlo Park-ESIC
Building 3, Rm. 3128, MS 532
345 Middlefield Road
Menlo Park, CA 94025-3591
415-329-4309; Fax 415-329-5130
TDD 415-329-5092*

Reston-ESIC
507 National Center
Reston, VA 22092
703-648-6045; Fax 703-648-5548
TDD 703-648-4119*

Rolla-ESIC
1400 Independence Road, MS 231
Rolla, MO 65401-2602
314-341-0851; Fax 314-341-9375
TDD 314-341-2716*

Salt Lake City-ESIC
2222 West 2300 South, 2nd Floor
Salt Lake City, UT 84119
801-975-3742; Fax 801-975-3740
TDD 801-975-3744*

Sioux Falls-ESIC
EROS Data Center
Sioux Falls, SD 57198-0001
605-594-6151; Fax 605-594-6589
TDD 605-594-6933*

Spokane-ESIC
U.S. Post Office Building, Rm. 135
904 West Riverside Avenue
Spokane, WA 99201-1088
509-353-2524; Fax 509-353-2872
TDD 509-353-3235*

Stennis Space Center-ESIC
Building 3101
Stennis Space Center, MS 39529
601-688-3541; Fax 601-688-2230
TDD 601-688-3315*

Washington, D.C.-ESIC
U.S. Department of the Interior
1849 C Street, NW., Rm. 2650
Washington, DC 20240
202-208-4047; Fax 202-208-6297
TDD 202-219-1510*

Geologic Information

Questions about geology can be directed to the Geologic Inquiries Group. This office answers questions on topics such as earthquakes, energy and mineral resources, the geology of specific areas, and geologic maps and mapping. Information on geologic map indexes for the States is also available.

Geologic Inquiries Group
U.S. Geological Survey
907 National Center
Reston, VA 22092
703-648-4383; Fax 703-648-6684

Minerals Information

The USGS operates five Minerals Information Offices (MIO) to answer questions about mineral resources and mining. These offices are staffed by USGS geologists and mineral specialists to provide publications and data base

* TDD - Telecommunications Device for the Deaf

searches on mineral topics. The MIO in Washington, D.C., is staffed by USGS and U.S. Bureau of Mines personnel.

Minerals Information Office
U.S. Department of the Interior
1849 C Street, NW.
MS 2647-MIB
Washington, DC 20240
202-208-5512/5520; Fax 202-208-6572

Minerals Information Office
Mackay School of Mines
University of Nevada-Reno
Reno, NV 89557-0047
702-784-5552; Fax 702-784-5079

Minerals Information Office
U.S. Post Office Building, Rm. 133
904 West Riverside Avenue
Spokane, WA 99201-1087
509-353-2649; Fax 509-353-0505

Minerals Information Office
340 North Sixth Avenue
Tucson, AZ 85705-8325
520-670-5544/5508; Fax 520-670-5113

Minerals Information Office
Denver Federal Center, MS 936
Box 25046, Building 20, Rm. B1324
Denver, CO 80225
303-236-5704; Fax 303-236-3200

Water Resources Information

The National Water Information Clearinghouse (NWIC) disseminates water resources information to government agencies, academia, the private sector, and the general public. NWIC has established a nationwide toll-free number to provide easy access for users. Water resources information requests, including those related to data, literature, abstracts, and publications, should be directed to the NWIC.

National Water Information Clearinghouse
U.S. Geological Survey
423 National Center
Reston, VA 22092
1-800-H2O-9000 (1-800-426-9000)

The Office of Water Data Coordination (OWDC) publishes and distributes publications, developed by Federal and

non-Federal organizations that cover a range of water resources information and activities. Also, the "National Handbook of Recommended Methods for Water Data Acquisition" and other publications are available from the OWDC.

Office of Water Data Coordination
U.S. Geological Survey
417 National Center
Reston, VA 22092
703-648-5023

The National Water Data Exchange (NAWDEX) maintains a computer data system that identifies sources of water data. The NAWDEX Program Office assists data users in locating sources of water data, identifying sites at which data have been collected, and obtaining specific data.

National Water Data Exchange
U.S. Geological Survey
421 National Center
Reston, VA 22092
703-648-6848; Fax 703-648-5704

Map Sales

To obtain free map indexes and catalogs, and to order topographic maps or any of the wide variety of thematic maps available from the USGS, contact:

USGS Information Services
Box 25286
Denver, CO 80225
303-236-7477; Fax 303-236-1972

Maps of Alaska can also be ordered from the ESIC in Fairbanks, Alaska.

Book Sales

To order USGS book publications such as the catalogs titled "Publications of the U.S. Geological Survey," which contain listings of USGS publications since 1879, as well as all other USGS professional papers, circulars, bulletins, and other reports, contact:

USGS Information Services
Box 25286
Denver, CO 80225
303-236-7477; Fax 303-236-1972

To order open-file reports, contact:

USGS ESIC-Open-File Report Sales
Box 25286, Building 810
Denver Federal Center, MS 517
Denver, CO 80225
303-236-7476; Fax 303-236-4031

To get on the mailing list for the free monthly catalog, "New Publications of the U.S. Geological Survey," send your name and address to:

USGS New Publications
582 National Center
Reston, VA 22092

For an annual subscription to the bimonthly bulletin, "Earthquakes and Volcanoes," contact:

Superintendent of Documents
Government Printing Office
Washington, DC 20402

Subscription costs are $6.50 (U.S. address) and $8.15 (foreign address). Single copies are available for $2.00 (domestic address) and $2.50 (foreign address) from:

USGS Information Services
Box 25286
Denver, CO 80225

U.S. Department of the Interior
U.S. Geological Survey
Earth Science
Information Center (ESIC)

Factsheet

How to Obtain Aerial Photographs

The U.S. Geological Survey's (USGS) Earth Science Information Center (ESIC) maintains an informational data base of aerial photographic coverage of the United States and its territories.

This information describes photographic projects from the USGS, other Federal, State, and local government agencies, and commercial firms.

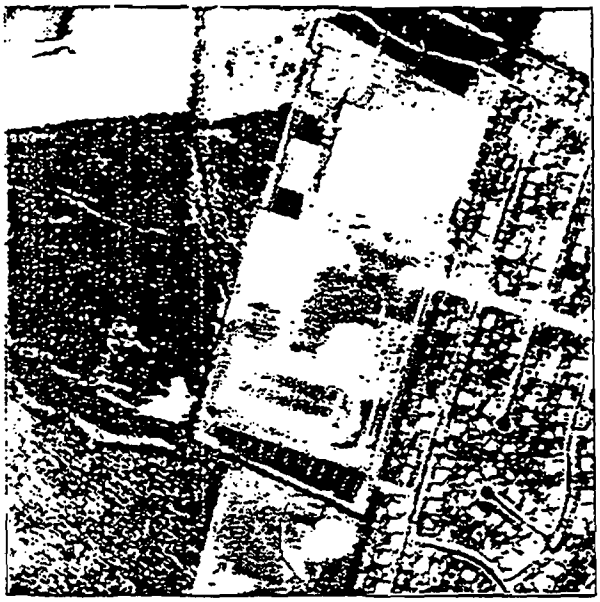
On receipt of the ***completed checklist*** on the reverse side of this form ***and your marked map***, ESIC representatives will assist you in locating and ordering photographs.

The following scenes show the results obtained by enlarging a section of an original 9- by 9-inch photograph two and four times. Compare the size of the football field, track, school building, and roads at the different scales.

NAPP B Roll 8 Frame 3

In this portion of the original photograph, at a scale of 1:40,000, 1 inch on the photograph represents 3,333 feet on the ground.

In this 2X enlargement of the same photograph, at a scale of 1:20,000, 1 inch on the photograph represents 1,666 feet on the ground.



In this 4X enlargement of the same photograph, at a scale of 1:10,000, 1 inch on the photograph represents 833 feet on the ground.

Checklist for Aerial Photographs

1. If you know the project, roll, and frame number of the photographs you want, contact your nearest ESIC for ordering assistance.

2. If you do not know the precise aerial photograph you need, complete this form and return it with your ***marked map*** to any ESIC. A researcher will provide information about available photographs that match your requirements. Please include your daytime telephone number. If you have questions, call 1-800-USA-MAPS.

Name (first, middle initial, last) Date

Company or agency Phone number (daytime)

Address FAX number

City, State, and ZIP code

Specific Area to be Shown (enclose a *detailed marked map*)

State: _____ County: _____ Town: _____

USGS quadrangle map name (if known): _____

Township, range, and section (if known): _____

Latitude and longitude: (if known): _____° _____' _____" N. _____° _____' _____" W.

Specific feature (crossroads, neighborhood, or farm) you want to see: _____

Please describe your intended use (to assist the researcher):

_____

_____

_____

Film Type

- ☐ Black and white
- ☐ Color infrared
- ☐ Color (limited availability)
- ☐ No preference

Most aerial photographs on record were taken with black-and-white film. Recent color-infrared photographs are available for the entire country. Some natural-color photographs are also available.

For detailed information about color-infrared film, refer to the publication "Understanding Color-Infrared Photographs and False Color Composites," available free from any ESIC.

Date of Photograph

- ☐ Most recent
- ☐ Oldest

Specific year or range of years: _____

Season of year, if you have a preference: _____

Stereoscopic Coverage

- ☐ Yes
- ☐ No

A three-dimensional view of the terrain can be obtained by overlapping and viewing a consecutive pair of photographs through a stereoscope.

Comments:

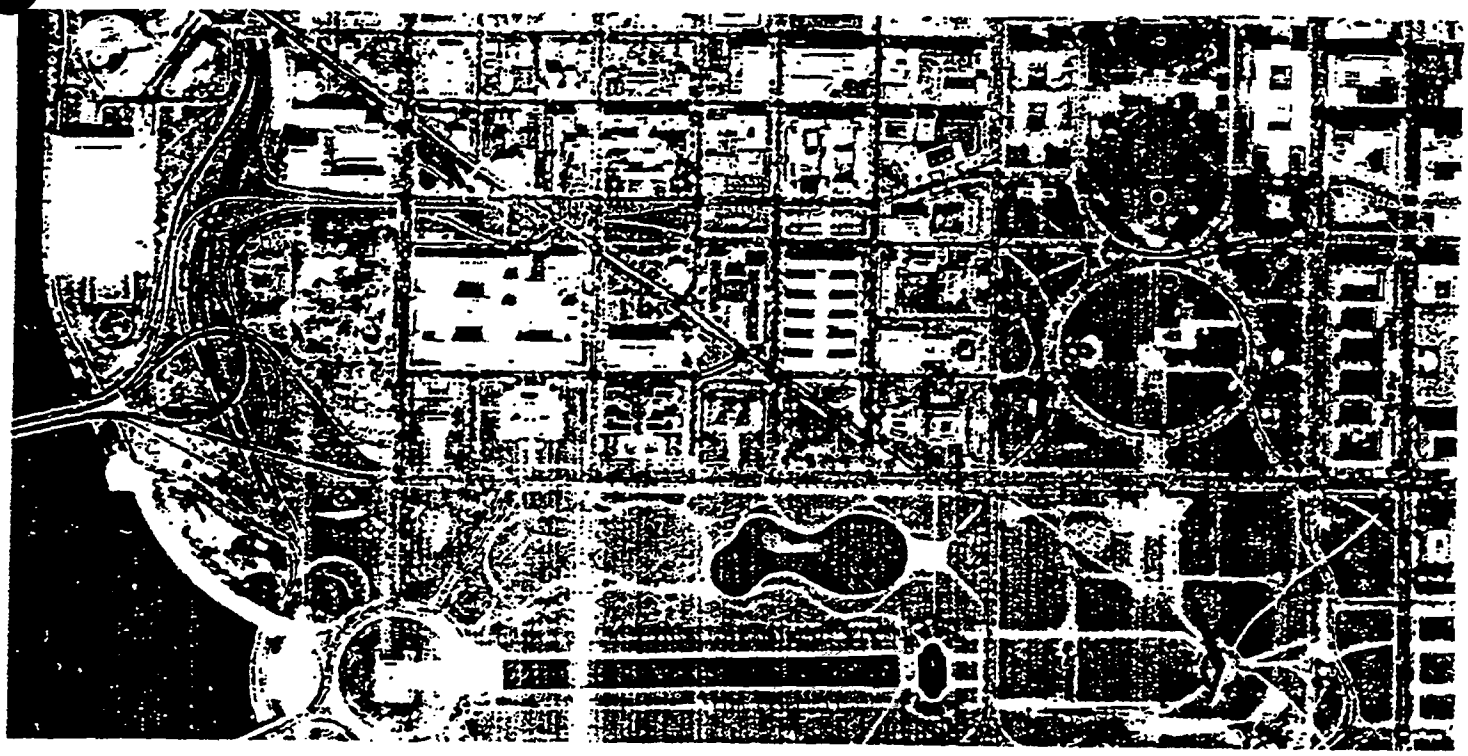
_____

_____

U.S. Department of the Interior
U.S. Geological Survey

Fact Sheet

Digital Orthophotos



Partial image of a digital orthophoto of Washington, D.C.

A digital orthophoto is a digital image of an aerial photograph in which displacements caused by the camera and the terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map.

Producing a Digital Orthophoto

The following items are required to produce a digital orthophoto:

(1) ground control points that can be identified from photographs,

(2) camera calibration and orientation parameters,

(3) a digital elevation model (DEM), and

(4) a digital image produced by scanning an aerial photograph with a precise, high-resolution scanner.

The digital image is rectified to an orthographic projection by processing each image pixel (picture element) through photogrammetric equations derived from items 1 through 3, on a high-speed image processing system. The finished product is a spatially accurate image with planimetric features represented in their true geographic positions.

Both a digital orthophoto and a conventional orthophoto are produced using the principles of differential rectification. When a conventional orthophoto is produced, the image is scanned in small strips or patches, with rectification occurring at the center of the strip or patch. In a digital orthophoto, each pixel is corrected for relief displacement and camera orientation, which results in a more accurate image. Unlike conventional orthophotos, a digital orthophoto can be manipulated in any geographic information system (GIS) that accepts raster images. Also, when a digital orthophoto is used as a foundation, other layers of data can be overlaid and manipulated in the GIS. This capability allows users of GIS data unlimited flexibility.

Characteristics of a Standard Digital Orthophoto

The standard digital orthophoto produced by the U.S. Geological Survey (USGS) is a black-and-white, color, or color-infrared, 1-meter ground resolution quarter-quadrangle image covering 3.75 minutes of latitude by 3.75 minutes of longitude, at a scale of 1:12,000. This image is called a digital orthophoto quadrangle (DOQ). DOQ's are cast on the Universal Tranverse Mercator projection based on the North American Datum of 1983. They also have between 50 and 300 meters of overedge image beyond the primary and secondary datum corner tick extremes to facilitate tonal matching for mosaicking of adjacent images.

Partial image of a digital orthophoto of Black Earth, Wisconsin.

Through image mosaicking, two or more rectified images can be combined and joined into one. For instance, a 7.5-minute DOQ can be produced by mosaicking four 3.75-minute DOQ's.

The standard black-and-white digital orthophoto is formatted as four 7-bit ASCII header records, followed by a series of 8-bit binary image data records. The radiometric image brightness values are stored as 256 gray levels. The file size of a digital orthophoto can be up to 55 megabytes.

The header record provided in the digital orthophoto contains a wide range of descriptive information about the image data, including photographic source type, date, instrumentation used to create the digital orthophoto, and the DEM used in the rectification process. Primary and secondary datum transformation constants included in the header record allow users to spatially reference other digital data with the digital orthophoto.

Accuracy Requirements

The accuracy and quality of USGS digital orthophotos must meet National Map Accuracy Standards at 1:12,000 scale for 3.75-minute quadrangles and at 1:24,000 scale for 7.5-minute quadrangles. Accuracy and quality are dependent on the following:

- Aerial photographs that meet National Aerial Photography Program standards—quarter-quadrangle centered (3.75 by 3.75 minutes in extent), exposed at a flying height of 20,000 feet above ground, and with a 6-inch focal-length camera.

- A DEM with the same area coverage as the digital orthophoto that is equal to or better than a level-1 DEM with a root-mean-square error no greater than 7 meters;

- A highly accurate image scanning process that employs a scanning resolution between 7.5 and 32 microns (a 9- by 9-inch image scanned at 25 microns produces a pixel ground resolution of 1 meter); and

- A photoidentifiable image and coordinates of ground control positions acquired from ground surveys or aerotriangulation.

Uses for Digital Orthophotos

A digital orthophoto can be used for a variety of applications. As a layer in a GIS, it can be used for revising digital vector files and topographic and planimetric maps. Other applications include vegetation and timber management, routing and habitat analysis, environmental impact assessments, emergency evacuation planning, flood analysis, soil erosion assessment, facility management, and groundwater and watershed analysis.

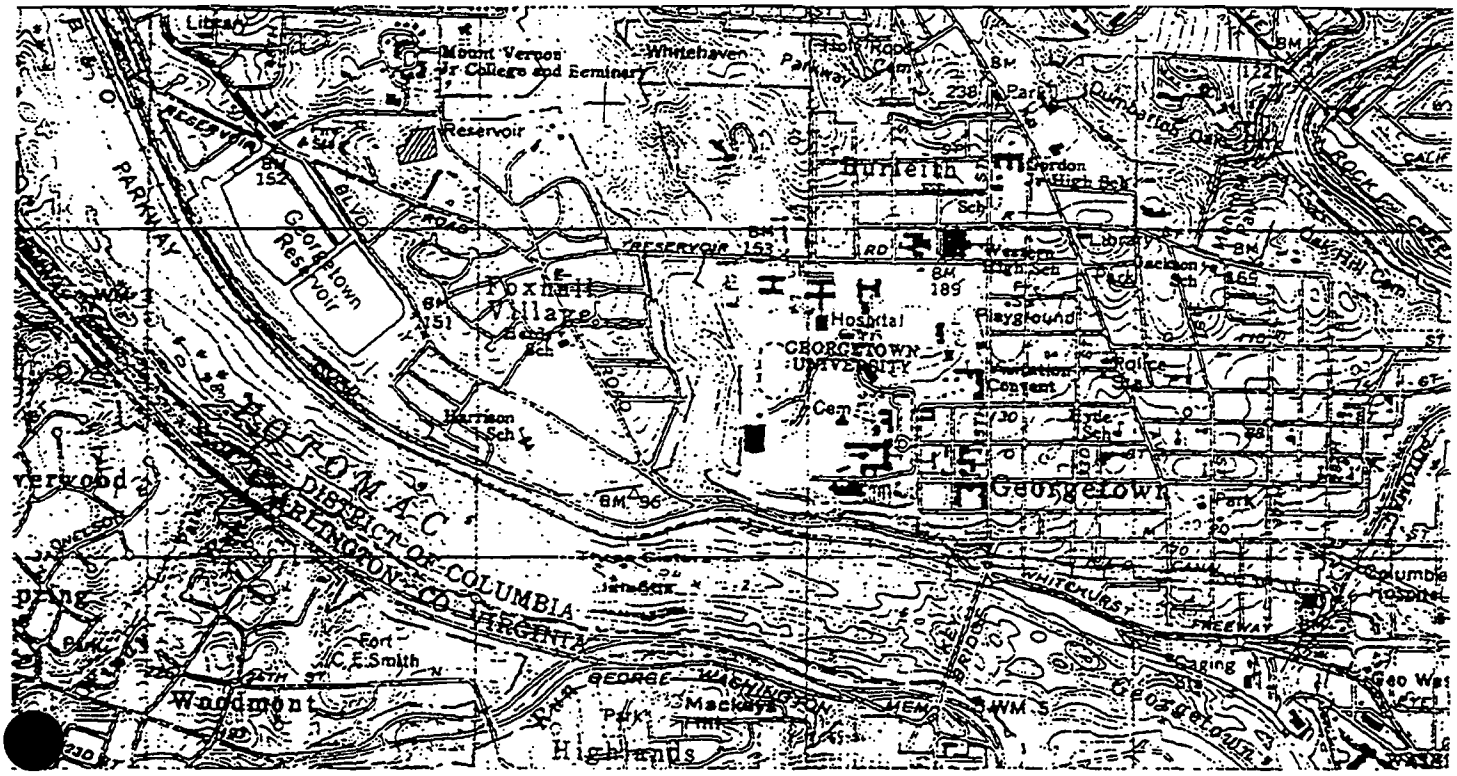
Information

For more information on digital orthophotos, contact any Earth Science Information Center or call 1-800-USA-MAPS.

U.S. Department of the Interior
U.S. Geological Survey

Digital Raster Graphics

U S
G S



A portion of the Washington West, D.C., digital raster graphic from the CD-ROM, titled "Capital Cities of the United States"

A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey (USGS) topographic map. The scanned image includes all map collar information. The image inside the map neatline is georeferenced to the surface of the Earth. The DRG can be used to collect, review, and revise other digital data, especially digital line graphs (DLG). When the DRG is combined with other digital products, such as digital orthophoto quadrangles (DOQ) or digital elevation models (DEM), the resulting image provides additional visual information for the extraction and revision of base cartographic information. The USGS plans to produce DRG's of the 1:24,000-, 1:24,000/1:25,000-, 1:63,360 (Alaska), and 1:100,000-scale topographic map series beginning with the 1:24,000-scale 7.5-minute quadrangles.

USGS production of DRG's will start in mid-1995. Production will be through contracts with the private sector. The ordered rate of production will be determined by user requirements and by partnerships with Federal and State agencies. Full coverage of the 1:24,000-scale map series is expected to be completed in 2 years.

The specifications in this fact sheet are not final; comments from the user community are invited.

Producing a DRG

Four items are needed to produce a DRG of a 7.5-minute topographic map:

(1) a USGS topographic map,

(2) the Universal Transverse Mercator (UTM) coordinates of the sixteen 2.5-minute grid ticks for georeferencing and rectification,

(3) a digital image produced by scanning a USGS map on a high-resolution scanner, and

(4) software to correct distortion and reference the scanned raster image to ground coordinates.

At the USGS, the first step in the process is to scan a paper 7.5-minute topographic map. Scanning a standard USGS quadrangle at a resolution of 500 dots per inch (dpi) results in a red-green-blue (RGB) file of up to 300 megabytes. The RGB file is converted to tagged image file format (TIFF), viewed, and the position of each of the sixteen 2.5-minute grid ticks on the image is collected. Software uses these coordinates to rectify and georeference the image to the UTM ground coordinates. A piecewise linear transformation completes the georeferencing.

The image is resampled to 250 dpi and compressed using lossless compression to reduce the size of the data set. The final result is a packbit-compressed TIFF file. The file size averages between 5 to 15 megabytes.

Draft Specifications

The standard USGS 7.5-minute DRG has the following specifications:

- The source material for a DRG is a paper USGS topographic map.

- The map is scanned at a minimum resolution of 250 dpi.

- The digital image is georeferenced to the true ground coordinates of the 2.5-minute grid ticks and projected to the UTM for projection consistency with USGS DOQ's and DLG's. The datum of the source materials is preserved in the DRG.

- If scanned at a finer resolution, the image is resampled to 250 dpi. The image is converted to an 8-bit color image in a packbit-compressed TIFF file.

- Color values are standard between DRG quadrangles. The USGS employs up to 12 colors on each DRG. Color values are contained in each TIFF file.

- The digital image is accompanied by a metadata file that complies with the Federal Geographic Data Committee approved Content Standards for Digital Geospatial Metadata (June 8, 1994).

- The DRG's will be available initially on CD-ROM's in blocks of sixty-four 1:24,000-scale files indexed by 1-degree by 1-degree cells.

Attribute and Positional Accuracy Requirements

The DRG uses a standard palette to ensure uniform color throughout a particular map series. The RGB values for a particular color, therefore, will remain consistent throughout that DRG series. Although the color values of the DRG may sometimes match those of the paper source map, a user will usually notice small differences between the colors on the digital image and on the paper map. Also, the quality of the user's monitor affects the DRG color displayed. Although the DRG generally contains the complete content of the source map, features may occasionally be blurred because of substandard source materials. The DRG also may contain small numbers of misclassified pixels (color noise).

The horizontal positional accuracy of the DRG matches the accuracy of the published source map; therefore, the 7.5-minute DRG complies with National Map Accuracy Standards for the 7.5-minute topographic map. To be consistent with other USGS digital data, the image is cast on the UTM projection and will therefore not always be consistent with the credit note on the image collar. Only the area inside the map neatline is georeferenced, so minor distortion of the text may occur in the map collar.

The distributed 1:24,000-scale DRG at 250 dpi will have a ground sample distance of 2.4 meters.

Uses of a DRG

The DRG is useful as a backdrop onto which other digital data can be overlaid. At the USGS, the DRG has shown potential for validating DLG's and for DLG data collection and revision. The DRG can help assess the completeness of digital data from other mapping agencies. It can also be used to produce "hybrid" products. These include combined DRG's and DOQ's for revising and collecting digital data, DRG's and DEM's for creating shaded-relief DRG's, and combinations of DRG, DOQ, and DLG data. Although a standard DRG has proven to be an effective mapping tool, its full potential for digital production will be realized in combination with other digital data.

Information

For information about Federal and non-Federal partnerships for cost-share, work-share and data exchange, contact:

U.S. Geological Survey
Office of Coordination and Requirements
590 National Center
Reston, VA 22092
703-648-5741; Fax 703-648-5755

To ask questions, submit comments, or inquire about the availability of sample data sets, contact:

Rolla-ESIC
U.S. Geological Survey
1400 Independence Rd., MS 231
Rolla, MO 65401-2602
314-341-0851; Fax 314-341-9375
E-mail: esic@mcdgs01.cr.usgs.gov

Additional information and sample images can be obtained through MOSAIC on the World Wide Web at:
<URL:http://mcmcweb.cr.usgs.gov/>

U.S. Department of the Interior
U.S. Geological Survey

Digital Orthophoto Quadrangles on CD-ROM

Product Announcement

Background

A digital orthophoto is a digital image of an aerial photograph in which displacements caused by the camera angle and the terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map.

The National Mapping Division standard digital orthophoto quadrangle (DOQ) is a black-and-white, color, or color-infrared, 1-meter ground resolution, 3.75- x 3.75-minute quadrangle that meets National Aerial Photography Program standards. The radiometric image brightness values are stored as 256 gray levels. The DOQ's are cast on the Universal Transverse Mercator projection based on the North American Datum of 1983 (primary). They also have between 50 and 300 meters of overedge image to accommodate the corner ticks of both the primary and a secondary datum, such as the North American Datum of 1927, and to facilitate tonal matching and mosaicking of adjacent images.

Areas of coverage

DOQ's of some areas of the United States are available on CD-ROM, in county format.

Contents

Each CD-ROM usually covers one county. The images are compressed using the Joint Photographic Experts Group (JPEG) compression algorithm, with some loss of texture. This software allows up to 120 DOQ's to be placed on a single disc, although most counties are covered in far fewer files. Each disc includes compression and decompression software for DG-UNIX and MS-DOS users and C-language makefiles that can be configured and compiled for use on other computers.

Each DOQ in the CD-ROM consists of an 8-bit binary image file and a separate metadata file. The metadata files contain descriptive information including file identification, data sources and dates, data storage, coordinate systems and datums, and information relating to image compression.

Price

$32 each disc.

Hardware

Requires an 80386 IBM-compatible microcomputer with 640 kilobytes of memory, with MS-DOS version 3.1 or greater; a CD-ROM reader using Microsoft Extensions, version 2.0 or greater; and approximately 55 megabytes of hard disk space for each DOQ to be retrieved in full reconstituted format.

Information

For more information on ordering DOQ's on CD-ROM, contact any Earth Science Information Center or call 1-800-USA-MAPS.

Geographic Names Information System on CD-ROM

Background

The Geographic Names Information System (GNIS), the Nation's official automated names repository, is now available on compact disc read-only memory (CD-ROM). The GNIS contains information for known places, features, and areas of the United States identified by proper names. The GNIS is the official toponymic reference for the Federal Government and was designed by the U.S. Geological Survey (USGS) in cooperation with the U.S. Board on Geographic Names.

Contents

The CD-ROM contains three GNIS data bases:

1. The National Geographic Names Data Base (NGNDB) contains almost 2 million entries for areas in and under the jurisdiction of the United States.

2. The Topographic Map Names Data Base (TMNDB) is an inventory of all USGS-published topographic maps at various scales.

3. The Reference Data Base (RDB) is a collection of annotated bibliographies of all sources used in compiling information for the NGNDB.

Each record in the NGNDB and TMNDB can contain a variety of location and description fields. All can be displayed, and some can be searched. Not all fields, however, contain data. The RDB contains one field—bibliography.

The following fields in the NGNDB can be searched: State, feature name, feature type, county name, topographic map name, variant name, forest name, geographic coordinates, source coordinates, elevation, and bibliographic reference code. The fields that can be displayed only are: State/county Federal Information Processing Standards (FIPS) code, history, description, status, decision list, and record entry date.

The following fields in the TMNDB can be searched: State, topographic map name, reference coordinate, map scale, map reference code, county name, 7.5-by 15-minute map name, and history. There is one field that is for display only—percent of map in county. The data contained in this field, however, has not been verified and should be used for reference only.

The CD-ROM contains software for searching, sorting, displaying, printing, and exporting the data. The software must be installed onto a hard disk before the data can be used. The CD-ROM is accompanied by a users manual entitled the GNIS Digital Gazetteer.

Price

$57 each.

Hardware

Requires an IBM PC-XT-AT or compatible microcomputer with 512 kilobytes of memory, with DOS operating system version 3.0 or greater; one 20 megabyte hard disk drive; and a CD-ROM reader with software drivers that read ISO-9660 formatted CD-ROM's.

Information

For more information about GNIS, contact the USGS Branch of Geographic Names, Data Base Administrator, 523 National Center, Reston, VA 22092, or call 703-648-4544.

For information on ordering the CD-ROM, contact any Earth Science Information Center or call 1-800-USA-MAPS.

STREAM MEASUREMENT AND SURVEY

Tony Stein and Kim K. Jones

Introduction

Overview: How this fits into other curriculum topics

The goal of ecosystem management is to maintain and restore ecosystems, their species, and productive capacities taken in present and future social context. To achieve this goal there is a need to determine present aquatic habitat conditions and fish populations within watersheds. Natural resource agencies and private landowners cannot manage fish populations without protecting the larger ecosystems of which they are a part. It's important to protect these ecosystems and their diverse components and complicated processes.

Spawning fish surveys are done regularly on many streams by the Oregon Department of Fish and Wildlife (ODFW), other natural resource agency biologists, and private landowners. It requires working outdoors in rainy and cold weather conditions. The terrain encountered may be isolated and steep, and requires walking on slippery rocks. The information collected is vital to assess the escapement of salmon and steelhead runs. It is an index to the status of those populations and helps predict future runs. It also offers insight to whether a stream is being adequately seeded by spawners in a given year. Selected typical sections of streams are surveyed throughout the spawning season to cover the peak run of returning adults. Adult salmon and steelhead are counted and fish-per-mile is calculated.

Land managers may also use spawning survey data to determine where stable or depressed runs are located within watersheds. The focus for restoration efforts may be around the vicinity of a stable population that will provide a source of fish for adjacent streams where runs are low and quality habitat is limited.

Planning and coordination are essential in designing and implementing a spawning survey for any natural resource agency or private landowner. In the state of Oregon, the standard protocol is the method used by the ODFW. Other natural resource agencies or private landowners may use similar methods in evaluating populations. Whatever method is used, the key contacts would be local natural resource agency fish biologists, industrial forest or private landowner, or ODFW District Fish Biologist in the area you are planning on working in. These individuals can provide information on existing surveys (called standard surveys) and other types of surveys that are called random or supplemental surveys. They can also provide information on priorities for species and locations for spawning surveys. The main concern is to avoid duplication of effort and confusion with private landowners who provide access.

As with *Aquatic Habitat Surveys,* landowner contact and permission is mandatory.

Competency measures

- Understand why collecting data on salmon spawning populations is important.
- Ability to communicate with appropriate natural resource agency(s) and private landowners in planning and implementation of a spawning survey.
- Know how to identify different species of salmon.
- Able to conduct a spawning survey and record data.
- Uses of habitat data
  List three uses of the habitat survey data
- Survey protocol
  Describe "Hankin-Reeves" approach
  Describe the three basic survey components
- Describe some of the landforms that may be adjacent to a stream
- How can the riparian zone be characterized
- Habitat characteristics
  List six instream habitat characteristics
  Why are they important to measure
  How are they measured

Salmon species monitored

Chinook *(Oncorhynchus tshawytscha)*

Chinook salmon are supported by all but the smallest Oregon coastal river basins. As a species, Oregon's Chinook salmon include many distinct populations. These populations exhibit a striking range of life history diversity, including variation in the date, size, and age at which juveniles enter the ocean, oceanic migration pattern, season of return to fresh water, length of upriver migration, date of spawning, average age at maturity, and age-specific size. During surveys, Chinook are easily recognizable by their main stem river spawning sites, large size, and early fall spawning period.

Coho *(Oncorynchus kisutch)*

Coho salmon have been considered the most important commercially-caught salmonid in Oregon. Until recently, they were usually the most common salmonid in most coastal streams. Compared to other anadromous salmonids in Oregon, Coho salmon have a very simple life history, with populations primarily on a three-year cycle. During surveys, mature males are easily recognizable by their bright red coloration.

Chum *(Oncorynchus keta)*

Chum salmon were formerly abundant in most mid and north coastal rivers in Oregon and lower Columbia River tributaries. These populations have undergone significant declines over the last 35 years, resulting in several local populations being on the verge of extinction. Chum salmon have been added to the Oregon Sensitive Species

List, which serves as an early-warning system to alert land managers and the public that the species may qualify for threatened or endangered status in the future. Chum salmon in Oregon rivers exhibit a strikingly uniform life history and dependence on similar types of habitat in freshwater and estuarine environments. During surveys, Chum are easily recognizable by purple tiger striping on males and location of spawning in areas just above tidewater sloughs.

Steelhead *(Oncorynchus mykiss)*

Historically, steelhead were abundant in Oregon's coastal rivers and the Columbia Basin. Steelhead currently support popular sport fisheries and contribute millions of dollars annually to Oregon's economy through various businesses that serve recreational anglers. For many people, steelhead and steelhead fisheries were and continue to be an important part of the tradition of living in the Pacific Northwest. Just as importantly, the future health of our environment is essential to the persistence of wild populations of steelhead.

Salmon anatomy

Spawning surveyors need to be able to identify each species of salmon while performing a spawning survey. The time of year and the location within a watershed where the survey takes place will help in identification.

Mapping

Determining sections of a selected stream that will be surveyed should be done in consultation with natural resource biologists or the landowner requesting a survey. Read the mapping section in Aquatic Habitat Surveys.

Gear and equipment

Clothes, rain gear

Most spawning surveys are done during the fall and winter months and in inclement weather. Proper outdoor gear is necessary and should be 100% waterproof. The standard is lightweight neoprene chest waders and felt-soled wading boots. A waterproof jacket with attached hood is worn over the chest waders. Layering of clothes underneath is recommended, and the type and amount is up to the individual. A small waist pack or backpack is sometimes worn to hold water, compass, safety equipment, lunch, etc., depending on the location and length of the survey.

Spawning surveys are also conducted by snorkel swims down a selected stream. A neoprene diving suit or drysuit with mask and snorkel is used to count adult spawners.

Survey and sampling equipment

Polarized glasses cut the reflection of light on the surface of the water. Surveyors are able to view fish underwater much better than with the naked eye.

Knife with sheath: when a fish is missing the adipose fin, its snout may contain a coded wire tag (CWT). The knife is used to cut off the snout.

Wading staff with gaff (optional) is used to collect dead fish from the bottom of deep pools in the stream.

Hand-held tally counter (optional) is useful when counting large numbers of fish.

Orange field vest (optional): a safety measure, especially used during hunting season.

Scale envelopes: when a fish is sampled, the scales are placed here.

Measuring tape (in millimeters): when a fish is sampled, its length is measured.

Forceps for scale collection, snout bags, and ID numbers: scales are pulled off the fish with this device. An ID tag number is placed in a plastic bag with the fish snout.

Spawning survey field form: This is the small waterproof form that is used in the field to record what watershed you are in, what sub-basin within a watershed, name of the stream, date, weather, water flow level, and how clear the water is. The number of dead and live fish of each species observed and the number of egg nests or redds observed is counted and recorded on this form.

Pre-Planning

Stream sections

Before a stream is surveyed, a great deal of planning and coordination will have already taken place. The stream or streams to be surveyed will have been identified, and selected reaches or sections to walk will have been identified. The landowners will already have been contacted and access permitted. Signs or flagging of the exact location to start and end the survey will have been placed in easily observed spots.

Basic instructions

a) Foot surveys are always conducted from the start point upstream.
b) Walk all stream channels.
c) Examine all fish carcasses for fin clips and tags, and remove snouts from all adipose-clipped fish.
d) Leave dead fish where found.
e) Count only carcasses with intact skeleton (skull through caudal penduncle), although fish tails may be severed if scale sample was previously taken.
f) Use polarized sunglasses during survey. Amber tinted glass lenses are best.
g) Wait until the end of the survey to classify flow and visibility for each survey.
h) Count all species of salmon and steelhead seen in each survey area.
i) If live fish of the target species are observed during any visit to a survey area, note whether most are: 1) in holding pools, 2) migrating through survey area, 3) actively spawning, or 4) spawned out.
j) Intervals between successive counts cannot exceed 15 days from the date whenthe first visit is made. Try not to exceed intervals of more than 10 days.

k) Surveys cannot be made when visibility is poor due to high flows or turbid water.

l) Record data collected from the *spawning fish survey field* form to the *spawning fish survey* form.

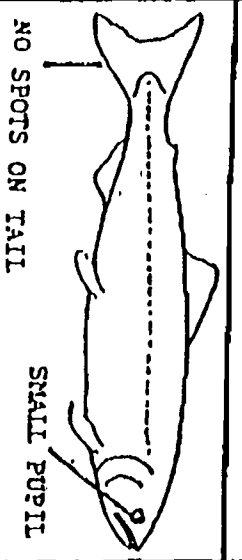
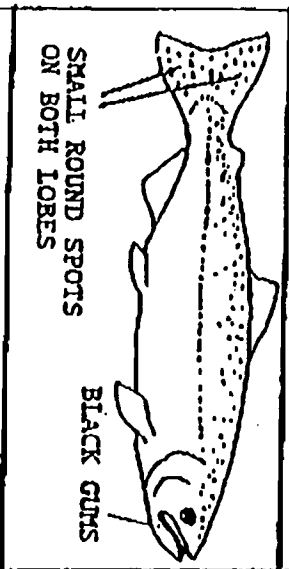
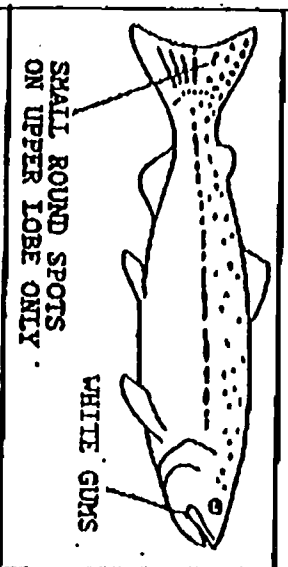
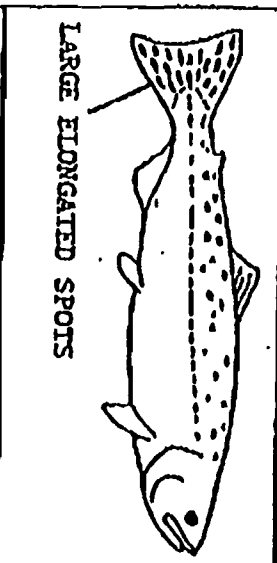
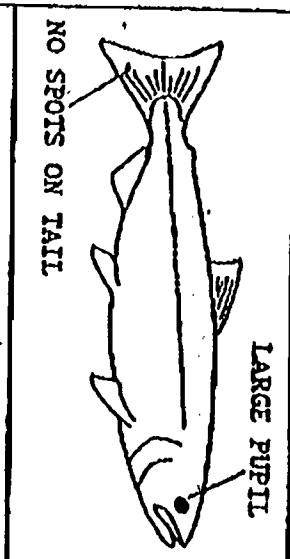
m) The use of a weather radio can be a helpful tool in determining stream levels and incoming storm conditions. NOAA provides daily updates on river conditions in all major coastal rivers that can be used as a guide for understanding expected flows in smaller tributary streams. Local knowledge is also very valuable.

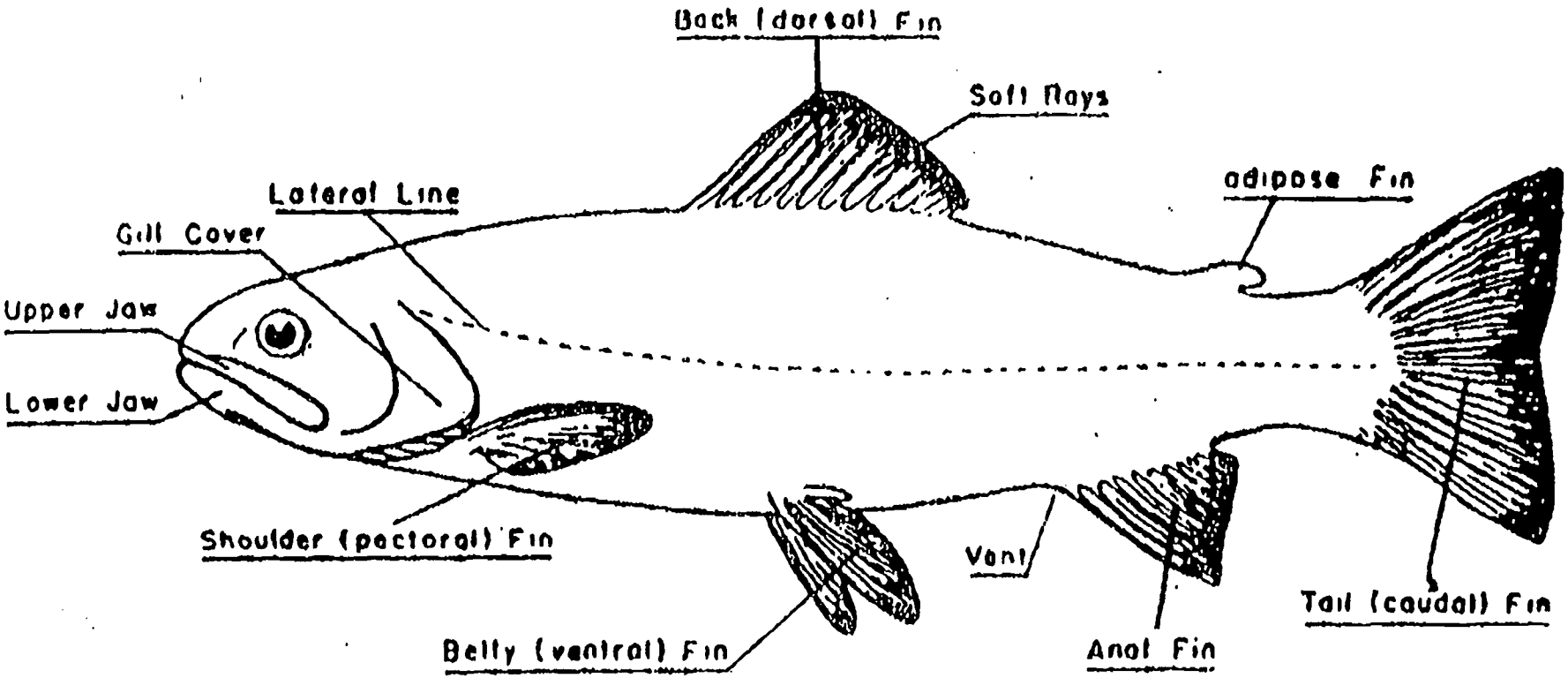
n) *Sampling fish carcasses.* Sometimes surveyors are requested to collect data on sex, weight and length, as well as scale samples. The scales from salmon grow and increase in size as the fish grows, while the number of scales remains the same. Under a microscope, a single scale can reveal the age, growth rate of a fish, age distribution of a population, and size-to-age comparison.

o) *Data summarization.* The field data are summarized using the *spawning salmon survey* form to record counts of spawning salmon and other stream parameters. Codes are used to summarize the data for weather, stream flow, water visibility, temperature, and other additional comments.

p) *Coded wire and fin-mark recoveries.* Recoveries of CWT's in fish snouts and missing fin marks from salmon observed on spawning fish surveys are used to assess straying of hatchery salmon to natural spawning areas. CWT's are very small pieces of wire (each with its own unique mark) that are inserted into the fleshy part of the snout of young salmon just prior to release from a hatchery. These tags are the primary means of identifying unique groups of salmon released from hatcheries. CWT's are recognized by the absence of their adipose fin that is cut off during the time of tagging.

SALMON CHART

					What it looks like when it is an adult.
Sockeye (red)	King (chinook)	Silver (coho)	Pink (humpback)	Chum (dog)	Name of Salmon
Summer	Fall	Fall	Summer	Fall	When does it spawn?
*blue tinged silver color *speckles on sides *turns bright red when spawning	*blue-green back *spots on both sides of tail and back	*bright silver *spots on top of body and top of tail fin *teeth are needle sharp	*heavily spotted back *hump behind the head	*fine dark speckles on back *no spots *dark side markings *large teeth at spawning	What does it look like
5 to 7 lbs.	10 to 50 lbs.	6 to 16 lbs.	3 to 5 lbs.	0 to 10 lbs.	How much does it weigh?
dark red	orangish-pink	dark pink	light pink to white	pink	What color of "flesh" to look for at the grocery store
3 to 7 years	5 to 7 years	2 to 4 years	2 years	3 to 5 years	How long it lives



FIN NOMENCLATURE OF SALMON

OREGON
Fish & Wildlife

SPAWNING SURVEY LOCATION DESCRIPTION FORM

DATE _____ SURVEYOR ID _____

BASIN _____ | |

SUBBASIN _____ |

SURVEY _____ | | | | | | | | |

DISTRICT _____ | |

MAP COORDINATES: (at downstream end of survey segment)

TOWNSHIP T | | | RANGE R | | | SECTION | |

DESCRIPTION: (PRINT LEGIBLY. USE COMPLETE SENTENCES, AND OBSERVE STANDARD RULES OF GRAMMAR. INCLUDE AS MUCH DETAIL AS NECESSARY SO THAT YOUR DESCRIPTION WILL ENABLE FUTURE SURVEYORS TO LOCATE EXACTLY THE SAME STREAM SEGMENT. TRY TO AVOID USING LANDMARKS AND NAMES WHICH ARE LIKELY TO CHANGE OVER TIME.)

30 SEP 1993

VOLUNTEER SPAWNING FISH SURVEY LOCATION AND SURVEY DESCRIPTION
UMPQUA DISTRICT

SURVEY DESCRIPTION EXAMPLES

BASIN NAME	SUBBASIN NAME	SURVEY NAME	LOCATION	SURVEY DESCRIPTION	SUR. YR.
UMPQUA RIVER (43)	SMITH RIVER (2)	PEARL CR (42574001)	T25 R07W 22	FROM SMITH RIVER ROAD (AT GUNTHER), GO 1.0 MILE UP ROAD 20-7-26.2 AND PARK ON LEFT AT "NO HUNTING" SIGN. PROCEED TO THE YELLOW SIGN ON TREE 20 METERS UP ROAD AND FOLLOW THE TRAIL 20 METERS TO HANEY CR. WALK UP HANEY CR 25 METERS TO THE MOUTH OF PEARL CR. SURVEY FROM THE MOUTH (SIGN ON TREE ON LEFT) UPSTREAM 0.50 MILES TO A HUGE BEAVER DAM (SIGN ON LARGE DIAMETER TREE ON RIGHT 15 METERS FROM THE WATER). EXIT VIA SURVEY AREA. ****NOTE: WINTER SURVEYORS SHOULD DETERMINE IF BEAVER DAMS ARE A PERMANENT BARRIERS TO FISH PASSAGE AND CONTACT LANDOWNER (MRS. BENIGHT) WHO LIVES AT THE CONFLUENCE.	91 * 93
		ELK CR (42587001)	T20S R06W 32	SURVEY FROM THE MOUTH OF ELK CR (SIGN ON ALDER ON RIGHT) UPSTREAM 0.95 MILES TO A CULVERT (SIGN ON ALDER ON LEFT). EXIT VIA GRAVEL ROAD ON LEFT.	90 * 93
	ELK CREEK (3)	BRUSH CR (42715003)	T22S R07W 13	FROM ELKTON, TAKE HWY 38 6.0 MILES TO BLM 22-7-14.1. TURN RIGHT ACROSS ELK CR AND GO 1.2 MILES ON 22-7-14.1 TO A BRIDGE OVER BRUSH CR. SURVEY FROM HERE (SIGN ON ALDER ON LEFT) UPSTREAM 1.44 MILES TO THISTLEBURN CR ON THE LEFT (SIGN ON LARGE ALDER ON LEFT). EXIT DOWN ROAD AT BRIDGE.	93
		THEFT CR (42804003)	T22S R04W 15	FROM I-5 EXIT 154, FOLLOW ANLAUF ROAD NORTH 1.9 MILES TO COX ROAD. TURN RIGHT AND GO 1.6 MILES TO BLM 22-4-20. FOLLOW 22-4-20 2.2 MILES TO 22-4-16. FOLLOW 22-4-16 0.6 MILES TO WHERE IT CROSSES THEFT CR. SURVEY FROM ABOVE THE CULVERT (SIGN ON ALDER ABOVE CULVERT ON RIGHT). UPSTREAM 0.41 MILES TO A 6 FOOT BOULDER CASCADE BARRIER (SIGN ON ALDER IN THE MIDDLE OF THE CASCADE). EXIT VIA SURVEY AREA. ***NOTE: THE CREEK IS NAMED CURTIS CR ON ALL MAPS EXCEPT WATER RESOURCES. ALSO NOTIFY CORVALLIS IF THE END IS NOT A BARRIER.	93
		LANE CR (42816302)	T23S R04W 21	FROM I-5, TAKE EXIT 154 AND FOLLOW ELKHEAD ROAD 5.0 MILES TO SCOTTS VALLEY ROAD. FOLLOW SCOTTS VALLEY 0.1 MILES TO LANE CREEK CROSSING. SURVEY FROM CULVERT (NO SIGN POSTED) UPSTREAM 1.0 MILES TO A BEDROCK STRETCH (SIGN ON ALDER ON LEFT). EXIT VIA SURVEY 400 METERS TO ROAD ON RIGHT.	93

FIELD SURVEY FORM

FRONT

BASIN Kilchis WEATHER Clear
SUBBASIN MAINSTEM FLOW MED
SURVEY Clear Cr VIS. 2
DATE 11/15/90 TEMP. 45°F

SPECIES	LIVE A	LIVE J	DEAD M	DEAD F	DEAD J	DEAD U
CH	IIII	II		I		II
CO	I					
CHUM	IIII I					
REDDS	IIII	II				

(USE REVERSE SIDE FOR COMMENTS)

BACK

CH - Spawning

Snout - female 980 mm
916 5101 RV-AD clip

Coho - holding

Chum - spawning

04002

1992 SALMON SPAWNING SURVEY FORM

trict: 01 NORTH COAST
Basin: 01 NECANICUM RIVER
basin: 1 MAIN STEM
urvey: CIRCLE CREEK

Distance: 1.1 miles
Target Species: _____
Survey Type: SUPPLEMENTAL SURVEY
Influence: _____

ation: SURVEY FROM HWY 101 CULVERT SOUTH OF CANNON BEACH JCT. UPSTREAM APPROX. 1.1 MILES TO CULVERT ON HWY 101.

ATE m/dd	SUR-VEY I.D.	CHINOOK						COHO						CHUM				STLHD	REDDS	WTHR	FLOW	VIS	TEMP	COMMENTS		
		LIVE		DEAD				LIVE		DEAD				LIVE	DEAD											
		Adult	Jack	Male	Female	Jack	Unk.	Adult	Jack	Male	Female	Jack	Unk.	Adult	Male	Female	Unk.							1	2	3

JAN 29 '96 09:13AM ODFW NEWPORT

P.12/12

Stream Surveys

Stream habitat surveys are designed to obtain basic information about stream habitat. The data collected will help fish biologists and resource managers identify habitat protection and restoration needs, determine factors and sections of streams that limit natural production, establish monitoring programs, and provide information for fish and land management plans and policies. The process of conducting a stream survey involves collection of general information from maps and other sources and the direct observation of stream characteristics in the field. The information is both collected and analyzed based on a hierarchical system of regions, basins, streams, reaches, and habitat units. The survey teams will collect field data based on stream, reach, and habitat units. The field data will focus on channel and valley morphology (stream and reach data), riparian characteristics and condition (reach data), and instream habitat (habitat unit data).

The survey information can be summarized by habitat unit, by reach of stream, and by stream or watershed. It can be displayed in tables, graphs, and on a geographical information system. Summaries of the stream surveys are used individually and together to determine overall stream and watershed condition and to compare current condition to historical condition. The information is also used to determine distribution of fish or size of fish populations, estimate limiting factors or carrying capacity of stream habitat, and to set transect locations for stream flow studies. Standards can be developed based on the survey results for protection, desired future condition, and habitat restoration of streams in each ecoregion. Finally, analysis of inventory data can determine what land use or resource use activities are compatible with fish and aquatic habitat management goals.

Survey design

The survey design is based on a continuous walking survey in each of the major streams and tributaries in a watershed, from the mouth or confluence to the headwaters. Each stream is stratified into a series of long sections called reaches and into short habitat units within each reach. This survey approach relies on a visual estimation technique described by Hankin and Reeves (1988) in order to be able to estimate habitat area and characteristics in a time-efficient manner. Other survey approaches relied on surveying "representative" sections or systematically surveying short sections of stream. These approaches failed to provide information that could accurately describe unsurveyed portions of stream and failed to identify many site-specific features that are important to distribution and production of fish.

The stream survey is organized by reach and channel units. Reaches vary in length from as short as 1/2 kilometer to more than 8 kilometers and are defined by valley geomorphology, land use, riparian characteristics, and stream flow. Within each reach, the stream is described as a sequence of habitat units. Each unit is longer than one active channel width and is an area of relatively homogeneous slope, depth, and flow pattern representing different channel forming processes. The channel can be classified into

pools, glides, riffles, rapids, steps, and cascades. At every unit, attributes are estimated or measured to describe gradient, substrate, woody debris, shade, instream cover, and bank stability.

The methodology and the characteristics described in this manual are similar to surveys conducted by Oregon Department of Fish and Wildlife (ODFW), Oregon State University (OSU), the U.S. Bureau of Land Management (BLM), the U.S. Forest Service (USFS), and the Oregon Forest Industry Council (OFIC). This compatibility of survey methods, while allowing each agency or group to achieve its objectives, prevents a duplication of survey efforts.

Pre-survey knowledge

Using and understanding maps

Basic information about the stream and basin is gathered prior to and during the course of the survey. Some of this information, usually gathered from map sources, must be collected in the office. Surveyors must have the 7.5 minute (1:24,000 scale) topographic maps and appropriate road maps for the stream they will survey. Knowledge of basic maps skills (refer to "Land Measurement and Survey" section) and possession of the map in the field is essential. Data that cannot be linked to the maps is virtually useless. The maps will be used to orient to the stream and to identify the beginning and end of the survey, the location of reach changes, named tributaries, roads, and bridge crossings. It is particularly essential that maps be accurate in order to link to sets of data collected by other survey teams to and map-based data sets.

Working with private landowners and the public

Survey crews must request permission from landowners for access to survey the streams. Prior to the survey, the field crew will need to find out who owns the land adjacent to the stream. This may require looking at published maps or searching through property ownership maps in a county office. Large landowners are usually contacted by phone or by letter, then visited. Landowners in rural residential areas may need to be contacted by phone, letter, and/or visited. The landowners should be told:

1) Why the stream is being surveyed
2) The basic components of the survey
3) How the data is used: Stress that the data is used in a non-regulatory manner
4) When you will be on the stream and for how long
5) The surveyors will respect the landowners requests and property
6) The surveyors would appreciate any comments from the landowner as regards the survey or the fish and wildlife along the stream
7) The landowner is welcome to join the surveyors
8) The report can be sent to the landowner
9) The biologist will discuss the results with the landowner if requested

Regardless of type of landowner, it is important that their wishes be respected, all gates remain as they were, and keys be promptly returned. Gates with cylindrical lock housing must be inspected before reaching in to unlock. Surveyors should write any information on the stream or the fish provided by the resident. Historical and current insights may be very informative when the data is summarized.

Survey crews will come in contact with members of the public. They should be able to explain the basic components of the survey, how they survey, and the uses of the information.

Photographs

A good photographic record of the stream provides additional information and documentation. Take pictures that typify reach changes, riparian zones, and other stream characteristics as described in the survey manual such as debris jams, barriers, or landslides. For each picture, record the habitat unit number, date, time, and a description of the subject on the photo record sheet. Try to include the wetted channel of the stream and part of the riparian zone in each photo. Also, include a person or other feature that indicates scale or size. It is difficult to take pictures of streams under a thick tree canopy. Use the flash fill for closeup photos and turn the flash off for distant subjects. Always make sure the date and time feature is operating and accurate on the camera. Understand the different features and operating instructions of the camera you use. When the slides are returned, immediately label each with the stream name and habitat unit number.

Relationship between measurement techniques and data summary

The survey methodology is designed to be an extensive type of survey. That is, we are willing to sacrifice some accuracy in order to be able to survey more stream miles. As a result, the methods include characteristics which may require subjective judgement or estimation. The descriptions of some of the characteristics state what level of accuracy is suggested. The results are usually summarized at the reach level so a particular summary value may represent 100 or more different data records. We do expect that survey crews should be able to replicate a survey on a section of stream within 5-10% of its original survey depending on the variable. The most important features to accurately record are the named tributary junctions, road crossings, and beginning and end of the survey.

Final stream summaries always include the following variables which are summarized for each reach on each stream:

Channel characteristics

- Principal channel length
- Percent secondary channels
- Gradient
- Channel form
- Width:Depth ratio
- Land use

Pools
- Number pools per kilometer
- Pool area (m2)
- Pools >1m deep per kilometer
- Active channel width
- Frequency of pools
- Residual pool depth

Wood
- Pieces
- Volume
- Key pieces

Instream habitat
- Percent shade
- Fines sediments in riffles
- Gravel in riffles
- Bank erosion

Riparian zone
- Composition
- Height

Field Survey Techniques

The following discussion of survey technique is based on Moore, Jones, and Dambacher, 1995, *Aquatic Inventory Project: Methods for Stream Habitat Surveys,* Research and Development Section, Oregon Department of Fish and Wildlife, Corvallis, OR. We identify each of the primary features, how they are measured or estimated, and why each is important to collect.

Comments combined with the survey's continuous record of stream length allow biologists to locate potential problems, enhancement sites, or unique features. It is also an internal check to verify survey section locations and other observations.

Reach

A reach is a length of stream defined by some functional characteristic. A reach may be simply the distance surveyed. More frequently, reaches are defined as: stream segments between named tributaries, changes in valley and channel form, major changes in vegetation type, or changes in land use or ownership.

Active channel width and height. Active channel width is the distance across channel at "bank full" or annual high flow. The boundary of the active channel can be difficult to determine; use changes in vegetation, slope breaks, or high water marks as clues. Sum the width of all active channels in multichannel situations. Measure the active channel width every 10th unit when verifying estimates and at start of new reaches. Active channel height is the vertical distance from the water surface to the top of the active channel. Measured by standing at the edge of the wetted channel and determining the height of bank full flow (measured every 10th unit

and at change in reach type).

Refer to Moore et al (1995): the diagrams in the appendix for illustrations of active channel and terrace measures.

Active channel width gives an absolute reference to stream size regardless of flow at the time of the survey. It is the scale used to evaluate all stream and valley characteristics. For example, this information is used to estimate valley width index, establish minimum habitat unit size, and determine appropriate types of enhancement efforts.

Valley width index. Ratio of the width of the active stream channel to the width of the valley floor. The Valley Width Index (VWI) is estimated for the reach by dividing the average active channel width into the average valley floor width. In practice, the number of active channels that could fit across the valley floor

Valley width index gives us information about the form of the valley. It reflects the potential for the stream to migrate back and forth across the valley floor and its ability to create complex lateral habitats. This information helps biologists to design appropriate restoration treatments.

Channel form. Determined by the morphology of the active channel, hill slopes, terraces, and flood plains. Identify the channel form and enter the appropriate two-letter code in this column.

Refer to Valley and Channel Classification in Moore et al (1995) for definitions, allowable combinations, and examples.

First look at the relationship between the active channel width and the valley width to determine if you are in a wide or narrow valley floor type.

Next, look at the types of land forms adjacent to the stream channel to characterize and complete your classification.

Channel constraint occurs when adjacent land forms restrict the lateral movement of the channel. In constrained channels, stream flows associated with all but the largest flood events are confined to the existing channel configuration.

Valley form. General description of the valley cross section with emphasis on the configuration of the valley floor. Divided into types with a narrow valley floor (valley floor width (VFW) < 2.5 times stream active channel width (ACW) and types with a broad valley floor (VFW > 2.5 times ACW). Typical configurations may have the active channel in several positions on the valley floor.

Make a sketch of the valley cross section on the reach sheet. Label and dimension important features. Ambiguous or atypical configurations can be reclassified later if you make a good sketch.

Land form. Identify and describe the land forms adjacent to the active channel margin on the left and right sides.

Hill slope

High terrace (above flood zone, height > 10% ACW)

Low terrace (within flood zone, height < 10% ACW)

Alluvial fan

Flood plain
Road fill (riprap)
Wetlands-meadow
Bed rock
Other (make note in comment column)

Identification of land forms is easier if you look at the types and age classes of vegetation on different surfaces. Young grasses, herbs, and small shrubs typify a low terrace subject to frequent disturbance by floods. Mature trees can sometimes be seen on comparatively low, but stable terraces adjacent to the channel, this type of surface should be called high terrace.

Streamside vegetation. Describe the composition of the riparian (streamside) area plant community in each reach. Generally, we consider the vegetation observed in the area within at least one active channel width of either side of the channel to represent the riparian zone. Separate entries for the overstory and the understory community may be appropriate in some vegetation area (i.e. Ponderosa pine/grass communities). It is especially important to note vegetation types that would not normally be found in a typical wetted riparian habitat. Note species if known.

Knowing the vegetation status at the time of the survey allows biologists to interpret the history of land use and estimate the potential for recruitment of large woody debris into the stream. Habitat projects can be designed to help reestablish vegetative cover.

Flow. Flow is one of the most variable stream conditions. A record of the conditions on the day of the survey is valuable to evaluating and implementing future projects. If possible, measure the flow using a flow meter or if there is a gauge on the stream, record the gauge height or flow during the survey. Important differences to note include the following stream levels.

Dry

Puddled. Series of isolated pools connected by surface trickle or subsurface flow.

Low flow. Surface water flowing across 50 to 75 percent of the active channel surface. Consider general indications of low flow conditions.

Moderate flow. Surface water flowing across 75 to 90 percent of the active channel surface.

High flow. Stream flowing completely across active channel surface but not at bankfull.

Bankfull flow. Stream flowing at the upper level of the active channel bank.

Flood flow. Stream flowing over banks onto low terraces or flood plain.

Water temperature: Record water temperature at each reach change or a minimum of every two hours At named tributary junctions record the stream temperature just above the tributary and in the tributary. Record time. Note if temperature is °C or °F.

Habitat Unit Characteristics

Recording all unit types as described below describes the order of channel habitat units and provides a continuous record of habitat types in the surveyed reach. Habitat units are segments of the stream with similar characteristics. Each is generally longer than the active channel width. Habitat units are classified by channel shape, slope of the water's surface, flow, and substrate.

The information identifies habitat types and conditions throughout the reach. The composition and pattern of habitat unit types characterize the stream. Habitat unit identification is the basic information that indicates fish habitat potential (spawning, rearing, and cover). A relative ratio of habitat unit types can indicate if a particular habitat unit type is lacking and what can be accomplished with habitat techniques. It is used in a variety of ways to describe and evaluate specific fish habitat in response to a number of different requests from Department staff, other agencies, and the public.

Characteristic water surface slopes are given for each group of habitat unit types. However, channel bed form and flow characteristics are the primary determinant of unit classification. Use the unit's slope to help make determinations when the other characteristics are ambiguous.

Refer to Moore et al (1995) for detailed descriptions of the units. The following is a brief summary.

Habitat unit type

Pools: Units with water surface slope usually zero, not more than 0.5 percent.

Subunit pools: Alcoves, backwaters, and isolated pools are types of habitat subunits; generally not as long as the full channel width. They are, however, generally easy to identify and are important habitat types. Alcoves, backwaters, and isolated pools are formed by eddy scour flow near lateral obstructions.

Glide: An area with generally uniform depth and flow with no surface turbulence. Low gradient; 0-1 % slope. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. Generally deeper than riffles with few major flow obstructions and low habitat complexity. There is a general lack of consensus regarding the definition of glides (Hawkins et al. 1993). Their most distinguishing feature is their lack of distinguishing characteristics.

Riffles: Fast, turbulent, shallow flow over submerged or partially submerged gravel and cobble substrates. Often with 5-15% of surface area with white water. Generally broad, uniform cross section. Low gradient; usually 0.5-2.0% slope, rarely up to 6%.

Rapids: Swift, turbulent flow including chutes and some hydraulic jumps swirling around boulders. At moderate to high flow the stream surface with 15-50% white water. Exposed substrate composed of individual boulders, boulder clusters, and partial bars. Moderate gradient; usually 2.0-4.0% slope, occasionally 7.0-8.0%.

Cascades: Much of the exposed substrate composed of boulders or bedrock organized

into cluster, partial bars, or step-pool sequences. Fast, turbulent flow; many hydraulic jumps, strong chutes, and eddies; 30-80% white water. High gradient; usually 3.5-10% slope, sometimes greater.

Steps: Steps are abrupt, discrete breaks in channel gradient. Steps are usually much shorter than the channel width. However, they are important, discrete breaks in channel gradient with 10->100 % slope. Steps can separate sequential units of the same type. Low steps (<0.3m high) and steps formed by gravel and small cobbles on the face of transverse bars can usually be included in the next unit upstream. Steps are classified by the type of structure forming the step.

Channel type: All secondary channel are considered as important as the primary channel. Our inventory considers the stream as the system of all channels that transport water down the drainage. The intention is to survey and quantify all aquatic habitats located within the valley floor. All active channels and unit types will be classified with a channel code and an estimate of the percent of total flow carried.

Secondary channels and off channel habitat units are considered critical for life history stages of some species of salmonids. Cataloging these channel type provides information for identifying the location of these features.

Unit length and width: Length and width of each unit in meters. The length and width are estimated every unit; it is estimated and verified every 10th unit.

Slope: Gradient of water surface in the unit. Expressed as the percent change in elevation over the length of the unit. Estimated with a clinometer using the scale on the right side in the viewfinder.

An accurate measure of gradient helps identify unit types. It can also identify areas of streams that are important to fish production and sharp gradient changes that may affect distribution of fish.

Channel exposure: Measured with the clinometer as the degrees (left side scale) above horizontal to the top of riparian vegetation or land forms. Measured perpendicular to the channel unit on the left and right banks (see diagram). This variable requires integration of topographic shading and canopy closure.

Exposure has a strong influence on heating and cooling of the stream. Shade prevents rapid warming of the stream in the summer and can prevent or retard ice formation in the winter.

Depth: Determine the maximum depth in pools, or typical depth in glides and fast water unit types. Measure as carefully as possible in pools. Probe the bottom with the depth staff to find the deepest point. Small differences in pool depth are significant. Note units of measurement used (i.e. meters, yards, feet, etc.)

Depth information is the key component in clarifying unit identification and analyzing the data. Pool depth reflects the potential quality of the pool. Depth of fast water units indicates the channel cross section.

Verified length and width: The measured length and width of the habitat unit are taken at every 10th unit. The actual measurements are used to calibrate the estimates made on each unit.

Substrate: Percent distribution by streambed area of substrate material in six size classes: silt and fine organic matter, sand, gravel (pea to baseball; 2-64mm), cobble (baseball to bowling ball; 64-256mm), boulders, and bedrock. Estimate distribution relative to the total area of the habitat unit (wetted area). Round off each class to nearest 10 percent.

Substrate data provides information about fish habitat, potential amounts and quality of spawning gravel, and stream condition (i.e., silt overloads, etc.).

Boulder count: Count of boulders greater than 0.5 m in average diameter that protrude above the low flow water surface. Include boulders at the margin of the wetted channel. In dry units and dry channels, estimate the boulder count by including boulders with sizes and orientation similar to those counted in wetted units of the same stream.

Boulders contribute to fish habitat quality by increasing the habitat complexity. Boulder counts verify habitat unit definitions, provide additional reach information, and indicate something about the geology of the area.

Bank classification: A general description of the stream bank at the active channel margin.

Non-erodible. Stable bedrock, hardpan, or boulder-lined bank.

Boulder cobble. Stable matrix dominated by boulders and cobble combined with soil, vegetation, and large roots.

Vegetated-stabilized. Vegetated and/or overhanging bank, partly or wholly stabilized by root systems. Some exposed soils may be present, but with no evidence of recent bank failure.

Actively eroding. Actively or recently eroding or collapsing banks. Exposed soils and inorganic material. Superficial vegetation may be present, but it does not contribute to bank stability. If any portion of the stream bank is eroding, enter AE for that side of the unit.

Bank classification indicates channel stability, sediment sources, and riparian condition immediately adjacent to the stream. This information may identify areas where bank and riparian protection is appropriate.

Large wood debris

The objective of this effort is to apply a standardized and consistent methodology to obtain quantitative estimates of wood volume and distribution within stream reaches. Information will be used to evaluate effects on fish habitat and channel structure and to make quantitative comparisons between streams.

- Minimum size to consider is 15 cm diameter by 3 m length. Exception is root wads with cut ends which may be less than 3 m long.
- Collect data for all wood that meets the minimum size criteria. Do not attempt to evaluate its effectiveness as fish.
- Count all pieces that are within, partially within, or suspended over the active channel.
- Estimate the entire length of all pieces; include portion outside the active channel.

Diameter class. Enter 0.15, 0.30, 0.50, 0.90, or estimated diameter in meters (particularly for larger pieces). Assign each piece or group of pieces to the closest size class. Use the average diameter or the diameter at the middle of tapered pieces.

Length classes. Count and tally the number of pieces within each length class. Root Wad less than Three Meters Long (usually with a cut end) is a special case.

Daily and weekly record keeping

Maintain a succinct log of your activities in the field book. Each day, record the date and name of the stream where you worked. Enter the approximate distance covered and number of hours spent working on the stream. Keep track of your travel time separately.

Record relevant details about access to the stream, contact people from cooperating industry or agency groups, and people you contact to gain permission to survey. Record the names and phone numbers of people you may contact as you complete the survey.

Write a paragraph or so of general description for sections of each stream in the field book or on a separate stream report form. Pay particular attention to descriptions of the riparian zone, additional details concerning land use, or factors that influence the fish populations. This is the appropriate place to express your opinions. Other comments, sketches of complex features, suggestions, complaints, etc. are often useful.

Field Exercises and Training

Take a field trip early in the salmon spawning season before actual surveys begin. Walk the stream and demonstrate how fish are counted. If possible, provide salmon carcasses purchased by local supermarkets to demonstrate snout removal and scale sampling.

Equipment

1. Maps - 7.5 minute quad (1:24,000 scale) USGS topographic maps of the stream and basin. Road map coverage by county or fire district. Oregon Atlas and Gazetteer (Delorme Mapping).
2. Recording Materials - Waterproof field book, survey forms for each portion of the survey, waterproof paper, and pencils.

3. Clothes - Neoprene chest waders, wading shoes, and/or hip boots (non-slip soles of felt, studded "corkers," outdoor carpet or similar material is advised), rainwear, snag and thorn proof clothing appropriate for the weather.
4. Two-meter-long staff (marked in meters and tenths), compass, 60 meter fiberglass measuring tape, day pack, polarized glasses, thermometers, clinometer, clipboard, vest, flagging, permanent markers, and date-back camera.

Agenda for classroom and field training sessions

Day 1

10:00	Introduction Reach and Riparian Methods
11:30	Travel to Stream
Noon	Lunch in field
12:30	Break into groups
12:45	Field surveys in stream
3:30	Return to classroom
4:00	Questions/Discussion
5:00	Adjourn

Day 2

8:00	Habitat Unit and Wood Survey Methods
10:00	Break
10:15	Field surveys on stream
Noon	Lunch in field
2:30	Return to classroom
3:00	Question/Discussion
5:00	Adjourn

Resources for Further Information and Training

a) 1994 ODFW Spawning Survey Report.
b) Coastal Salmon Spawning Survey Procedures Manual, 1994 (ODFW).
c) STEP Spawning Fish Survey Handout. STEP Program (ODFW).

Suggested references

Bisson. P. A., J. A. Nielsen, R. A. Palmason, and E. L. Grove. 1982. "A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low stream flow." Pages 62-73 in: N. B. Armantrout, ed. *Acquisition and Utilization of Aquatic Habitat Inventory Information.* Western Division, American Fisheries Society, Portland OR.

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WORKER HEALTH, EQUIPMENT OPERATION, AND SAFETY

Flaxen Conway and Dan Burgess

Introduction

According to the Oregon Safe Employment Act, every employer has a legal obligation to provide and maintain a safe and healthful workplace for their employees. This means that if you want to have your own forest/ecosystem restoration and enhancement business, and run it the best way possible (not to mention legally), you should have an understanding of the best ways to provide a safe and productive work environment... no matter if you are in the office, the shop, in transit, or in the field.

If you are an employee, you should be aware of these expectations and legalities, and work with your employer to provide and maintain a safe and healthful workplace. If you don't feel that safe equipment operation or worker health and safety are important to your employer or integrated into daily operations, it is important for you to know how to help yourself and your employer do what it takes to achieve success in this critical area of business operation.

In the Oregon Administrative Rules, Chapter 437, section 437-01-015, there is a list of definitions of terms often found in these rules and in the codes specific to different types of activities. It would be a good idea to get a copy of these rules.[1] Here are just a few:

Employee: Any individual who is currently employed or formerly employed, including a minor whether lawfully or unlawfully employed, who engages to furnish services for a remuneration, financial or otherwise, subject to the direction and control of an employer...

Employer: Any person who has one or more employees, or any sole proprietor or member of a partnership who elects workers compensation coverage as a subject worker pursuant to ORS 656.128.

Hazard: A condition, practice or act which could result in an injury or illness to an employee.

Inspection: An official examination of a place of employment by a Compliance Officer to determine if an employer is in compliance with the Act. There are seven classifications of inspections: routine, periodic, area, follow-up, complaint, accident and emphasis.

[1] See the "Resources for Further Information," Training/Certification segment at the end of this section for instructions on how to do this.

Lost workdays: The actual number of days after, but not including, the day of injury or illness during which the employee would have worked, but could not perform all or any part of his/her normal assignment during all or any part of the employe's next regular workday or shift because of the occupational injury or illness.

Owner: Every person having ownership, control or custody of any place of employment or of the construction, repair or maintenance of any place of employment.

Place of employment: Includes every place, whether fixed or movable, whether indoors or out or underground, and the premises and structures connected to, where either temporarily or permanently an employee works or is intended to work and every place where there is carried on any process, operation or activity related, either directly or indirectly to an employer's industry, trade ... including a labor camp provided by an employer for his/her employees or by another person engaged in providing living quarters or shelter for employees...

These are just a few of the terms listed. It is interesting to scan these and wise to keep the list handy.

You might be thinking to yourself, "all of these rules and codes are hard to understand and is this truly important for forestry/ecosystem management workers?" The answer is a definite YES. It is a good idea to have read over this information, order and keep readily available the appropriate chapters, divisions, and sub-divisions as related to forest/ecosystem restoration operations.

For example, it certainly makes sense when you think about the "operating a legal business" part of a forest/ecosystem-related business. The best way to get and stay legal is to know what legal is. With regard to the "science" part of a forest/ecosystem-related business, performing tasks that lead to the desired environmental and economical outcomes of a contract or project will only be effective in the long run if the work was done in a manner that provided the utmost safety for the worker. For example, it's not going to help to understand the reasons why providing spawning habitat for young salmonids is important if the chain saw is operated recklessly and the tree falls the wrong way injuring the faller or another worker. So, the take home here is whether you are working with fire or surveying or measuring land or stream habitat, the idea is to use the latest techniques and your best skills to do the job well *and* safely.

Competency measures

Finally, in order to do the best job, and to do it safely, it's important for you to understanding this stuff enough to operate your business or yourself legally and safely. **So before you read this section or attend the training session on this topic, think about what you need to do in order to, in your own words, do the following:**

1) List the five basic core concepts of this topic:
   - Why is this important for employers and employees.
   - What is a worker/equipment injury and illness prevention program.
   - How to create, understand, and maintain a worker/equipment injury and illness prevention program.
   - The records needed to be kept.
   - The safety and health codes applicable to a forest/ecosystem-related business.
2) Describe what worker health, equipment operation, and safety would look like on a typical forest/ecosystem restoration project.
3) Demonstrate that you understand and know how to safely use equipment related to performing tasks related to a typical forest/ecosystem restoration project.
4) Say why worker health, equipment operation and safety are important for ecosystem management and stewardship.,
5) Be able to list three reasons why worker health, equipment operation and safety are important for land owners/managers.
6) List three sources of support/assistance/reference for worker health, equipment operation and safety.

The information for this part of the EWP Curriculum was gathered and synthesized from materials received from Oregon OSHA, especially the "Developing Your Workplace Injury & Illness Prevention Program" workbook. The author wishes to thank Dave Wooley, Accident/Fatality Investigator, Dept. of Consumer and Business Services, Eugene, Oregon for all of his help and input.

Worker/Equipment Injury and Illness Prevention Programs

Taking risks is part of running a business, especially for small business owners. There are some risks, like in marketing or advertising, scheduling, etc., that you take in order to become or stay competitive. But there are some risks that should never be taken risking equipment or worker health and safety.

Preventing personal and equipment losses means that you place as much emphasis on safety and health issues as you do on production. Establishing an injury and illness prevention program helps you to do this. How? By creating and communicating safety and health goals, and outlining policies and procedures that achieve those goals.

Why should you do this? Simply put, accidents cost money. Consider what one lost-workday injury could cost you:

- Productive time lost by that injured employee and the employees/supervisors helping the injured employee,
- Time to hire or train a replacement worker until the injured employee returns to work,

- Time and cost for repair/replacement of damaged equipment/materials,
- Cost of continuing all or part of the injured employee's wages, plus compensation,
- Reduced morale and/or efficiency among other employees,
- Increased worker's compensation insurance rates, and
- Cost of completing paperwork generated by the incident.

So, once you've decided this is a good thing to do and you're going to do it, who can help you? Who needs to be involved?

Well, your workers' compensation insurance carrier and Oregon OSHA (OR-OSHA) Consulting Services Program, or a private occupational safety and health consultant, are good places to get some help.

Forest/ecosystem contractors and supervisors for the company must show their commitment to this by creating and maintaining clear, written company policies with written goals and objectives. These should convey your beliefs regarding accident and illness prevention, and importance of worker safety and health, and safe equipment operation. If the owner(s) or supervisors do not support and participate in this worker/equipment injury and illness prevention program, *you are doomed to failure from the start.*

But it's not only the owners or supervisors. All employees need to be involved in the creation and maintenance of this worker/equipment injury and illness prevention program if it is to be successful. As such, all need to be accountable for maintaining a safe and healthful workplace.

Create Your Action Plan

If you want maximum production and quality, you need to control potential workplace hazards and correct hazardous conditions or practices as they occur or are recognized. Hazard control is the heart of any effective injury and illness prevention program. Periodic inspections and procedures for correction provide methods of identifying existing or potential hazards in the workplace and eliminating or controlling them.

First do a hazard assessment survey an evaluation of the workplace conditions. For example, does everyone know the safety and health regulations, and the employers and employees responsibilities? OR-OSHA states in 437-01-760 (Rules for all workplaces):

1) Employers shall:

   - See that workers are properly instructed and supervised in the safe operation of any machinery, tools, equipment, process, or practices which they are authorized to use or apply.
   - Take all reasonable means to require employees to work and act in a safe and healthful manner, work in compliance with all applicable safety and health rules, use all means, methods, and materials (equipment safety guards, etc.) that are necessary to safely accomplish all work, etc.

2) Employees shall:
   - Conduct their work in compliance with the safety rules.
   - Report all injuries immediately to the appropriate person.
   - Make full use of safeguards provided for their protection.
3) Include in this your company policy regarding drug and alcohol use. OR-OSHA states that the use of intoxicating liquor or drugs is strictly prohibited, and anyone whose ability to work safely by these substances shall not be allow on the job while in that condition. Company policies many be more specific.

Your assessment survey should cover:

1) Equipment: Make and maintain a list of your equipment (pay attention to inspection schedules, maintenance activities, etc.).
2) Chemicals: Make and maintain a list of chemical used and where they're used and employee exposures.
3) Work Practices: Detail specific work practices associated with equipment, etc., paying extra attention to protective equipment, guarding, ventilation, emergency procedures, and the proper use of tools.
4) OR-OSHA Rules: Review rules applicable to your operation, both the "General Industry Safety & Health Rules" and the specific standards for forest activities.[2]

You will be able to prevent many hazards from occurring through scheduled and documented self-inspections. Be sure to look for hazards *and* safe work practices. Make these regularly and keep good records.[3]

Secondly, recognize that employers or assigned, trained workers are responsible for investigating accidents, to determine why the accident or near miss occurred, and what actions can be taken to prevent this from happening again. **The focus should be on solutions and never on blame.** Keep good records.

Thirdly, recognize that *training is one of the most important elements of any injury and illness prevention program.* It allows employees to learn their jobs properly, bring new ideas into the workplace, reinforce existing ideas and practices, and make your worker/equipment injury and illness prevention program into action. What will this look like on the "bottom line":

- fewer work-related injuries and illnesses
- reduced stress and worry caused by exposure to hazards
- increased productivity
- lower costs, higher profits
- and a more cohesive and dependable workforce.

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[2] See the order form included in this section. Note, if you're out of the Salem area, call 1-800-922-2689.

[3] See the "Self-Inspection Checklists" at the end of this section for some ideas/things to consider. Note that they are by no means inclusive and you'll want to add or specify them to meet your needs of your operation.

Your program should include training for:

- all employees when they are first hired
- new employees for each specific task
- all employees when new procedures/equipment are introduced
- all employees when new personal/equipment protective devises, etc. are introduced
- etc.

Safety and Health Recordkeeping: Documenting Reality

In the business section of this curriculum, you learn how important good recordkeeping is to create and operate a legal forest/ecosystem management business. These records help you to plan, learn from past experiences, and make corrections in future operations. Records of accidents, work-related injuries, illnesses, and equipment losses serve a valuable purpose.

OR-OSHA requires that you keep a OSHA 200 Log. They call this a minimum amount of paperwork. In any event, the idea here is to give you a clear way of noting and recalling information about employee injuries or illnesses in a given year.

What do you keep in this log:

- Reports on every injury or illness requiring medical treatment.
- OSHA Form 200 "Summary of Occupational Injuries & Illnesses", filled in yearly and posted where employees can see it for at lease one month.
- OSHA Form 801 "Employer's Report of Injury or Illness"
- Maintain these records for **5 years.**

Regularly review these records to see where injuries and illnesses are occurring, looking for patterns or repeat situation. You can also expand this to include unsafe acts, condition, or procedures.

Injury and illness records may not be the only records you need to maintain. Check into what you need to do related to toxic substances, hazardous exposures, physical examination reports, employment records, etc. Essential records, including those legally required for workers' compensation, insurance, government inspections, etc. must be maintained for as long as required.

Safety and Health Codes

There are General Administrative Rules. There are also Oregon Administrative Rules with different chapters, divisions, and subdivisions. Once again, see the order form for a listing. After reviewing several of them, listed below are some that might be of special interest for forest/ecosystem workers.

For example, a "must-have" for all forest/ecosystem businesses and workers would be Division 6, Forest Activities, which goes into detail about:

1) **Subdivision A = General Requirements**

   Topics such as rules, definitions, purpose, site planning.

   For example, under "site planning" it discusses that prior to the commencement of any logging activity at a new job site, the employer shall conduct a jobsite safety survey.

2) **Subdivision B = Safety and Health Program**

   For example, under "supervisory practices" it discusses that an authorized person for each job with the authority and responsibility to supervise all employees at the site and to enforce the company's safety and health program...

3) **Subdivision C = Work Conditions, Personal Protective Equipment, First Aid**

   Topics such as checking system, working alone, hazard identification, power line safeguards, weather conditions, working below unstable objects, night logging, personal protective equipment, medical services and first aid.

   For example, under "personal protective equipment" it states that personal protective equipment shall be maintained in a safe and effective condition or removed from service or use.

4) **Subdivision D = Tools, Explosives, and Extinguisher**

   Topics such as hand and portable power-driven tools, explosives and blasting agents, power saws, fire extinguishers, etc.

   For example, under "hand and portable power-driven tools" it states that the employer shall be responsible for the safe condition of tools regardless of tool ownership, and that the employee shall inspect each tool to assure safe condition and shall report any unsafe condition to the employer.

5) **Subdivision E = Fire Protection/Suppression and Prescribed Burning**

   Topics such as fire suppressions by employees other than fire fighters, wildland fire suppression and prescribed burning by fire fighters, general requirements, fire fighting training and education, protective clothing, head, eye and ear protection, fire fighting equipment, etc.

   For example, under "protective clothing" it states that hand protection shall consist of protective gloves or glove system which will provide protection against cut, puncture and heat penetration.

6) **Subdivision F = Roads and Vehicles**

   Topics such as roads, fuels, transportation of employees, seat belts, etc.

   For example, under "seat belts" it discusses that all motor vehicles designed, used or maintained primarily for the transportation of persons or materials over private or public roads shall be equipped with seat belts which shall be used.

7) **Subdivision G = Rigging and Climbing Equipment**

Topics such as general requirements for rigging, inspection of rigging, molles and shackles, straps, blocks, pass lines, chains and blocks, etc.

For example, under "straps" it says that straps or chokers used to hang or support blocks, jacks, tree shoes, or rigging shall be sized in accordance with Table 6-3 (see this document for this and other tables).

8) **Subdivision H = Logging Machines**

Topics such as exhaust pipes, glass, brakes, outriggers, hydraulics, moving logging machines, tractors and skidders, protective structures for operators, etc.

For example, under "tractors and skidders" it states arches shall be equipped with line guards.

9) **Subdivison I = Timber Cutting**

Topics such as falling, wedges, bucking, tree jacking, tree pulling, etc.

For example, under "falling" it states that at not time shall cutters work if the wind is strong enough to prevent the falling of trees in the desired direction.

10) **Subdivision J = Yarding, Swinging and Loading**

Topics such as landing areas, yarding, skidding landing of logs, log decks, fueling areas, loading machines helicopter logging, etc.

For example, under "tongs, hooks, and grapples" it states that tongs shall not be carried by being rested on both shoulders with the tong points around the neck.

11) **Subdivision K = Transportation of Logs**

Topics such as safety chain or cable, couplings, trailers, bunks and stakes, binders and wrappers, etc.

For example, under "safety chain or cable" it states that safety chains or cables shall be attached not more than 12 inches from the eye of the reach.

12) **Subdivison L = Log Dumps and Ponds**

Topics such as removal of wrappers/barriers, hoists, log ponds and booms, etc.

For example, under "removal of wrapper/barriers" it states that no employee shall enter the area next to the log truck except when the truck is unloaded, when protected by a barrier or log handling machine, or when the load is contained by the wrappers.

13) **Subdivision M = Signaling and Signal Systems**

Topics such as hand signals, voice communication on combined signal/voice transmitters, electrical signal systems, radio signal systems, etc.

For example, under "hand signals" it states that hand signals may be used at any time as an emergency stop signal.

As you can see, there is a lot of information here and it is very specific to the job.

Another example of a division that would be of interest to forest/ecosystem workers would be Division 2, General Occupational Safety and Health Rules. Subdivision I, Personal Protective Equipment, covers such topics as eye and face protection, respiratory protection, foot protection, etc. For example, under foot protection, there are criteria for protective footwear purchased after July 5, 1994 which is different from footwear purchased before July 5, 1994. And in Subdivision K, Medical and First Aid, the topics covered include first aid supplies, emergency medical plans, etc.

Included in all of these are tables with specific information and diagrams, so it's not just rules numbers and "legalese."

Three Specific Types of Equipment with Safety Considerations for Each

An important aspect of watershed management is stream habitat restoration technology. This technology uses techniques to improve fish habitat conditions in streams. Tools and equipment that are commonly used to implement stream habitat restoration projects include portable motor power-driven tools such as chain saws and earth augers. Nonmotorized hand equipment includes various rigging equipment also used for logging purposes. Chemicals used to secure logs and root wads to boulders include cleaning solvents and adhesive mortars. These tools and equipment pose potential safety concerns that both the forest/ecosystem contractor and forest worker need to be aware of.

The safety considerations listed in this unit include the following specific types of equipment:

- Safety considerations for chain saw sawyers
- Safety considerations for two and one person motor-driven earth augers and drills
- Safety considerations for anchoring boulders, logs, and root wads used for salmonid habitat improvement projects

Safety considerations for chain saw sawyers

To become a sawyer the first thing you need is the desire to run a chain saw. What you don't need is a fear for chain saws. What you DO need is to read and understand the information presented to you, and to ask a lot of questions that you might not understand. Safety is the key to becoming a confident and reliable sawyer.

Safety features and safety equipment are no substitute for training and experience in operating a chain saw. All personnel should receive verbal and written instructions on safe operations, and should operate a saw in a variety of situations under the guidance of a qualified sawyer before being authorized to use a saw.

A saw operator should take periodic breaks and drink plenty of fluids to avoid fatigue. Fatigue can diminish reaction time and increase errors in judgment which may lead to injury. Drugs, including prescription medicine, or alcohol diminishes muscular control and dulls the senses. Therefore these substances should not be used before or during the operation of a chain saw.

Types of chain saw injuries

The most common and serious types of chain saw injuries involve being cut by the chain. These cuts can be caused by unsafe operations leading to a kickback (a definition of a "kickback" is described further on). Careless movement or poor footing can cause serious cuts to the legs or feet. Improper carrying or handling of a saw, running or stopped, may cause cuts to the hands, face, or neck.

Besides cuts, saws produce poisonous exhaust which can impair or injure the sawyer. A running or recently run saw has hot, exposed parts which can cause burns. The fuel/oil mixture can ignite and/or explode.

Many of these injuries can be avoided with the use of safety equipment, safety features on the saw, and safe operations by the sawyer.

Safety gear

1) COMMON SENSE!
2) Hard hat
3) Ear protection
4) Eye protection
5) Chaps
6) Leather gloves
7) Leather boots
8) Personnel first aid kit.

Ten operating procedures

1) Assess your cut.
2) Have proper footing.
3) Stand with your feet shoulder width apart.
4) Toes and knees pointed towards your cut.
5) Both hands on the saw.
6) Left elbow locked.
7) Work to the left side of the saw
8) Use a swamper for obstructed cuts you can't see
9) Listen for sounds over and above your saw.
10) Reassess your cut.

Kickbacks

What exactly is a kickback? A kickback is best described as when the saw jerks up or bounces back. A kickback occurs whenever the parts of the rotating chain hang up on an obstruction. (e.g., limbs, twigs, knots in tree, wires, etc.) The bar of your chain saw has two different kickback zones:

1) The rotational kickback zone is the upper quadrant of the bar nose. This kickback is an abrupt upward thrust of the saw bar.

2) The linear kickback zone is the upper half of the saw bar. This kickback will cause the saw to quickly thrust back.

Some common kickbacks:

1) Low RPM's - A slow moving chain tends to butt against wood and thus hang up and cause a kickback.
2) Dull cutters- Dull teeth tend to butt their way through wood, leading to excessive teeth vibration and hang ups that can cause a kickback.
3) Inconsistency in the wood - (Knots, grosgrain)
4) Diameter of log to big- When the log your cutting is bigger than the length of your bar, the tip binds on the wood causing a kickback.

Pre-start of your saw

When you pre-start your saw you run a basic check over the saw, checking things such as the throttle lock, fuel tank, oil tank, and the chain brake. You also check the bar and the chain, making sure the chain is sharp and not to loose. You also need to make sure your bar nuts are on tight. Before using a saw, you should always do a pre-start for safety reasons and to help familiarize yourself with the saw.

Cleaning the saw and basic maintenance

You should clean the saw after every time you use to help keep it in good working order. This will include:

1) Removing the side plate and bar to clean inside.
2) Removing chain from bar and cleaning the groove.
3) Check and be familiar with: The air filter, spark plug, fuel filter and spark arrestor.

If something goes wrong with your saw, check those basic parts and see if that is the problem.

If after checking the above parts don't fix your problem, DON'T DO ANYTHING ELSE WITH THE SAW because to an untrained saw mechanic, you can and will do more harm than good to the saw.

Sharpening the chain

There are some things you need to know before you can sharpen a chain. They include:

1) Know what a sharp chain looks like.
2) Be able to identify hooked cutters, back sloped cutters, and beveled cutters.
3) Sharpen your cutters at the right angle.
4) Always keep your right and left cutters the same size.
5) Be able to identify shiners.
6) Make sure you are using the correct file size.

Sharpening a chain correctly is the most difficult thing to do when your not very experienced in doing so. With a lot of patience and practice, you can sharpen a chain as good as new, every time.

Free hand filing is often the most difficult way to learn how to sharpen a chain because there are so many ways to mess your angle up. A **saw-jig** is recommended for correct and more accurate chain sharpening.

Further Reference

"Husquvarna Owners Manual" (ANSI 175.1) Annex C
Chainsaws by Walter Hill, Rodale Press, c1977
Chainsaws by Harold C. Macintosh, Pruett Publishing Co., c1980
Chainsaws by A. Robert, 1st edition, Tab Books, c1981
Chain Saw Maintenance and Repair, 7th edition, Intertec Publishing Corp., c1985

Safety Considerations for Two Person and One Person Motor Driven Earth Augers and Drills

Typical settings where the earth auger is used includes fencing projects to dig fence post holes. The earth auger is also used on riparian improvement projects to dig holes for large conifer planting stock. Both one-person and two-person augers are available.

General safety considerations

The two-person earth augur requires the use of two people to operate it; for this reason each operator must be sure of each other's capabilities. Both operators must understand the use of the tool and the risks involved.

It is the responsibility of both operators of the tool to know what specific requirements, precautions and work hazards that may exist on each job. Both operators must read and understand all of the information contained in the operators manual and inform any person who might be assisting the digging.

The rotation of the auger or drill bit of any type of drill, electric or gas driven, will cause a counter rotation of the power unit while digging or drilling. The force exerted on the operators will vary according to the type of soil, the diameter of the auger and the condition the machine, or in the case of a hand drill, the material that is being drilled. In the event that the auger or drill bit should encounter an object that stops the rotations suddenly, the digging force will be transmitted directly to the operators. For this reason, the operators must have secure footing and control of the machine and be mentally and physically prepared to react to this force.

Because earth drills are hand held, low horse power, portable type machines, they are limited in what they are capable of doing . The job site, soil conditions, job specifications, and operator experience may dictate that a different tool or method be found to do the job.

Given that earth drills are motor driven, safety considerations applied to motor driven chain saws also apply to the earth auger. Review the chain saw information presented in this section of the curriculum.

It is critical that operators of earth drills receive and read available safety information and practice the information on the job site. Again, it is encouraged that the operator using the earth drill or any motor driven drill study a variety of operators manuals religiously. Often one manufactures safety considerations will be more extensive than others. The following are only a few safety tips taken from operator's safety manuals.

Specific safety considerations

Keep bystanders away from the hole and earth drill while it is in use.

Always stop the machine if another person is in an area that could interfere with the safe operation of the machine.

Before using the earth drill, be sure that the area to be drilled, is clear of potential hazards, such as, any other materials that could possible entangle itself around the drill unit.

Make sure locations of all buried utility lines are known.

Use extreme caution while operating the earth drill on uneven terrain. Be sure the operator has proper footing and proper physical abilities.

Always stop the motor when moving between holes and when the machine is not being used to drill with.

Never leave the machine running when it is unattended.

Always wear the proper clothing and equipment for the job. Eye and hearing protection, helmet, boots, gloves and dust masks are some of the items that may be required.

Never wear a watch, ring, or necktie when working on or with the drill. Keep your hands, loose clothing and you hair away from moving parts.

Never operate the machine, or run the engine in unventilated areas.

Avoid coming in contact with the muffler and other engine parts while engine is running. Temperatures may exceed 150 degrees F. Allow engine to cool before performing maintenance.

Safety considerations specific to drilling

Under certain digging conditions, such as hitting a buried boulder or root, severe and sudden side thrust can be exerted upon the operator(s). Injury can occur if operator(s) are not physically and mentally prepared to deal with this condition. When drilling in areas filled with obstructions, such as large rocks and debris, operate the earth drill at less than full throttle to assure a quicker clutch release when an object is hit.

Do not attempt to drill the hole in one pass. Drill to a depth of 1 to 2 feet, lift the machine and spin the dirt off, being careful not to lift the auger completely out of the hole . Repeat this procedure until you have reached the required depth. Turn the machine off and lift the rest of the dirt out for a clean hole.

It is not recommended that the earth drill be operated with arms in an extended positions or with the handle bars above the shoulders.

The higher the handle bars are above the hips the less control the operators will have. If an object is encountered while the auger is turning, the handle bars could be jerked from the operators hands, causing possible injury to the operator(s) and damage to the

machine.

Move close enough to the machine to allow the left handle bar grip to rest firmly against left hip. Be sure the throttle is in operator's right hand.

Information resources

Operators manuals for brand name earth drills including Ground Hog Inc. and "Tanaka" earth drills.

Oregon-OSHA Rules: Section IV of this curriculum tilted Worker Health, Equipment Operation, & Safety.

Safety Considerations for Anchoring Boulders, Logs, and Up-Rooted Stumps (Root Wads) Used for Salmonid Habitat Improvement Projects

Salmonid habitat restoration technology commonly uses cable, steel rebar, adhesive mortar, and solvents to join and secure downed trees, root wads, and boulders. The following are general safety considerations when using these materials.

Glossary of Terms

Cable: The generic name for wire rope and air craft cable used in part with rigging systems to move heavy objects.

Material Safety Data Sheet (MSDS): A potential health hazard disclosure document required of chemical manufactures.

Working load limit: The maximum mass or force which the product (rigging) is authorized to support in general service when the pull is in-line, unless noted otherwise, with respect to the center line of the product.

Ultimate load or breaking strength: The maximum mass or force which the product is authorized to support in a particular service.

Root wad: An up rooted cut stump used in streams as fish cover.

Rigging: A general term for lines that bare heavy loads that are required to move. The following are examples of rigging: logging cable, shackles, slings, and chokers.

Hilti glue: A brand name for adhesive mortar used to secure cable or rebar to boulders and bed rock.

Adhesive mortar and solvents used in combination with cable used to secure logs, root wads and boulders

Adhesive mortar or more commonly called "rock glue" is often used to secure stream enhancement structures. The rock glue is used in combination with cable, as a cost effective method of anchoring logs and root wads to boulders, and securing a series of boulders together. Hilti adhesive mortar ("Hilti glue") is a commonly used rock glue for this purpose. Because Hilti glue is widely accepted for use in securing the stream

structures, safety considerations listed below will revolve around the use of this product.

Request and read material safety data sheets (MSDS)

Personnel need to be familiar with potential safety hazards of chemicals used for stream enhancement purposes. Hilti glue, for instance, is a known suspected carcinogen. Additional information concerning this product is available from the manufacture via a material safety data sheet (MSDS). The data sheet discloses potential health hazards and preventative safety measures.

Solvents used to clean factor lubricated cable also pose potential health and safety considerations. In order for the cable to work with the rock glue, the cable needs to absolutely free of this grease. The grease dissolving solvents used to clean the cables include acetone and muriatic acid. It is important when using these solvents that precautions are taken to protect the person doing the cleaning, and that the cleaning is accomplished away from a stream in case of an accidental spill. These cleaning solvents are highly flammable and require proper storage procedures. Protective clothing when using solvents and Hilti glue need to be considered as well.

Additional safety consideration resources relating to polyester fastening resins and solvents

Oregon-OSHA Rules: See section IV of this curriculum tilted: Worker Health, Equipment Operation, & Safety.

Material Safety Data Sheets (MSDS) for specific solvent or adhesive resin in use.

Fish Habitat Restoration Course Outline developed by: College of the Redwoods, Del Norte Campus.

Safety considerations for cable and associated rigging equipment

Rigging equipment is designed to support heavy objects in motion including both large logs and boulders. Rigging equipment can include shackles, cables, cable pullers, nylon slings, chokers, and other accessories used to maneuver large heavy items.

Rigging similar to logging operations is also used to place logs and boulders in configurations that benefit salmonid habitat. Rigging is also used on recreation projects that involve hiking trail construction and maintenance projects. Because rigging supports heavy loads in motion, there exists safety considerations for the personnel using this equipment.

Rigging safety considerations

Griphoist cable puller: Griphoist brand cable pullers are extremely versatile tools for both stream restoration use and trail work. Their built-in overload protection makes them very safe. The following are safety considerations to keep in mind when setting up a pulling operation using the griphoist or any pulling machine designed to pull logs.

Safe working capacity: Before setting up to pull a load (object being moved), consider the capacities of all the components of the system. Look for capacities of the griphoist main lines, wire ropes, and nylon slings. Also look for capacities or shackles,

blocks, and cable pullers to be stamped on the side of the units. Safe working capacities for rigging equipment are available from rigging manufactures.

Line safety: Frequently, simply setting up a direct pull is not enough to accomplish the desired job. High leads, skylines, and mechanical advantage systems are often needed.

Cable fly zones: Cables under tension sometimes move quickly. There are zones in any rigging operation that are unsafe for persons to stand or work in.

The "V of Death": Wherever a cable changes direction at a block, the cable forms a "V" shape. If the block anchor should fail, the cable and possibly the block will fly suddenly down into this V-shaped area. No personnel should be allowed in this area while the lines are under tension. If someone needs to cross through the "V" zone, they should have all cable pulling equipment (hand griphoist or power winches) stop pulling until the personnel are out of the danger zone.

Rolling loads: Whenever a load is pulled across a side hill or down hill, the possibility exists that the load may roll or slide down the hill suddenly. This may even be the desired effect. When the load takes off down hill though, it will take the cable with it. The cable will swing down hill with the load possibly injuring an personnel in its path until the load stops on its own, reaches the end of the cable, or the cable wraps around an obstruction. Personnel operation pulling equipment (hand griphoist or power winches) must be aware of this and be sure to stand in a safe area relative to the machine moving with the cables.

Additional safety consideration resources relating to rigging

Oregon-OSHA Rules: See section IV of this curriculum tilted Worker Health, Equipment Operation, & Safety; number 5: Safety & Health Codes for general safety considerations.

Trails Manual developed by California Department of Parks & Recreation Klamath District 1991

Rigging Procedures Manual developed in part by: Divers Institute of Technology

Fish Habitat Restoration Course Outline developed by: College of the Redwoods, Del Norte Campus.

Suggested Field/Classroom Exercises

Most people learn by reading, watching, listening, and doing. Hence, the following field/classroom exercises might be of help:

1) Take a field trip to a typical job site. Do a brief hazard assessment survey and have each person say two things they found in order and in disrepair (equipment, activities, etc.).
2) Have each worker trainee create an outline of their company's injury and illness prevention plan. Discuss the parts and the needs for each.
3) Have the worker trainees break into small groups that create a system of recordkeeping for "their contracting company."

Resources for Further Information, Training/Certification

Oregon's workers' compensation insurance carriers must, by law, provide you with consultative services at no charge, upon request. They must:

- offer partial or complete on-site health and safety evaluations,
- explain the Oregon Safe Employment Act to employers and others.

The following resources are available through OR-OSHA:

- **Consultative services, all provided at no charge, include:**
  - hazard assessment
  - occupational safety and health programs
  - new and small business assistance
  - accident investigation
  - and others.

  Call 1-800-922-2689 to request these services.
- **Training, provided though a variety of workshops and classes, on a year-round schedule, on topics such as:**
  - recordkeeping
  - accident investigation
  - job hazard analysis
  - and others.

  All are no-cost workshops and most require pre-registration.
- **An audiovisual library, offering videos, films, slide programs, and training materials on numerous aspects of workplace safety and health.** All available on a loan basis. Topics include:
  - back injury prevention
  - eye safety
  - personal protective equipment
  - supervision/management
  - violence in the workplace
  - and many others.

  To get a catalog or order, see your local OR-OSHA office:

  Salem Central Office, 503-378-3272/1-800-922-2689
  Portland Office, 503-229-5910
  Eugene Office, 541-686-7562
  Bend Office, 541-388-6066
  Medford Office, 541-776-6030
  Pendleton Office, 541-276-9175

Other sources of information include trade associations, similar businesses, equipment manufacturers, labor unions, companies specializing in workplace safety, etc.

DEPARTMENT OF CONSUMER & BUSINESS SERVICES

CODE ORDER FORM

Oregon Occupational Safety & Health Division (OR-OSHA)
Standards & Technical Resources Section
(503) 378-3272 / Fax (503) 373-7013

Send to

Firm

Name

Street address | City | State | ZIP

( )

PO Box No. | PO ZIP | Phone

CODE ORDER

One copy of each **complete** division (1, 3, 5, 6) free. Additional copies $10 each. See back page for payment information.

No. of copies	Money enclosed		
_____	_____	**Division 1**	General Administrative Rules *(Includes some rules from Divisions 40 & 136)*
_____	_____	**Division 2**	General Occupational Safety & Health Rules *(Note: Until Division 2 becomes a completed volume, separate subdivisions are still available. SEE BACK PAGE.)*
_____	_____	**Division 3**	Construction
_____	_____	**Division 5**	Maritime Activities
_____	_____	**Division 6**	Forest Activities
_____	_____	**Division 81**	Agricultural Activities *(will become Division 4)*

First copy is free. Additional copies are $3 each.

_____ _____ **Oregon Revised Statutes (ORS) 654 –** The Oregon Safe Employment Act (OSEAct)

Text-Trieve: A private vendor also provides Oregon OSHA and other safety and health codes in a computerized retrieval format. Contact: Text-Trieve, Inc. at 1-800-578-4955, or fax (206) 367-8812.

OR-OSHA MAILING LIST

Send me: ☐ **Both proposed and final code change notices**

or ☐ **Final code change notices only**

Only notices will be sent. Please call the Resource Center, 378-3272, for actual copies of codes.
I want to receive change notices on: (Mark appropriate boxes below)

- ☐ **Division 1** General Administrative Rules
- ☐ **Division 2** General Occupational Safety & Health Rules
- ☐ **Division 3** Construction
- ☐ **Division 5** Maritime Activities
- ☐ **Division 6** Forest Activities
- ☐ **Division 81** Agricultural Activities

(CONTINUED ON OTHER SIDE)

DIVISION 2 SUBDIVISIONS

Until Division 2 becomes a completed volume, its separate subdivisions will continue to be available. First copy of each item below is free. Additional copies are $3 each.

No. of copies

_____ **Subdivision A** – General

_____ **Subdivision B** – Adoption & Extension of Established Federal Standards

_____ **Subdivision C** – Access to Employee Exposure & Medical Records

_____ **Subdivision D, E, F** – Walking-Working Surfaces, Means of Egress, Powered Platforms

_____ **Subdivision G** – Occupational Health & Environmental Control

_____ **Subdivision H** – Hazardous Materials (includes Hazardous Waste Operations & Emergency Response, PSM)

_____ **Subdivision I** – Personal Protective Equipment

_____ **Subdivision J** – General Environmental Controls (includes Lockout/Tagout, Permit-Required Confined Spaces)

_____ **Subdivision K** – Medical & First Aid

_____ **Subdivision L** – Fire Protection

_____ **Subdivision M** – Compressed Gas & Compressed Air Equipment

_____ **Subdivision N** – Material Handling & Storage (includes Commercial & Industrial Trucks)

_____ **Subdivision O** – Machinery & Machine Guarding

_____ **Subdivision P** – Hand & Portable Powered Tools & Other Hand-Held Equipment

_____ **Subdivision Q** – Welding, Cutting & Brazing

_____ **Subdivision R** – Special Industries (includes Ornamental Tree & Shrub Services, Grain Handling Facilities)

_____ **Subdivision R** – Electrical Power

_____ **Subdivision R** – Pulp, Paper & Paperboard Mills

_____ **Subdivision R** – Sawmills

_____ **Subdivision R** – Telecommunications

_____ **Subdivision S** – Electrical

_____ **Subdivision T** – Commercial Diving Operations

Subdivision Z – Toxic & Hazardous Substances

_____ Air Contaminants

_____ Asbestos

_____ Benzene

_____ Bloodborne Pathogens

_____ Cadmium

_____ Ethylene Oxide

_____ Formaldehyde

_____ Lead

_____ MDA

_____ Includes Carcinogens; Hazardous Chemicals in Labs; Hazard Communication, also available in stand alone.

_____ Hazard Communication (stand alone copy)

PAYMENT

Make check payable to:
Dept. of Consumer & Business Services

Mail this form to:
Dept. of Consumer & Business Services
Oregon OSHA
350 Winter St. NE, Rm. 430
Salem, OR 97310

(If check is enclosed, add to envelope: Attn: Fiscal Section)

Fiscal Use Only

51100/1105

Self-Inspection Checklists:

Since OR-OSHA regulations are quite extensive, these checklists are by no means inclusive. You should add to them or delete items which don't apply to your operations. More information regarding rules which may apply to your workplace are available from OR-OSHA's Standards and Technical Resources Section by calling (503) 378-3272.

Employer Posting

- ❑ Is the OR-OSHA poster, *Job Safety and Health*, displayed in a prominent location where all employees are likely to see it?

  Are other Oregon posters or notices properly displayed, such as:

  - ❑ Field Sanitation Notice for farm workers?
  - ❑ Safety Committee meeting minutes?
  - ❑ OSHA 200 Summary in February?
  - ❑ Notice of compensation guarantee contract?

- ❑ Are emergency telephone numbers posted where they can be readily used in case of emergency?

- ❑ Where employees may be exposed to any toxic substances or harmful physical agents, has appropriate information concerning employee access to medical and exposure records and Material Safety Data Sheets (MSDSs) been posted or otherwise made readily available to affected employees?

- ❑ Are signs regarding exits from buildings, room capacity, floor loading, exposure to x-ray, microwave, or other harmful radiation or substances posted where required?

Recordkeeping

- ❑ Are all occupational injuries & illnesses, except minor injuries requiring only first aid, being recorded as required on the *OSHA Form 200?*

- ❑ Are copies of *OSHA Form 200* and First Report of Injury, Form 801, kept for five years?

- ❑ Are employee medical records and records of employee exposures to hazardous substances or harmful physical agents current?

- ❑ Have arrangements been made to maintain required records for the legal period of time for each specific type of record? (Some records must be maintained for at least 40 years.)

- ❑ Are operating permits and records current for such items as elevators, pressure vessels, and liquefied petroleum gas tanks?

- ❑ Are employee safety and health training records maintained?

- ❑ Is documentation of safety inspections and corrections maintained?

Injury & Illness Prevention Program

- ❑ Do you have top management commitment?

- ❑ Have you established labor and management accountability?

- ❑ Do you have a system in place for hazard identification and control?

- ❑ Do you investigate all incidents and accidents?

- ❑ Do you encourage employee involvement in health and safety matters?

- ❑ Do you provide occupational safety and health training for your workers and supervisors?

- ❑ Do you perform periodic evaluations of the program?

Medical Services & First Aid

- ❑ Has an emergency medical plan been developed?

- ❑ Are emergency phone numbers posted?

- ❑ Are first aid kits easily accessible to each work area, with necessary supplies available, periodically inspected and replenished as needed?

- ❑ Are means provided for quick drenching or flushing of the eyes and body in areas where caustic or corrosive liquids or materials are handled?

Safety Committees

- ❑ Do you have an active safety committee with equal numbers of management and employees?

- ❑ Are records kept documenting safety and health training for each employee by name or other identifier, training dates, type(s) of training, and training provider?

- ❑ Does the committee meet at least monthly, or quarterly for office type environments?

- ❑ Is a written record of safety committee meetings distributed to affected employees, and maintained for division review?

- ❑ Does the safety committee conduct quarterly hazard identification surveys?

- ❑ Does the committee review results of periodic, scheduled work site inspections?
- ❑ Does the committee review accident and near-miss investigations and, where necessary, submit recommendations for prevention of future incidents?
- ❑ Does the committee involve all workers in the safety and health program?
- ❑ Are safety committee minutes kept three years and are each month's minutes posted?
- ❑ Has your safety committee developed an accident investigation procedure?
- ❑ Has the committee reviewed your safety and health program and made recommendations for possible improvements?
- ❑ Have committee members been trained and instructed in safety committee purpose and operation, methods of conducting meetings, OR-OSHA rules which apply to the workplace, hazard identification, and accident investigation principles?

Fire Protection

- ❑ Do you have a written fire-prevention plan?
- ❑ Does your plan describe the type of fire protection equipment and/or systems?
- ❑ Have you established practices and procedures to control potential fire hazards and ignition sources?
- ❑ Are employees aware of the fire hazards of the materials and processes to which they are exposed?
- ❑ If you have a fire alarm system, is it tested at least annually?
- ❑ Are sprinkler heads protected by metal guards when exposed to physical damage?
- ❑ Is proper clearance maintained below sprinkler heads?
- ❑ Are portable fire extinguishers provided in adequate numbers and types?
- ❑ Are fire extinguishers mounted in readily assessable locations?
- ❑ Are fire extinguishers recharged regularly and then noted on the inspection tag?
- ❑ Are employees trained in the use of extinguishers and fire protection procedures?

Personal Protective Equipment & Clothing

- ❑ Has there been an assessment of the hazards that might require PPE, including a review of injuries?
- ❑ Has the assessment been verified through written certification?
- ❑ Does it identify the workplace evaluated?
- ❑ Has training been provided to each employee required to wear PPE?
- ❑ Has the training been verified through written certification?
- ❑ Are protective goggles or face shields provided and worn when there is any danger of flying material or caustic or corrosive materials?
- ❑ Are approved safety glasses required to be worn at all times in areas where there is risk of eye injury?
- ❑ Are protective gloves, aprons, shields, or other protection provided against cuts, corrosive liquids, and chemicals?
- ❑ Are hard hats provided and worn where danger of falling objects exists?
- ❑ Are hard hats inspected periodically for damage to the shell and suspension system?
- ❑ Are approved respirators provided for regular or emergency use where needed?
- ❑ Is there a written respirator program?
- ❑ Are the respirators inspected before and after each use?
- ❑ Is a written record kept of all inspection dates and findings?
- ❑ Have all employees been trained in adequate work procedures, use and maintenance of protective clothing, and proper use of equipment when cleaning up spilled toxic or other hazardous materials or liquids?
- ❑ Is a spill kit available to clean up spilled toxic or hazardous materials?
- ❑ Where employees are exposed to conditions that could cause foot injury, are safety shoes required to be worn?

- ❑ Is all protective equipment maintained in a sanitary condition and ready for use?
- ❑ Do you have eyewash facilities and a quick-drench shower within a work area where employees are exposed to caustic or corrosive materials?
- ❑ When lunches are eaten on the premises, are they eaten in areas where there is no exposure to toxic materials or other health hazards?
- ❑ Is protection against the effects of occupational noise exposure provided when sound levels exceed those of the OR-OSHA noise and hearing conservation standard?

General Work Environment

- ❑ Are all work sites clean and orderly?
- ❑ Are work surfaces kept dry or appropriate means taken to assure the surfaces are slip-resistant?
- ❑ Are all spilled materials or liquids cleaned up immediately?
- ❑ Is combustible scrap, debris, and waste stored safely and removed from the work site promptly?
- ❑ Are covered metal waste cans used for oily and paint-soaked waste?
- ❑ Are the minimum number of toilets and washing facilities provided?
- ❑ Are all toilets and washing facilities clean and sanitary?
- ❑ Are all work areas adequately lighted?

Walkways

- ❑ Are aisles and passageways kept clear and are they at least 22 inches wide?
- ❑ Are aisles and walkways appropriately marked?
- ❑ Are wet surfaces covered with non-slip materials?
- ❑ Are openings or holes in the floors or other treading surfaces repaired or otherwise made safe?
- ❑ Is there safe clearance for walking in aisles where vehicles are operating?
- ❑ Are materials or equipment stored so sharp objects can not obstruct the walkway?
- ❑ Are changes of direction or elevations readily identifiable?
- ❑ Are aisles or walkways that pass near moving or operating machinery, welding operations, or similar operations arranged so employees will not be subjected to potential hazards?
- ❑ Is adequate headroom (of at least 6.5 feet) provided for the entire length of any walkway?
- ❑ Are standard guardrails provided wherever aisle or walkway surfaces are elevated more than four feet above any adjacent floor or the ground?
- ❑ Are bridges provided over conveyors and similar hazards?

Floor & Wall Openings

- ❑ Are floor holes or openings guarded by a cover, guardrail, or equivalent on all sides (except at entrance to stairways or ladders)?
- ❑ Are toe boards installed around the edges of a permanent floor opening (where persons may pass below the opening)?
- ❑ Are skylight screens of such construction and mounting that they will withstand a load of at least 200 pounds?
- ❑ Is the glass in windows, doors, and glass walls (which may be subject to human impact) of sufficient thickness and type for all conditions of use?
- ❑ Are grates or similar covers over floor openings, such as floor drains, of such design that foot traffic or rolling equipment will not be caught by the grate spacing?
- ❑ Are unused portions of service pits and pits not actually in use either covered or protected by guardrails or equivalent?

Stairs & Stairways

- ❑ Are standard stair rails and handrails present on all stairways having four or more risers?
- ❑ Are all stairways at least 22 inches wide?
- ❑ Do stairs have at least a 6.5 feet overhead clearance?
- ❑ Do stairs angle no more than 50 degrees and no less than 30 degrees?
- ❑ Are step risers on stairs uniform from top to bottom, with no riser spacing greater than 7.5 inches?
- ❑ Are steps on stairs and stairways designed or provided with a surface that renders them slip resistant?

- ❑ Are stairway handrails located between 30-34 inches above the leading edge of stair treads?
- ❑ Do stairway handrails have at least 3 inches clearance between handrails and the wall or surface they are mounted on?
- ❑ Are stairway handrails capable of withstanding a load of 200 pounds applied in any direction?
- ❑ Where stairs or stairways exit directly into any area where vehicles may be operated, are adequate barriers and warnings provided to prevent employees from stepping into the path of traffic?

Elevated Surfaces

- ❑ Are signs posted, when appropriate, showing elevated floor load capacity?
- ❑ Are elevated surfaces (more than four feet above the floor or ground) provided with standard guardrails?
- ❑ Are all elevated surfaces (beneath which people or machinery could be exposed to falling objects) provided with standard toe boards?
- ❑ Is a permanent means of access/egress provided to elevated work surfaces?
- ❑ Is material on elevated surfaces piled, stacked, or racked in a manner to prevent it from tipping, falling, collapsing, rolling, or spreading?
- ❑ Are dock boards or bridge plates used when transferring materials between docks and trucks or railcars?
- ❑ When in use, are dock boards or bridge plates secured in place?

Exit or Egress

- ❑ Are all exits marked with an exit sign and illuminated by a reliable light source?
- ❑ Are the directions to exits, if not immediately apparent, marked with visible signs?
- ❑ Are doors, passageways, or stairways, that are neither exits nor access to exits and which could be mistaken for exits, appropriately marked "NOT AN EXIT," or "TO BASEMENT," "STOREROOM," and the like?
- ❑ Are exit signs provided with the word "EXIT" in lettering at least six inches high and the stroke of the lettering at least ¾ inch wide?
- ❑ Are exit doors side-hinged?
- ❑ Are all exits kept free of obstructions and unlocked?
- ❑ Are at least two means of egress provided from elevated platforms, pits or rooms where the absence of a second exit would increase the risk of injury from hot, poisonous, corrosive, suffocating, flammable, or explosive substances?
- ❑ Are there sufficient exits to permit prompt escape in case of emergency?
- ❑ Are the number of exits from each floor of a building and the number of exits from the building itself appropriate for the building occupancy load?
- ❑ When workers must exit through glass doors, storm doors and such, are the doors fully tempered and meeting safety requirements for human impact?

Exit Doors

- ❑ Are doors which are required to serve as exits designed and constructed so that the way of exit travel is obvious and direct?
- ❑ Are windows (which could be mistaken for exit doors) made inaccessible by barriers or railing?
- ❑ Are exit doors able to open from the direction of exit travel without the use of a key or any special knowledge or effort?
- ❑ Is a revolving, sliding, or overhead door prohibited from serving as a required exit door?
- ❑ When panic hardware is installed on a required exit door, will it allow the door to open by applying a force of 15 pounds or less in the direction of the exit traffic?
- ❑ Are doors on cold-storage rooms provided with an inside release mechanism which will release the latch and open the door even if it is padlocked or otherwise locked on the outside?
- ❑ Where exit doors open directly onto any street, alley, or other area where vehicles may be operated, are adequate barriers and warnings provided to prevent employees from stepping directly into the path of traffic?
- ❑ Are doors that swing in both directions and are located between rooms where there is frequent traffic, provided with viewing panels in each door?

Portable Ladders

- ❑ Are all ladders maintained in good condition, joints between steps and side rails tight, all hardware and fittings securely attached, and moveable parts operating freely without binding or undue play?
- ❑ Are nonslip safety feet provided on each ladder including metal or rung ladders?
- ❑ Are ladder rungs and steps free of grease and oil?
- ❑ Is it prohibited to place a ladder in front of doors opening toward the ladder except when the door is blocked open, locked, or guarded?
- ❑ Is it prohibited to place ladders on boxes, barrels, or other unstable bases to obtain additional height?
- ❑ Are employees instructed to face the ladder when ascending/descending?
- ❑ Are employees prohibited from using ladders that are broken, missing steps, rungs or cleats, broken side rails, or other faulty equipment?
- ❑ Are employees instructed not to use the top step of ordinary stepladders as a step?
- ❑ When portable rung ladders are used to gain access to elevated platforms, roofs, and the like, does the ladder always extend at least three feet above the elevated surface?
- ❑ Is it required that when portable rung or cleat-type ladders are used, the base is so placed that slipping will not occur, or it is lashed or otherwise held in place?
- ❑ Are portable metal ladders legibly marked with signs reading "CAUTION — Do Not Use Around Electrical Equipment" or equivalent wording?
- ❑ Are the rungs of ladders uniformly spaced at 12 inches, center to center?

Hand Tools & Equipment

- ❑ Are all tools and equipment (both company and employee-owned) in good working condition?
- ❑ Are hand tools such as chisels or punches (which develop mushroomed heads during use) reconditioned or replaced as necessary?
- ❑ Are broken or fractured handles on hammers, axes, or similar equipment replaced promptly?
- ❑ Are appropriate handles used on files and similar tools?
- ❑ Are appropriate safety glasses, face shields, and similar equipment used while using hand tools or equipment which might produce flying materials or be subject to breakage?
- ❑ Are jacks checked periodically to assure that they are in good operating condition?
- ❑ Are tool handles wedged tightly in the head of all tools?
- ❑ Are tool cutting edges kept sharp so the tool will move smoothly without binding or skipping?
- ❑ Is eye and face protection used when driving hardened or tempered tools, bits, or nails?

Portable (Power-Operated) Tools & Equipment

- ❑ Are grinders, saws, and similar equipment provided with appropriate safety guards?
- ❑ Are power tools used with the shield or guard recommended by the manufacturer?
- ❑ Are portable circular saws equipped with guards above and below the base shoe?
- ❑ Are circular saw guards checked to assure guarding of the lower blade portion?
- ❑ Are rotating or moving parts of equipment guarded to prevent physical contact?
- ❑ Are all cord-connected, electrically-operated tools and equipment effectively grounded or of the approved double-insulated type?
- ❑ Are effective guards in place over belts, pulleys, chains, and sprockets on equipment such as concrete mixers, air compressors, and the like?
- ❑ Are portable fans provided with full guards having openings of ½ inch or less?
- ❑ Is hoisting equipment available and used for lifting heavy objects, and are hoist ratings and characteristics appropriate for the task?
- ❑ Are ground-fault circuit interrupters (provided on all temporary electrical 15 and 20 ampere circuits) used during periods of construction?
- ❑ Are pneumatic and hydraulic hoses on power-operated tools checked regularly for deterioration or damage?

Abrasive Wheel Equipment Grinders

- ❑ Is the work rest used and kept adjusted to within ⅛ inch of the wheel?
- ❑ Is the adjustable tongue on the top side of the grinder used and kept adjusted to within ¼ inch of the wheel?
- ❑ Do side guards cover the spindle, nut, flange, and 75 percent of the wheel diameter?
- ❑ Are bench and pedestal grinders permanently mounted?
- ❑ Are goggles or face shields always worn when grinding?
- ❑ Is the maximum RPM rating of each abrasive wheel compatible with the RPM rating of the grinder motor?
- ❑ Are fixed or permanently mounted grinders connected to their electrical supply system with metallic conduit or by another permanent wiring method?
- ❑ Does each grinder have an individual on/off switch?
- ❑ Is each electrically-operated grinder effectively grounded?
- ❑ Before mounting new abrasive wheels, are they visually inspected and ring tested?
- ❑ Are dust collectors and powered exhausts provided on grinders used in operations that produce large amounts of dust?
- ❑ To prevent coolant from splashing workers, are splash guards mounted on grinders that use coolant?
- ❑ Is cleanliness maintained around grinders?

Machine Guarding

- ❑ Is there an employee training program for safe methods of machine operation?
- ❑ Is there adequate supervision to ensure that employees are following safe machine operating procedures?
- ❑ Is there a regular program of safety inspection for machinery and equipment?
- ❑ Is all machinery and equipment clean and properly maintained?
- ❑ Is sufficient clearance provided around and between machines to allow for safe operations, set up and servicing, material handling, and waste removal?
- ❑ Is equipment and machinery securely placed and anchored when necessary to prevent tipping or other movement that could result in personal injury?
- ❑ Is there a power shut-off switch within reach of the operator's position at each machine?
- ❑ Are the noncurrent-carrying metal parts of electrically-operated machines bonded and grounded?
- ❑ Are foot-operated switches guarded or arranged to prevent accidental actuation by personnel or falling objects?
- ❑ Are manually operated valves and switches (controlling the operation of equipment and machines) clearly identified and readily accessible?
- ❑ Are all emergency stop buttons colored red?
- ❑ Are all pulleys and belts (that are located within seven feet of the floor or working level) properly guarded?
- ❑ Are all moving chains and gears properly guarded?
- ❑ Are methods provided to protect the operator and other employees in the machine area from hazards created at the point of operation, ingoing nip points, rotating parts, flying chips, and sparks?
- ❑ Are machinery guards secured and arranged so they do not offer a hazard in their use?
- ❑ If special hand tools are used for placing and removing material, do they protect the operator's hands?
- ❑ Are revolving drums, barrels, and containers (required to be guarded by an enclosure that is interlocked with the drive mechanism so that revolution cannot occur) guarded?
- ❑ Do arbors and mandrels have firm and secure bearings, and are they free from play?
- ❑ Are provisions made to prevent machines from automatically starting when power is restored (following a power failure or shut-down)?
- ❑ Are machines constructed so as to be free from excessive vibration (when the largest size tool is mounted and run at full speed)?
- ❑ If machinery is cleaned with compressed air, is air pressure controlled and personal protective equipment or other safeguards used to protect operators and other workers from eye and body injury?

- ❑ Are fan blades protected with a guard having openings no larger than ½ inch when operating within seven feet of the floor?
- ❑ Are saws used for ripping equipped with anti-kickback devices and spreaders?
- ❑ Are radial arm saws guarded and so arranged that the cutting head will gently return to the back of the table when released?

Lockout/Tagout Procedures

- ❑ Is all machinery or equipment (capable of movement) required to be de-energized or disengaged and locked out during cleaning, servicing, adjusting, or setting-up operations?
- ❑ Is it prohibited to lock out control circuits in lieu of locking out main power disconnects?
- ❑ Are all equipment control valve handles provided with a means of lockout?
- ❑ Does the lockout/tagout procedure require that stored energy (i.e., mechanical, hydraulic, air) be released or blocked before equipment is locked out for repairs?
- ❑ Are appropriate employees provided with individually keyed personal safety locks?
- ❑ Are employees required to keep personal control of their key(s) while they have safety locks in use?
- ❑ Is it required that employees check the safety of the lockout by attempting to start up after making sure no one is exposed?

  Where the power disconnecting means for equipment does not also disconnect the electrical control circuit:

  - ❑ Are the appropriate electrical enclosures identified?
  - ❑ Are means provided to assure the control circuit can also be disconnected and locked out?

Welding, Cutting & Brazing

- ❑ Are only authorized and trained personnel permitted to use welding, cutting, or brazing equipment?
- ❑ Are compressed gas cylinders regularly examined for signs of defect, deep rusting, or leakage?
- ❑ Are cylinders kept away from sources of heat?
- ❑ Is it prohibited to use cylinders as rollers or supports?
- ❑ Are empty cylinders appropriately marked, their valves closed, and valve-protection caps placed on them?
- ❑ Are signs reading: "DANGER — NO SMOKING, MATCHES OR OPEN LIGHTS," or the equivalent posted?
- ❑ Are cylinders, cylinder valves, couplings, regulators, hoses, and apparatus kept free of oily or greasy substances?
- ❑ Unless secured on special trucks, are regulators removed and valve-protection caps put in place before moving cylinders?
- ❑ Do cylinders without fixed hand wheels have keys, handles, or nonadjustable wrenches on stem valves when in service?
- ❑ Are liquefied gases stored and shipped with the valve end up, and with valve covers in place?
- ❑ Before a regulator is removed, is the valve closed, and then gas released from the regulator?
- ❑ Is open circuit (no load) voltage of arc welding and cutting machines as low as possible, and not in excess of the recommended limit?
- ❑ Are electrodes removed from the holders when not in use?
- ❑ Is it required that electric power to the welder be shut off when no one is in attendance?
- ❑ Is suitable fire extinguishing equipment available for immediate use?
- ❑ Is the welder forbidden to coil or loop welding electrode cable around his/her body?
- ❑ Are work and electrode lead cable frequently inspected for wear and damage, and replaced when needed?
- ❑ Do means for connecting cable lengths have adequate insulation?
- ❑ When the object to be welded cannot be moved and fire hazards cannot be removed, are shields used to confine heat, sparks, and slag?
- ❑ Are fire watchers assigned when welding or cutting is performed in locations where a serious fire might develop?
- ❑ When welding is done on all metal walls, are precautions taken to protect combustibles on the other side?

- ❑ Before hot work begins, are drums, barrels, tanks, and other containers so thoroughly cleaned and tested that no substances remain that could explode, ignite, or produce toxic vapors?
- ❑ Do eye protection helmets, hand shields, and goggles meet appropriate standards?
- ❑ Are employees exposed to the hazards created by welding, cutting, or brazing operations protected with personal protective equipment and clothing?
- ❑ Is a check made for adequate ventilation in and where welding or cutting is performed?
- ❑ When working in confined spaces, are environmental monitoring tests taken and means provided for quick removal of welders in case of an emergency?

Compressors & Compressed Air

- ❑ Are compressors equipped with pressure-relief valves and pressure gauges?
- ❑ Are compressor air intakes installed and equipped to ensure that only clean, uncontaminated air enters the compressor?
- ❑ Are air filters installed on the compressor intake?
- ❑ Are compressors operated and lubricated in accordance with the manufacturer's recommendations?
- ❑ Are safety devices on compressed air systems checked frequently?
- ❑ Before any repair work is done on the pressure systems of the compressor, is the pressure bled off and the system locked out?
- ❑ Are signs posted to warn of the automatic starting feature of the compressors?
- ❑ Is the belt drive system totally enclosed to provide protection on the front, back, top, and sides?
- ❑ Is it strictly prohibited to direct compressed air toward a person?
- ❑ Are employees prohibited from using compressed air (at over 29 PSI) for cleaning purposes?
- ❑ Are employees prohibited from cleaning off clothing with compressed air?
- ❑ When using compressed air for cleaning, do employees use personal protective equipment?
- ❑ Are safety chains or other suitable locking devices used at couplings of high pressure hose lines where a connection failure would create a hazard?
- ❑ Before compressed air is used to empty containers of liquid, is the safe working pressure of the container checked?
- ❑ When compressed air is used with abrasive blast cleaning equipment, is the operating valve a type that must be held open manually?
- ❑ Is it prohibited to use compressed air to clean up or move combustible dust, if such action could cause the dust to be suspended in the air and cause a fire or explosion?
- ❑ If plastic piping is used, is the plastic approved for air line service? (Some ABS is OK — PVC is not.)

Compressed Gas & Cylinders

- ❑ Are cylinders with water-weight capacity over 30 pounds equipped (with means for connecting a valve protector or device, or with a collar or recess) to protect the valve?
- ❑ Are cylinders legibly marked to clearly identify the gas contained?
- ❑ Are compressed gas cylinders stored in areas which are protected from external heat sources (such as flames impingement, intense radiant heat, electric arcs or high temperature lines)?
- ❑ Are cylinders located or stored in areas where they will not be damaged by passing or falling objects or be subject to tampering by unauthorized persons?
- ❑ Are cylinders stored or transported in a manner to prevent them from creating a hazard by tipping, falling, or rolling?
- ❑ Are cylinders containing liquefied fuel gas stored or transported in a position so that the safety relief device is always in direct contact with the vapor space in the cylinder?
- ❑ Are valve protectors always placed on cylinders when the cylinders are not in use or connected for use?
- ❑ Are all valves closed off before a cylinder is moved, when the cylinder is empty, and at the completion of each job?
- ❑ Are low-pressure fuel-gas cylinders checked periodically for corrosion, general distortion, cracks, or any other defect that might indicate a weakness or render them unfit for service?

- ❑ Does the periodic check of low-pressure fuel-gas cylinders include a close inspection of the bottom of each cylinder?

Industrial Trucks / Forklifts

- ❑ Are only trained personnel allowed to operate industrial trucks?
- ❑ Is substantial overhead protective equipment provided on high-lift rider equipment?
- ❑ Are the required lift-truck operating rules posted and enforced and is the capacity rating posted in plain view of the operator?
- ❑ Is directional lighting provided on each industrial truck that operates in an area with less than two footcandles per square foot of general lighting?
- ❑ Does each industrial truck have a warning horn, whistle, gong, or other device which can be clearly heard above the normal noise in the area where operated?
- ❑ Are the brakes on each industrial truck capable of bringing the vehicle to a complete and safe stop when fully loaded?
- ❑ Will the industrial truck's parking brake effectively prevent the vehicle from moving when unattended?
- ❑ Are industrial trucks operating in areas where flammable gases or vapors, combustible dust, or ignitable fibers may be present in the atmosphere, approved for such locations?
- ❑ Are motorized hand and hand/rider trucks so designed that the brakes are applied and power to the drive motor shuts off when the operator releases his/her grip on the device that controls the travel?
- ❑ Are industrial trucks with internal combustion engines (and operated in buildings or enclosed areas) carefully checked to ensure such operations do not cause harmful concentrations of dangerous gases or fumes?

Spray Finishing Operations

- ❑ Is adequate ventilation assured before spray operations are started?
- ❑ Is mechanical ventilation provided when spraying is performed in enclosed areas?
- ❑ When mechanical ventilation is provided during spraying operations, is it arranged so that it will not circulate contaminated air?
- ❑ Is the spray area free of hot surfaces?
- ❑ Is the spray area at least 20 feet from flames, sparks, operating electrical motors, and other ignition sources?
- ❑ Are the portable lamps used to illuminate spray areas suitable for use in a hazardous location?
- ❑ Is approved respiratory equipment provided and used during spraying operations?
- ❑ Do solvents used for cleaning have a flash point of 100°F or more?
- ❑ Are fire control sprinkler heads kept clean?
- ❑ Are "NO SMOKING" signs posted in the spray areas, paint rooms, paint booths, and paint storage areas?
- ❑ Is the spray area kept clean of combustible residue?
- ❑ Are spray booths constructed of metal, masonry, or other substantial noncombustible material?
- ❑ Are spray booth floors and baffles noncombustible and easily cleaned?
- ❑ Is infrared drying apparatus kept out of the spray area during spraying operations?
- ❑ Is the spray booth completely ventilated before the drying apparatus is used? Is the electric drying apparatus properly grounded? Do all drying spaces have adequate ventilation?
- ❑ Are lighting fixtures for spray booths located outside the booth, and the interior lighted through sealed clear panels?
- ❑ Are the electric motors for exhaust fans placed outside booths or ducts?
- ❑ Are belts and pulleys inside the booth fully enclosed?
- ❑ Do ducts have access doors to allow cleaning?

Confined Spaces

- ❑ Is there a written permit confined space program?
- ❑ Is the program available for inspection?
- ❑ Are confined spaces thoroughly emptied of any corrosive or hazardous substances, such as acids or caustics, before entry?
- ❑ Before entry, are all pipe lines to a confined space containing inert, toxic, flammable, or corrosive materials valved off and blanked or disconnected and separated?

- ❑ Are all impellers, agitators, or other moving equipment inside confined spaces locked out if they present a hazard?
- ❑ Is either natural or mechanical ventilation provided prior to confined space entry?
- ❑ Before entry, are appropriate atmospheric tests performed to check for oxygen deficiency, toxic substances, and explosive concentrations in the confined space?
- ❑ Is adequate lighting provided for the work being performed in the confined space?
- ❑ Is the atmosphere inside the confined space frequently tested or continuously monitored during the work process?
- ❑ Is there an attendant standing by outside the confined space, whose sole responsibility is to watch the work in progress, sound an alarm if necessary, and help render assistance?
- ❑ Is the attendant or other employees prohibited from entering the confined space without lifelines and respiratory equipment if there is an emergency?
- ❑ In addition to the attendant, is there at least one other trained rescuer in the vicinity?
- ❑ Are all rescuers appropriately trained and using approved, recently inspected equipment?
- ❑ Does all rescue equipment allow for lifting employees vertically through a top opening?
- ❑ Are rescue personnel first aid and CPR-trained and immediately available?
- ❑ Is there an effective communication system in place whenever respiratory equipment is used, and the employee in the confined space is out of sight of the attendant?
- ❑ Is approved respiratory equipment required if the atmosphere inside the confined space cannot be made acceptable?
- ❑ Is all portable electrical equipment used inside confined spaces either grounded and insulated or equipped with ground-fault protection?
- ❑ Before gas welding or burning is started in a confined space, are hoses checked for leaks, compressed gas bottles forbidden inside the confined space, torches lighted only outside the confined space area, and the confined space area tested for an explosive atmosphere each time before a lighted torch is taken into the confined space?
- ❑ When using oxygen-consuming equipment (such as salamanders, torches, furnaces) in a confined space, is air provided to assure combustion without reducing the oxygen concentration of the atmosphere below 19.5 percent by volume?
- ❑ Whenever combustion-type equipment is used in a confined space, are provisions made to ensure that the exhaust gases are vented outside the enclosure?
- ❑ Is each confined space checked for decaying vegetation or animal matter which may produce methane?
- ❑ Is the confined space checked for possible industrial waste which could contain toxic properties?
- ❑ If the confined space is below the ground and near areas where motor vehicles are operating, is it possible for vehicle exhaust or carbon monoxide to enter the space?

Environmental Controls

- ❑ Are all work areas properly lighted?
- ❑ Are hazardous substances identified which may cause harm by inhalation, ingestion, skin absorption, or contact?
- ❑ Are employees aware of the hazards involved with the various chemicals they may be exposed to in their work environment, such as ammonia, chlorine, epoxies, and caustics?
- ❑ Is employee exposure to chemicals in the workplace kept within acceptable levels? Can a less harmful method or product be used?
- ❑ Is the work area's ventilation system appropriate for the work being performed?
- ❑ Are proper precautions being taken when handling asbestos and other fibrous materials?
- ❑ Are caution labels and signs used to warn of asbestos?
- ❑ Is the possible presence of asbestos determined prior to the beginning of any repair, demolition, construction, or reconstruction work?
- ❑ Are asbestos-covered surfaces kept in good repair to prevent release of fibers?
- ❑ Are wet methods used (when practicable) to prevent emission of airborne asbestos fibers, silica dust, and similar hazardous materials?
- ❑ Is vacuuming with appropriate equipment conducted, rather than blowing or sweeping dust?

- ❑ Are grinders, saws, and other machines that produce respirable dusts vented to an industrial collector or central exhaust system?
- ❑ Are all local exhaust ventilation systems designed and operated properly (at the airflow and volume necessary) for the application? Are the ducts free of obstructions? Have you checked to ensure that the belts are not slipping?
- ❑ Is personal protective equipment provided, used, and maintained whenever required?
- ❑ Are there written *Standard Operating Procedures* for the selection and use of respirators?
- ❑ Are restrooms and washrooms kept clean and sanitary?
- ❑ Is all water (provided for drinking, washing, and cooking) potable?
- ❑ Are all outlets for water (that is not suitable for drinking) clearly identified?
- ❑ Are employees instructed in the proper manner of lifting heavy objects?
- ❑ Where heat is a problem, have all fixed work areas been provided with a proper means of cooling?
- ❑ Are employees working on streets and roadways, where they are exposed to the hazards of traffic, required to wear high-visibility clothing?
- ❑ Are exhaust stacks and air intakes located so that contaminated air will not be recirculated within a building or other enclosed area?

Flammable & Combustible Materials

- ❑ Are combustible scrap, debris, and waste materials stored in covered metal receptacles, and removed from the work site promptly?
- ❑ Are proper storage methods used to minimize the risk of fire and spontaneous combustion?
- ❑ Are approved containers and tanks used for the storage and handling of flammable and combustible liquids?
- ❑ Are all connections on drums and combustible liquid piping (vapor and liquid) tight?
- ❑ Are all flammable liquids kept in closed containers when not in use?
- ❑ Are bulk drums of flammable liquids grounded and bonded to containers during dispensing?
- ❑ Do storage rooms for flammable and combustible liquids have explosion-proof lights?
- ❑ Do storage rooms for flammables and combustible liquids have mechanical or gravity ventilation?
- ❑ Are safe practices followed when liquid petroleum gas is stored, handled, and used?
- ❑ Are liquefied petroleum storage tanks guarded to prevent damage from vehicles?
- ❑ Are all solvent wastes and flammable liquids kept in fire-resistant, covered containers until they are removed from the work site?
- ❑ Is vacuuming used whenever possible, rather than blowing or sweeping combustible dust?
- ❑ Are fire separators placed between containers of combustibles or flammables when stacked one upon another (to assure their support and stability)?
- ❑ Are fuel-gas cylinders and oxygen cylinders separated by distance, fire-resistant barriers or other means while in storage?
- ❑ Are fire extinguishers provided for the type of materials they will extinguish, and placed in areas where they are to be used?

  CLASS A: *Ordinary combustible materials fires*

  CLASS B: *Flammable liquid, gas, or grease fires*

  CLASS C: *Energized-electrical equipment fires*
- ❑ If a Halon 1301 fire extinguisher is used, can employees evacuate within the specified time (for that extinguisher)?
- ❑ Are appropriate fire extinguishers mounted within 75 feet of outside areas containing flammable liquids, and within 10 feet of any inside storage area for such materials?
- ❑ Is the transfer/withdrawal of flammable or combustible liquids performed by trained personnel?
- ❑ Are fire extinguishers mounted so that employees do not have to travel more than 75 feet for a Class A fire or 50 feet for a Class B fire?
- ❑ Are employees trained in the use of fire extinguishers?
- ❑ Are all extinguishers serviced, maintained, and tagged at intervals not to exceed one year? Is a record maintained of required monthly checks of extinguishers?

- ❑ Are all extinguishers fully charged and in their designated places? Are extinguishers free from obstruction or blockage?
- ❑ Where sprinkler systems are permanently installed, are the nozzle heads directed or arranged so that water will not be sprayed into operating electrical switchboards and equipment?
- ❑ Are "NO SMOKING" signs posted where appropriate in areas where flammable or combustible materials are used or stored?
- ❑ Are "NO SMOKING" signs posted on liquefied petroleum gas tanks?
- ❑ Are "NO SMOKING" rules enforced in areas involving storage and use of flammable materials?
- ❑ Are safety cans used (for dispensing flammable or combustible liquids) at the point of use?
- ❑ Are all spills of flammable or combustible liquids cleaned up promptly?

Hazardous Chemical Exposures

- ❑ Is employee exposure to chemicals kept within acceptable levels?
- ❑ Are eyewash fountains and safety showers provided in areas where caustic corrosive chemicals are handled?
- ❑ Are all employees required to use personal protective clothing and equipment (gloves, eye protection, respirators) when handling chemicals?
- ❑ Are flammable or toxic chemicals kept in closed containers when not in use?
- ❑ Where corrosive liquids are frequently handled in open containers or drawn from storage vessels or pipelines, are adequate means provided to neutralize or dispose of spills or overflows (properly and safely)?
- ❑ Have standard operating procedures been established, and are they being followed, when cleaning up chemical spills?
- ❑ Are respirators stored in a convenient, clean, and sanitary location?
- ❑ Are emergency-use respirators adequate for the various conditions under which they may be used?
- ❑ Are employees prohibited from eating in areas where hazardous chemicals are present?
- ❑ Is personal protective equipment provided, used, and maintained whenever necessary?
- ❑ Are there written *Standard Operating Procedures* for selecting and using respirators where needed?
- ❑ If you have a respirator protection program, are your employees instructed on the correct usage and limitations of the respirators?
- ❑ Are the respirators NIOSH-approved for each particular application?
- ❑ Are respirators inspected and cleaned, sanitized, and maintained regularly?
- ❑ Are you familiar with the Threshold Limit Value (TLV) or Permissible Exposure Limit (PEL) of airborne contaminants and physical agents used in your workplace?
- ❑ Have you considered having an industrial hygienist or environmental health specialist evaluate your work operations?
- ❑ If internal combustion engines are used, is carbon monoxide kept within acceptable levels?
- ❑ Is vacuuming used rather than blowing or sweeping dusts whenever possible for cleanups?

Hazard Communication

- ❑ Have you compiled a list of hazardous substances that are used in your workplace?
- ❑ Is there a written hazard communication program dealing with Material Safety Data Sheets (MSDS), labeling, and employee training?
- ❑ Who is responsible for MSDSs, container labeling, and employee training?
- ❑ Is each container for a hazardous substance (vats, bottles, storage tanks) labeled with product identity and a hazard warning (communicating the specific health hazard and physical hazards)?
- ❑ Is there an MSDS readily available for each hazardous substance used?
- ❑ How will you inform other employers whose employees share the same work area where hazardous substances are used?

Do you have an employee training program for hazardous substances? Does this program include:

- ❑ An explanation of what an MSDS is, and how to use and obtain one? An explanation of "Right to Know?"
- ❑ The contents of the MSDS for each hazardous substance or class of substances?
- ❑ Informing employees where they can review the employer's written hazard communication program, and where hazardous substances are located in work areas?
- ❑ Explaining the physical and health hazards of substances in the work area, and how to detect their presence, and specific protective measures to be used?
- ❑ Hazard communication program details including labeling system and MSDS use?
- ❑ How employees will be informed of hazards of nonroutine tasks, and hazards of unlabeled pipes?

Electrical Safety

- ❑ Are your workplace electricians familiar with OR-OSHA electrical safety rules?
- ❑ Do you require compliance with OR-OSHA rules on all contract electrical work?
- ❑ Are all employees required to report (as soon as practical) any obvious hazard to life or property observed in connection with electrical equipment or lines?
- ❑ Are employees instructed to make preliminary inspections and/or appropriate tests to determine what conditions exist before starting work on electrical equipment or lines?
- ❑ When electrical equipment or lines are to be serviced, maintained, or adjusted, are necessary switches opened, locked out, and tagged?
- ❑ Are portable hand-held electrical tools and equipment grounded or are they of the double-insulated type?
- ❑ Are electrical appliances such as vacuum cleaners, polishers, and vending machines grounded?
- ❑ Do extension cords have a grounding conductor? Are multiple plug adaptors prohibited?
- ❑ Are ground-fault circuit interrupters installed on each temporary 15 or 20 ampere, 120-volt AC circuit at locations where construction, demolition, modifications, alterations, or excavations are being performed?
- ❑ Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junction with permanent wiring?
- ❑ Is exposed wiring and cords with frayed or deteriorated insulation repaired or replaced promptly?
- ❑ Are flexible cords and cables free of splices or taps?
- ❑ Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, and is the cord jacket securely held in place?
- ❑ Are all cords, cable, and raceway connections intact and secure?
- ❑ In wet or damp locations, are electrical tools and equipment appropriate for the use or locations (or otherwise protected)?
- ❑ Is the location of electrical power lines and cables (overhead, underground, underfloor, other side of walls) determined before digging, drilling, or similar work is started?
- ❑ Is the use of metal measuring tapes, ropes, hand lines, or similar devices with metallic thread woven into the fabric, prohibited where these could come into contact with energized parts of equipment or circuit conductors?
- ❑ Is the use of metal ladders prohibited in areas where the ladder or the person using the ladder could come into contact with energized parts of equipment, fixtures, or circuit conductors?
- ❑ Are all disconnecting switches and circuit breakers labeled to indicate their use or equipment served?
- ❑ Are disconnecting means always opened before fuses are replaced?
- ❑ Do all interior wiring systems include provisions for grounding metal parts or electrical raceways, equipment, and enclosures?
- ❑ Are all electrical raceways and enclosures securely fastened in place?
- ❑ Are all energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures?
- ❑ Is sufficient access and working space provided and maintained around all electrical equipment to permit ready and safe operations and maintenance?

- ❑ Are all unused openings (including conduit knockouts) of electrical enclosures and fittings closed with appropriate covers, plugs, or plates?
- ❑ Are electrical enclosures such as switches, receptacles, and junction boxes provided with tight-fitting covers or plates?
- ❑ Are employees prohibited from working alone on energized lines or equipment over 600 volts?
- ❑ Are employees forbidden from working closer than 10 feet of high-voltage (over 750 volts) lines?

Noise

- ❑ Are there areas in your workplace where continuous noise levels exceed 85 dBA? (To determine maximum allowable levels for intermittent or impact noise, see OR-OSHA's *Noise and Hearing Conservation* rules.)
- ❑ Are noise levels being measured using a sound level meter or an octave band analyzer, and records of these levels being kept?
- ❑ Have you tried isolating noisy machinery from the rest of your operation? Have engineering controls been used to reduce excessive noise?
- ❑ Where engineering controls are not feasible, are administrative controls (worker rotation) being used to minimize individual employee exposure to noise?
- ❑ Is there an ongoing preventive health program to educate employees in safe levels of noise and exposure, effects of noise on their health, and use of personal protection?
- ❑ Are employees who are exposed to continuous noise above 85 dBA retrained annually?
- ❑ Have work areas (where noise levels make voice communication difficult) been identified and posted?
- ❑ Is approved hearing protection equipment (noise attenuating devices) used by every employee working in areas where noise levels exceed 90 dBA?
- ❑ Are employees properly fitted, and instructed in the proper use and care of hearing protection?
- ❑ Are employees exposed to continuous noise above 85 dBA given periodic audiometric testing to ensure that you have an effective hearing protection system?

Identification of Piping Systems

- ❑ When nonpotable water is piped through a facility, are outlets or taps posted to alert employees that it is unsafe and not to be used for drinking, washing, or personal use?
- ❑ When hazardous substances are transported through above-ground piping, is each pipeline identified?
- ❑ Have asbestos-covered pipelines been identified?
- ❑ When pipelines are identified by colored paint, are all visible parts of the line well identified?
- ❑ When pipelines are identified by color-painted bands or tapes, are these located at reasonable intervals, and at each outlet, valve, or connection?
- ❑ When pipelines are identified by color, is the color code posted at all locations where confusion could introduce hazards to employees?
- ❑ When the contents of pipelines are identified by name or abbreviations, is the information readily visible on the pipe near each valve or outlet?
- ❑ When pipelines carrying hazardous substances are identified by tags, are the tags constructed of durable material, the message clearly and permanently distinguishable, and tags installed at each valve or outlet?
- ❑ When pipelines are heated by electricity, steam, or other external source, are suitable warning signs or tags placed at unions, valves, or other serviceable parts of the system?

Materials Handling

- ❑ Are materials stored in a manner to prevent sprain or strain injuries to employees when retrieving the materials?
- ❑ Is there safe clearance for equipment through aisles and doorways?
- ❑ Are aisleways permanently marked, and kept clear to allow safe passage?
- ❑ Are motorized vehicles and mechanized equipment inspected daily or prior to use?
- ❑ Are vehicles shut off and brakes set prior to loading and unloading?
- ❑ Are containers of combustibles or flammables, when stacked while being moved, always separated by dunnage sufficient to provide stability?

- ❑ Are dock boards (bridge plates) used when loading and unloading operations are taking place between vehicles and docks?
- ❑ Are trucks and trailers secured from movement during loading and unloading?
- ❑ Are dock plates and loading ramps constructed and maintained with sufficient strength to support imposed loading?
- ❑ Are hand trucks maintained in safe operating condition?
- ❑ Are chutes equipped with side boards of sufficient height to prevent materials from falling off?
- ❑ Are chutes and gravity roller sections firmly placed or secured to prevent displacement?
- ❑ At the delivery end of rollers or chutes, are provisions made to brake the movement of materials?
- ❑ Are materials handled at a uniform level to prevent lifting or twisting injuries?
- ❑ Are material-handling aids used to lift or transfer heavy or awkward objects?
- ❑ Are pallets usually inspected before loading and/or moving?
- ❑ Are hooks with safety latches or other devices used when hoisting materials so that slings or load attachments won't accidentally slip off the hoist hooks?
- ❑ Are securing chains, ropes, chokers or slings adequate for the job being performed?
- ❑ When hoisting materials or equipment, are provisions made to ensure that no one will be passing under suspended loads?

Transporting Employees & Materials

- ❑ Do employees operating vehicles on public thoroughfares have operator licenses?
- ❑ Are motor vehicle drivers trained in defensive driving, and proper use of the vehicle?
- ❑ Are seat belts provided and are employees required to use them?
- ❑ Does each van, bus, or truck routinely used to transport employees have an adequate number of seats?
- ❑ When employees are transported by truck, are provisions provided to prevent their falling from the vehicle?
- ❑ When transporting employees, are vehicles equipped with lamps, brakes, horns, mirrors, windshields, an turn signals that are in good repair?
- ❑ Are transport vehicles provided with handrails, step stirrups, or similar devices that have been placed and arranged so employees can safely mount or dismount?
- ❑ Is a fully-charged fire extinguisher, in good condition, with at least "4 B:C" rating maintained in each employee transport vehicle?
- ❑ When cutting tools with sharp edges are carried in passenger compartments of employee transport vehicles, are they placed in closed boxes or containers which are secured in place?
- ❑ Are employees prohibited from riding on top of any load which can shift, topple, or otherwise become unstable?
- ❑ Are materials that could shift and enter the cab secured or barricaded?

Split Rim & Multi-piece Wheel Tire Inflation

- ❑ Where tires are mounted and/or inflated on drop-center wheels, is a safe practice procedure posted and enforced?
- ❑ Where tires are mounted and/or inflated on wheels with split rims and/or retainer rings, is a safe practice procedure posted and enforced?
- ❑ Does each tire inflation hose have a clip-on chuck with at least 24 inches of hose between the chuck and an inline valve and gauge?
- ❑ Does the tire-inflation control valve automatically shut off the air flow when the valve is released?
- ❑ Is a tire-restraining device such as a cage rack used while inflating tires mounted on split rims or rims using retainer rings?
- ❑ Are employees strictly forbidden from taking a position directly over or in front of a tire while it is being inflated?

Emergency Action Plan

- ❑ Have you developed an emergency action plan?
- ❑ Have emergency escape procedures and routes bee developed and communicated to all employees?

- ❑ Do employees who must remain to operate critical plant operations before evacuating know the proper procedures?
- ❑ Is the employee alarm system that provides warning for emergency action recognizable and perceptible above ambient conditions?
- ❑ Are alarm systems properly maintained and tested regularly?
- ❑ Is the emergency action plan reviewed and revised periodically?

  Do employees know their responsibilities:

  - ❑ For reporting emergencies?
  - ❑ During an emergency?
  - ❑ For performing rescue and medical duties?

Infection Control

- ❑ Are employees potentially exposed to infectious agents in body fluids?
- ❑ Have occasions of potential occupational exposure been identified and documented?
- ❑ Has a training and information program been provided for employees exposed to or potentially exposed to blood and/or regulated body fluids?
- ❑ Have infection control procedures been instituted where appropriate, such as ventilation, universal precautions, workplace practices, and personal protective equipment?
- ❑ Are employees aware of specific workplace practices to follow when appropriate (handwashing, handling sharp instruments, handling of laundry, disposal of contaminated materials, reusable equipment, etc.)?
- ❑ Is personal protective equipment provided to employees, and in all appropriate locations?
- ❑ Is the necessary equipment (mouthpieces, resuscitation bags, other ventilation devices) provided for administering mouth-to-mouth resuscitation on potentially infected patients?
- ❑ Are facilities/equipment to comply with workplace practices available, such as handwashing sinks, biohazard tags and labels, sharps containers, and detergents/disinfectants to clean up spills?
- ❑ Are all equipment, and environmental and working surfaces cleaned and disinfected after contact with blood or potentially infectious materials?
- ❑ Is infectious waste placed in closable, leak-proof containers, bags, or puncture-resistant holders with proper labels?
- ❑ Has medical surveillance including HBV evaluation, antibody testing, and vaccination been made available to potentially exposed employees?

  How often is training done and does it cover:

  - ❑ Universal precautions?
  - ❑ Personal protective equipment?
  - ❑ Workplace practices which should include blood drawing, room cleaning, laundry handling, and cleanup of blood spills?
  - ❑ Needlestick exposure/management?
  - ❑ Hepatitis B vaccination?

Ergonomics

- ❑ Can the work be performed without eye strain or glare to the employees?
- ❑ Can the task be done without repetitive lifting of the arms above the shoulder level?
- ❑ Can the task be done without the worker having to hold his/her elbows out and away from the body?
- ❑ Can workers keep their hands/wrists in a *neutral position* when working?
- ❑ Are mechanical assists available to the worker performing materials-handling tasks?
- ❑ Can the task be done without having to stoop the neck and shoulders to view the work?
- ❑ Are pressure points on any part of the body (wrists, forearms, back of thighs) being avoided?
- ❑ Can the work be done using the larger muscles of the body?
- ❑ Are there sufficient rest breaks, in addition to the regular rest breaks, to relieve stress from repetitive-motion tasks?
- ❑ Are tools, instruments and machinery shaped, positioned, and handled so that tasks can be performed comfortably?

- ❑ Are all pieces of furniture adjusted, positioned, and arranged to minimize strain on the body?
- ❑ Are unnecessary distances eliminated when moving materials?
- ❑ Are lifts confined within the knuckle to shoulder zone?
- ❑ Does the task require fixed work postures?
- ❑ Is work arranged so that workers are not required to lift and carry too much weight?
- ❑ If workers have to push or pull objects using great amounts of force, are mechanical aids provided?

Ventilation for Indoor Air Quality

- ❑ Does your HVAC system provide at least the quantity of outdoor air designed into the system at the time the building was constructed?
- ❑ Is the HVAC system inspected at least annually and maintained in a clean and efficient manner?
- ❑ Are efforts made to purchase furnishings or building treatments which do not give off toxic or offensive vapors?
- ❑ Are indoor air quality complaints investigated, and the results conveyed to workers?

Video Display Terminals (VDTs)

- ❑ Can the work be performed without eye strain or glare to the employees?
- ❑ Can workers keep their hands/wrists in a neutral position when working?
- ❑ Can the task be done without having to stoop the neck and shoulders to view the task?
- ❑ Are pressure points on any part of the body (wrists, forearms, back of thighs) being avoided?
- ❑ Are there sufficient rest breaks, in addition to the regular rest breaks, to relieve stress from repetitive-motion tasks?
- ❑ Are all pieces of furniture adjusted, positioned, and arranged to minimize strain on the body?
- ❑ Are fixed work postures avoided in the task?

Recommended VDT Workstation Criteria

- ❑ Height of work surface: Adjustable 23 to 28 inches (58.4 to 71.1cm).
- ❑ Width of work surface: 30 inches (76.0 cm).
- ❑ Viewing distance: 16 to 22 inches (40.6 to 55.8 cm) for close-range focusing.
- ❑ Thickness of work surface: 1 inch (2.5 cm).
- ❑ Eyes in relation to screen: Topmost line of display should be at approximately eye level (or lower for bifocal wearers).
- ❑ Knee room height: Minimum of 26.2 inches (66.5 cm) non-adjustable surface and 24 inches (70.0 cm) adjustable surface.
- ❑ Knee room width: 20 inches (51.0 cm) minimum.
- ❑ Knee room depth: Minimum of 15 inches (38.1 cm) knee level; 23.5inches (59.7 cm) toe level.
- ❑ Seat height: Adjustable 16 to 20.5 inches (40.0 to 52.1 cm).
- ❑ Seat size: 13 to 17 inches (33.0 to 43.2 cm) depth; 17.7 inches (45.0 cm) to 20 inches (51.0 cm) width; "waterfall" front edge.
- ❑ Seat slope: Adjustable 0 degrees to 10 degrees backward slope.
- ❑ Backrest size: 15 to 20 inches high (38.1 to 50.8 cm); 13 inches wide (33.0cm).
- ❑ Backrest height: Adjustable 3 to 6 inches (8.0 to 15.0 cm) above seat.
- ❑ Backrest tilt: Adjustable 15 degrees.
- ❑ Angle between backrest and seat: 90 degrees to 105 degrees.
- ❑ Angle between seat and lower leg: 60 degrees to 100 degrees.
- ❑ Angle between upper arm and forearm in relation to keyboard: Upper arm and forearm should form a right angle (90 degrees); hands should be in a reasonably straight line with the forearm.

Additional VDT Workstation Criteria

- ❑ Non-adjustable work surfaces: Table surface should be about 29 inches (73.6 cm) high with a key board surface height of 27 inches (68.5 cm).
- ❑ VDT stands: Height-adjustable stands for all new installations.
- ❑ Seats: Easily adjustable swivel chairs on five-point base.
- ❑ Footrests: If operator cannot keep both feet flat on floor when chair height is properly adjusted to work surface.
- ❑ Keyboards: Thin; detached from console; palm rest.
- ❑ Non-keyboard entry devices: Position devices following same guidelines for keyboards.
- ❑ Screens: Readable with no perceptible flicker; brightness control necessary.
- ❑ Blink rate: No more than two different blink rates, at least 2 Hertz (Hz) apart—slow blink rate not less than 0.8 Hz; fast blink rate not more than 5 Hz.
- ❑ Glare control:
  - a) VDT screen placed at right angels to windows; screens have tilt and swivel adjustments.
  - b) Windows with curtains, drapes or blinds to reduce bright outside light.
  - c) Lighting levels at 30-50 footcandles when using a VDT; 50-70 footcandles where documents are read, compared to normal office levels of 75-160 footcandles.
  - d) Diffusers, cube louvres, or parabolic louvres to reduce overhead-lighting glare.
  - e) Work surfaces with anti-glare (matte) finish.
  - f) Movable task or desk lights; VDTs located between rows of overhead lighting; screen filters and/or hoods if above not successful.
- ❑ Cables and cords: Concealed, covered, or otherwise safely out of the way.
- ❑ Ventilation: Additional ventilation or air conditioning to overcome heat generated by more than one VDT workstation in the same room.
- ❑ Temperature and humidity: Maintain thermal comfort; 30-60 percent relative humidity.
- ❑ Noise: Acoustical enclosures for printers if sound levels exceed 55 dBA; main CPUs and disk drives isolated.
- ❑ Training: Operators trained on how to adjust chair, workstation heights, screen brightness, and correct seat posture.
- ❑ Fatigue control: Good operator posture; body and eye exercises; rest pauses; job rotation or substitution of less demanding tasks.
- ❑ Vision problems: Evaluate operators who may need glasses or wear bifocals.
- ❑ Psycho-social issues: Operator involvement in selection process; communication between operators and supervisors; user-friendly software, and adequate operator training.

Cranes & Hoists

- ❑ Are cranes visually inspected for defective components prior to the start of any work shift?
- ❑ Are all electrically-operated cranes effectively grounded?
- ❑ Is a crane preventive maintenance program established?
- ❑ Is the load chart clearly visible to the operator?
- ❑ Are all operators trained, and provided with the operator's manual for the particular crane being operated?
- ❑ Have construction industry crane operators been issued a valid operator's card?
- ❑ Are operating controls clearly identified?
- ❑ Is a fire extinguisher provided at the operator's station?
- ❑ Is the rated capacity visibly marked on each crane?
- ❑ Is an audible warning device mounted on each crane?
- ❑ Is sufficient lighting provided for the operator to perform the work safely?
- ❑ Are cranes with booms that could fall over backward, equipped with boomstops?
- ❑ Does each crane have a certificate indicating that required testing and examinations have been performed?
- ❑ Are crane inspection and maintenance records maintained and available for inspection?

Appendix A: Policy Statement Models

"The Oregon Safe Employment Act of 1973 clearly states our common goal of safe and healthful working conditions. Safety and health of our employees continues to be the first consideration in operating this business."

"Safety and health in our business must be part of every operation. Without question, it is every employee's responsibility at all levels."

"It is the intent of this company to comply with all laws. To do this, we must constantly be aware of conditions in all work areas that can produce injuries. No employee is required to work at a job they know is not safe or healthful. Your cooperation in detecting hazards and, in turn, controlling them, is a condition of your employment. Inform your supervisor immediately of any situation beyond your ability or authority to correct."

"The personal safety and health of each employee of this company is of primary importance. Prevention of occupationally-induced injuries and illnesses is of such consequence that it will be given precedence over operating productivity, whenever necessary. To the greatest degree possible, management will provide all mechanical and physical activities required for personal safety and health, in keeping with the highest standards."

"We will maintain an occupational safety and health program conforming to the best practices of organizations of this type. To be successful, such a program must embody proper attitudes toward injury and illness prevention on the part of supervisors and employees. It also requires cooperation in all safety and health matters, not only between supervisor and employee, but also between each employee and their co-workers. Only through such a cooperative effort can a safety and health program in the best interest of all be established and preserved."

"Our objective is a safety and health program that will reduce the number of injuries and illnesses to an absolute minimum, not merely in keeping with, but surpassing, the best experience of operations similar to ours. Our goal is zero accidents and injuries."

"Our safety and health program will include:

- Providing mechanical and physical safeguards to the maximum extent possible.
- Conducting a program of safety and health inspections to find and eliminate unsafe working conditions or practices, to control health hazards, and to fully comply with OR-OSHA safety and health standards for every job.
- Training all employees in good safety and health practices.
- Providing necessary personal protective equipment, and instructions for proper use and care.
- Developing and enforcing safety and health rules, and requiring that employees cooperate with these rules as a condition of employment.
- Investigating, promptly and thoroughly, every accident to find out what caused it, and correct the problem so it won't happen again.
- Setting up a system of recognition or awards for outstanding safety service or performance."

"We recognize that the responsibilities for occupational safety and health are shared:

- The employer accepts responsibility for leadership of the safety and health program, for its effectiveness and improvement, and for providing the safeguards required to ensure safe work conditions.
- Supervisors are responsible for developing proper attitudes toward safety and health in themselves and in those they supervise, and for ensuring that all operations are performed with the utmost regard for the safety and health of all personnel involved, including themselves.
- Employees are responsible for wholehearted, genuine operations of all aspects of the safety and health program — including compliance with the rules and regulations — and for continuously practicing safety and health while performing their duties."

FOREST RESOURCE PROTECTION AND REGULATION

Dave Degenhardt

Introduction

Overview

This topic is a summary of the regulatory program for commercial forest activities on non-federal forest land in Oregon. This summary of the Forest Practices Program describes the primary program elements so that the trainee will know when the other ecosystem management activities must meet forest practice regulations.

How this topic fits into the other topics in this section and ecosystem management as a whole

When any ecosystem management activity is planned on state, local government, or privately owned forest land, and it involves an exchange of money or barter, the Forest Practices rules must be met. Generally, the activities that must comply with Forest Practices rules include, but are not limited to:

- Harvesting of forest trees;
- Construction, reconstruction, or maintenance of forest roads;
- Reforestation of forest land;
- Applying chemicals to forest land; and
- Disposing of slash

These activities are further described in the Forest Practice rules themselves. Copies can be obtained from any Oregon Department of Forestry office.

Competency measures

Trainees will recognize when forest activities are under the jurisdiction of the Forest Practices Program, law, and rules. The trainees will be familiar with the Notification of Operation process to ensure compliance with that requirement of the Forest Practices statute.

The trainees will know the forest activities regulated by the Forest Practice rules and be able to obtain written information and advice about the best management practices (BMPs) by contacting local offices of the Department of Forestry. They will be able to comply with the regulations.

The trainees will know the types of forest resources protected by the Forest Practice

rules and will be able to consult the rules. They will determine when to get more information about BMPs before conducting forest activities.

The Oregon Forest Practices Act and Its Policies

The Forest Practices Act was originally adopted in 1971, and the first set of Forest Practice rules were promulgated in 1972. Major amendments came in 1987 (HB 3396) and 1991 (SB 1125).

Oregon Revised Statutes (ORS) 527.610 to 527.770 and 527.990 (1) are known as the Oregon Forest Practices Act.

The majority of the organized forestry community has supported compliance with the FPA and its OARs and led efforts to refine the FPA on current issues. Forests contribute jobs, products, tax base, and social and economic benefits.

Policy

Forest resources

Forest tree species, Soil, Air, Water, Habitat for wildlife and aquatic life.

Public policy

". . . encourage economically efficient forest practices that assure the continuous growing and harvesting of forest tree species and the maintenance of forestland for such purposes as the leading use on privately owned land, consistent with sound management of soil, air water, fish and wildlife . . . and scenic resources within visually sensitive corridors. . .that assures the continuous benefits of those resources for future generations of Oregonians." The duties and powers of the Board of Forestry are to:

Adopt rules, administered by the State Forester establishing forest practices standards.

Assure continuous growing and harvesting of forests and provide for the overall maintenance of: Air Quality; Water Resources; Soil Productivity; and Fish and Wildlife.

Establish inventories of sensitive resource sites.

Consult, in the rule adoption process, other agencies at the state and local level with related functions.

Enforcement

Violation of a rule results in a:

Citation, generally bearing a civil penalty of up to $5,000 (may be increased commensurate with higher timber prices).

Order to Cease Further Violation

Order to Repair Damage or Correct Unsatisfactory Condition

Intentional or profitable violations may be prosecuted as Class A misdemeanors with penalties of up to 1 year and fines of up to $5,000 and recovery of profits gained through violation(s).

Miscellaneous:

In land transactions, the seller is responsible to provide the buyer written notice of any reforestation obligation imposed on the land by the Act.

Board of Forestry authority in the forest practices act

Avoid uncertainty and confusion among laws and regulations relevant to forest operations.

Exclusive authority to develop and enforce Statewide and Regional rules that deal with the manner of conducting operations.

Preempts local government regulation of forest operations outside urban growth boundaries or within the city limits of cities of 100,000 if an acknowledged land use planning exception has been taken.

Coordinate with state agencies and local governments concerned with the forest environment.

The Board may adopt rules reducing to the degree practicable cumulative effects on air and water quality, soil productivity, fish and wildlife resource and watersheds.

Nothing in the Act prevents forest land conversion to any other use

Program Organization and Notification Process Administration

Program organization

The Department of Forestry organization administers a number of programs. One of those is the Forest Practices Program. Across the state, the Department has three administrative areas, the Northwest, Southern, and Eastern Oregon Areas. These areas are divided into thirteen districts. The districts maintain twenty-seven unit and satellite offices where Forest Practices Foresters (FPFs) are stationed. Supervision of the field foresters is provided by the area, district, and unit offices. The Northwest and Southern Oregon Area offices provide geotechnical specialists to support the field foresters, while Headquarter's geotech supports Eastern Oregon Area.

Fifty-four Forest Practices Foresters monitor commercial forest operations on all non-federal forest lands outside municipal urban growth boundaries. Each Forest Practices Forester is responsible for operations in an assigned inspection area.

Staff support of the program is supplied by the Program Director and the two units of the Forest Practices staff at ODF headquarters in Salem. The two units are the Operations and Policy Units. An administrative team provides logistical and policy support for the Program. The Operations Unit provides wildlife habitat consultation, rule interpretation guidance, civil penalties administration, and program training. The Policy Unit conducts new rule development, provides interagency coordination, geotechnical consultation, program effectiveness monitoring, hydrological consultation, legislative support, and coordination with federal agencies.

Operation planning

Planning to protect forest resources during operations varies in intensity according to the potential for effects on resources. Planning intensity ranges from getting basic information about the location and type of operation to specifying details of the operation in writing.

Notification of operation

ODF formally learns of plans for a forest operation when a Notification of Operation form is submitted to one of its offices. Notification forms are supplied at any ODF office. By law, the operator, landowner, or timber owner is required to make this notification any time there will be a commercial forest operation as defined in ORS527.620. Certain minimum information is required by the law, accompanied by additional information necessary to ODF.

ODF sends copies of notifications to other interested parties and agencies. Copies go to the operator, landowner, and timber owner regardless of which one submitted the notification. Copies are also sent to the Department of Revenue, the Oregon Occupational Safety and Health Division (OR-OSHA), the county assessor, and the Department of Fish and Wildlife.

Anyone may purchase a subscription to receive copies of these notifications at the local ODF office. The subscriber receives copies of all notifications for a desired geographic area. The ODF will mail these copies to subscribers within three working days of receiving the notifications. Subscribers may use this information to contact the operator or landowner, or to submit comments to ODF about the planned operation. ODF evaluates and responds to any comments received.

Operation evaluation and priority-setting

A planned operation cannot begin for 15 calendar days following notification. This waiting period is to allow the Forest Practices Forester to evaluate the site and the operation's potential for resource disturbance. The Forest Practices Forester uses this evaluation to set priorities for preventive efforts. The high and medium priority operations are most intensively planned and inspected.

Under the Compliance Rule, OAR629-24-102, operators must apply the BMPs as stated in the rules, unless prior approval is obtained from a Forest Practices Forester to apply alternate practices as BMPs. Sometimes an alternative to a normally-required practice is best suited to a specific site. Such alternate practices always require written prior approval. Forest Practices Foresters evaluate whether the normally-required BMP is necessary to achieve the purpose of the rule, or whether the alternate practice will achieve equal or better results.

Operators on sites given low priority because environmental disturbance is unlikely may not be inspected before operating. Each operator is supplied a copy of the Forest Practice rules when giving notification. Most operators are familiar with the BMPs in the rules and apply them without instructions from Forest Practices Foresters. Should an operator fail to apply a BMP necessary to accomplish the purpose of the rules, a citation, civil penalty, and possibly criminal prosecution will result.

Some operation activities automatically require the Forest Practices Forester's prior approval to ensure the operator knows how to use the appropriate BMPs. Most of these involve operations that might affect water quality. Two examples are road construction near streams and harvesting on steep, unstable sites above watercourses.

The BMP rules are keyed to types of activity. Operators take their cue as to required BMPs from the type of activity they are conducting. For example, one of the major types of activity is road construction and maintenance. There is a corresponding section of rules. This major section is divided into rules for more specific activities such as road location, road design, road construction, and road maintenance. Operators and Forest Practices Foresters match the activities planned in each individual operation to the applicable BMP rules.

Pre-operation inspections

Another operation planning tool is the pre-operation inspection. The Forest Practices Forester inspects high and some medium priority sites before activity begins, often accompanied by the operator or landowner. Technical specialists from the program staff and agencies such as the Department of Fish and Wildlife may be consulted during the pre-operation inspection. On-site, the Forest Practices Forester determines the resource protection practices needed and sees that the operator understands them. To confirm this, the Forest Practices Forester may write out recommendations to the operator.

Written plans

This is the Program's most intensive prevention planning method. A written plan describes how necessary preventive practices will be conducted to protect water quality, soil, air, fish, or wildlife. Specialists from consulting agencies may be asked to review the written plan. The Forest Practices Forester may approve changes to the written plan if unexpected conditions develop during the operation.

Written plans are used to plan two kinds of operations. One involves operations required by rule to have prior approval from the Forest Practices Forester. For these operations, requiring a written plan is the Forest Practices Forester's option. The other kind involves certain operations that may affect rule-specified resources, such as major fish-bearing streams. The rules automatically require a written plan for operating on or near these sites. The written plan must be followed or enforcement action is taken.

Preventive inspections

In-progress and post-operation inspections

The next step after operation planning is be sure of proper completion of the expected practices. Forest Practices Foresters do this by inspecting while the operations are active. They concentrate their inspections on the higher priority operations.

Where appropriate, the operator has latitude in choosing the equipment and methods of achieving required results. The Forest Practices Forester discusses planned methods with the operator to be sure the results will follow the rules.

Inspections made after the operator leaves the site focus on determining whether the site is in stable condition as required by the rules. For example, drainage patterns are to

be returned to normal or designed to keep sediment-bearing runoff diverted into filtering vegetation and absorbent soils. The operator may be required to return to the site to correct deficiencies, if necessary.

Time spent and the results of inspections are recorded in a data base. The data shows that Forest Practices Foresters spend more time on a typical high priority operation than on a medium or low priority operation. Statewide, they conduct from 13,000 to over 15,000 inspections of operations each year.

Operator education and recommendations

During inspections, Forest Practices Foresters check to see that required practices are being applied. They discuss upcoming aspects of the operation with the operator, reminding the operator of resource protection needed. These one-on-one inspections are the primary means of educating operators and landowners about required practices.

Where necessary, the Forest Practices Forester reinforces resource damage prevention by writing out recommendations. The Forester writes recommendations on the inspection report form, gets the operator's signature, and gives a copy to the operator.

Written statement of unsatisfactory condition

When an operator fails to follow with an applicable rule and necessary practice, without prior approval, it is termed an unsatisfactory condition. The Forest Practices Forester determines whether timely corrective action can be taken before resource damage is likely to occur. The Forest Practices Forester considers such factors as the risk of damage to protected resources and the time of year. When the Forest Practices Forester judges there is time to correct the unsatisfactory condition, the forester issues a written statement.

The written statement specifies corrective actions and a required completion date. Unsatisfactory conditions must be corrected by the completion date or be considered violations. Enforcement action is taken on all violations.

Enforcement Policy and Procedures

Citation

Enforcement action is taken whenever a violation occurs. A violation is a failure to follow a statute or rule. When a violation occurs, a citation is issued. The citation states the nature of the violation. An order to cease further violation accompanies each citation. This order requires the operator to stop the activity or the failure to act that resulted in a violation.

Order to repair damage or correct unsatisfactory condition

When the damage or unsatisfactory condition resulting from a violation can be practically and economically repaired, an order is issued requiring repair. When issued, the repair order normally accompanies the citation. If necessary, a circuit court order can be sought to obtain compliance with a repair order. The Board of Forestry may authorize the Department to make repairs and then recover costs from the offending party.

Civil penalty

The State Forester may assess a civil penalty for any violation. The civil penalty is determined by a formula established by rule. The formula contains several factors including a base fine, a cooperation value, a prior knowledge or prior violations value, a damage to protected resources value, and a repairability/repairs-made value. Penalties may range up to $5,000 , for each violation. The amounts of the fines are designed to make compliance more cost-effective than violation of the rules. Civil penalties are assessed for virtually all violations.

Criminal prosecution

Citations will be presented to the county District Attorney in two instances. The first is when the State Forester judges the operator acted knowingly or recklessly in violating the Forest Practice Rules. The second is when the State Forester judges the operator gained monetarily by violating the rules. If the monetary gain exceeds that amount recoverable by a civil penalty, criminal prosecution will be pursued.

Enforcement activity

In 1993, 290 citations were issued. To date, about 250 civil penalties for these citations have been issued, with fines totalling $80,000. Most of the remaining are not yet assessed because repairs are extensive or extended. Civil penalties are not normally assessed until the operator has completed the repair order

Interagency Coordination

The Oregon Department of Forestry and the Oregon Department of Environmental Quality (DEQ) have a Memorandum of Agreement (MOA) concerning water quality programs related to forestry activities. As the lead agency for water quality programs in the state, DEQ may enter into agreements with other agencies to implement its water quality programs. The MOA between DEQ and ODF designate the Department of Forestry to be the implementing agency for nonpoint source water pollution control on state and private forest lands.

The Forest Practice Rules are developed and implemented by the Board of Forestry in consultation with other agencies and programs. In particular, DEQ is the lead consultant for water quality issues. In general, coordination with other agencies and parties is addressed in ORS 527.710 which that, before adopting rules, the board shall consult with other agencies that have functions with respect to the purposes of the Act or programs affected by forest operations.

Furthermore, pursuant to the specific reference to the Board's responsibility for adopting rules concerning nonpoint source control, ORS527.765 (2) directs the board to consult with the Environmental Quality Commission in adoption and review of best management practices and other rules to address nonpoint source discharges of pollutants resulting from forest operations on forestlands.

At the operational level, ODF Foresters coordinate with other agencies where necessary to implement the Forest Practice Rules. Operators must file a notification of operations with the department. Copies are sent to interested parties and agencies. Consulta-

tion occurs in both the planning and operating stages of an operation. In 1993, FPF's reported 838 technical consultations with other agencies.

Program Monitoring

Program implementation monitoring

The major program monitoring effort to date has been ensuring implementation of the Forest Practice Rules. These rules are best management practices for maintaining water quality. Implementation is monitored by maintaining and analyzing a data base of program activities. Analysis of this program data leads to program management adjustments. Data is compiled in five general categories:

- Administration, including the budgeted fund levels, personnel levels, and forestry activities in the program.
- Coordination, involving consultations with other agencies on operations.
- Prevention activity, including such activities as notifications of operations, pre-operation inspections, on-site inspections, and written recommendations.
- Enforcement, including reforestation compliance, violations, court actions, civil penalties, and repairs.
- Complaint investigation, including sources, types, and disposition of complaints.

This data indicates whether the best management practices are being properly administered. If adequately-designed practices are properly administered, water quality is maintained as desired.

Monitoring program implementation also provides information for managing program resources. For example, much of budgeting is based on the workload. Part of program workload is reflected in the number of notifications of operations received each year, the number of high priority operations encountered, and the number of inspections needed.

Implementation monitoring is a good indication of proper program administration. However, it is an indirect indication of design adequacy of the management practices. To address adequacy of the practices, program effectiveness monitoring is being increased.

Program compliance monitoring

A recent addition to program instream monitoring is water sampling to determine compliance with TMDL load allocations. Achieving the load allocations of a TMDL should result in the desired water quality conditions and hence maintenance of the beneficial uses. Complying with TMDLs indicates BMPs are properly designed and adequately administered to meet water quality standards and support beneficial uses. Exceeding TMDLs may mean that the program, the BMPs, the load allocations, and the TMDLs need to be reviewed.

A forest practices monitoring coordinator oversees the monitoring program. Development of the monitoring program involved very substantial public, agency, and in-

terest group involvement. To date, completed monitoring projects have included: implementation and effectiveness of riparian protection rules; watershed turbidity and relation to forest operations; relationship of landslides to forest operations; sources of phosphorus in the Tualatin and Bear Creek basins' (TMDL) forested streams; and water temperature after forest harvesting.

Results of monitoring are used to provide feedback for determining the adequacy of rule administration and for rule development when necessary. For example, monitoring data from the previous riparian rules were used in the development of the current water classification and protection rules.

Most ODF monitoring will be oriented at specific practices at individual sites rather than cumulative effects, in part because of the incredible complexity involved in understanding cumulative effects. The department is doing some modelling to link site specific practices to watershed and landscape effects, especially with regards to temperature and sediment.

Program effectiveness monitoring

Effectiveness monitoring is assessing whether control practices are producing the desired results on the condition of the resource. In water quality management, this means evaluation of the condition of the water itself and the resulting condition of beneficial uses. State instream water quality standards are to require water conditions that support these beneficial uses. Program effectiveness monitoring may confirm existing practices' design and administration or indicate a need for program modifications.

In addition, OAR 629-635-120 describes a process for determining whether additional watershed specific protection rules are needed for watersheds that have been designated as water quality limited or for watersheds containing threatened or endangered aquatic species. The board will adopt watershed specific practices if, based on a technical investigations, it finds such practices necessary. The board has not yet found it necessary to use this process.

The department has conducted monitoring in the Tualatin River and Bear Creek watersheds. Laboratory results from regular grab sampling have shown a pattern indicating no significant contributions to water quality standard violations by forest practices. Phosphorus concentrations in forested watersheds cannot be consistently correlated with the acreage harvested in sub-basins. Rather, the instream phosphorus levels or more consistent with the underlying rock types. If future monitoring finds that forestry practices contribute to the water quality limited status of these basins, there is a process described in OAR629-635-120 that may be used if program adjustments are not done voluntarily by the Board and department.

Forest Practice Rules as Best Management Practices

The Forest Practice Rules include specific practices and required results that maintain the forest soil, water, air, fish and wildlife during commercial forest operations. In 1979, the rules were certified by the Environmental Protection Agency as best manage-

ment practices (BMPs) for forestry nonpoint source (NPS) pollution control in Oregon.

The rules receive periodic interagency review of their effectiveness in meeting water quality standards. Based on these reviews, the rules are accepted as best management practices by DEQ. The rules address the following activities on forest land:

- Chemical application, including pesticides and fertilizers;
- Handling of petroleum products;
- Disposing of slashing
- Stream channel changes;
- Surface mining for road surfacing rock;
- Reforestation;
- Road location;
- Road design;
- Road construction;
- Road maintenance;
- Harvesting methods;
- Location of landings, skid trails, and fire trails;
- Drainage systems for landings, skid trails, and fire trails;
- Disposition of excess soil and woody debris;
- Riparian area management;
- Harvesting around streams;
- Operating around bogs, swamps, and other wetlands;
- Disposition of debris from land clearing;
- Construction of landing fills; and
- Harvesting on sites with high risk of mass soil movement.

Most of the activities associated with growing and harvesting trees may affect water quality. In summarized form, the rules specify the following practices to protect water quality:

- Keeping chemicals out of waters;
- Keeping soil in stable locations, and out of streams;
- Retaining near-natural water drainage paths around roads, landings, skid trails, and fire trails to maintain slope stability;
- Retaining ground cover to filter overland water flows;
- Protecting vegetation around stream channels;
- Protecting stream banks and beds from disturbance;
- Limiting soil disturbance;
- Stabilizing exposed soil surfaces by seeding, mulching, or riprapping;
- Falling trees away from streams;

- Maintaining a stable road surface;
- Keeping activities above high water marks of streams; and
- Keeping organic debris out of road and landing fills.

Interpretation and enforcement of the Forest Practice rules are supported by program directives and rule guidance. Program directives and rule guidance are included in ODF's *Forest Practices Foresters' Handbook.* The directives establish policies, standards, and procedures for aspects of program administration such as enforcement. Rule guidance provides discussions of rule intent, what constitutes an unsatisfactory condition, and enforcement guidance for each rule as appropriate. These documents can be examined at ODF offices. Forest Practices Program managers and foresters use the directives and rule guidance to achieve consistent implementation of the program.

Road Construction and Maintenance

Operators must submit a Notification of Operation form for all forest road construction and timber harvesting in Oregon. This form must be accompanied by a map showing the precise location of the operation. Completion of this notification requires advance planning.

The department maintains maps of: stream classification, high risk (landslide) areas; and the National Wetland Inventory. The department will notify the operator of stream type (including fish use), size and presence of significant wetlands or potential for high risk sites. Confirmation of sensitive resource areas may require on-site field investigation by the FPF.

Operators must keep soil disturbance to a minimum by constructing roads when soil moisture conditions are favorable. Operators must avoid tractor or wheel skidding on unstable, wet, or easily compacted soils, and on slopes which exceed percent. Such operations can be conducted when conditions and methods allow them without causing deep soil disturbance or accelerated erosion. The rules require harvesting operators to select the logging method, size of equipment, and type of equipment best adapted to the given slope, landscape, and soil materials to minimize soil deterioration.

The high risk site designation is the tool which allows regulation of harvesting practices on sites prone to landslides. The rules require prior approval for harvesting on high risk sites, and thereby authorize the department to require written plans for harvesting and harvest-associated stand management on such sites. Rules for high risk sites include establishing or maintaining plant species that will enhance slope stability in harvested areas. The high risk site rules function by reducing soil disturbance and preventing mass soil movement rather than by prohibiting harvesting.

The watershed specific rule, OAR 629-635-120 may be used to develop practices tailored for specific watersheds of concern.

Rules for roads are designed to minimize sediment delivery from roads to waters of the state. Operators must avoid locating roads on steep slopes, slide areas, wetlands, flood plains, riparian management areas, drainage channels or high risk sites if alternatives exist. If there is a risk of material entering the waters of the state, the operator

must obtain prior approval from the State Forester before locating roads in these areas. Prior approval is not granted if other alternatives would result in lower impacts to waters of the state. Compliance with this rule requires the operator to plan road location carefully.

Operators are required to plan and construct landings of minimum size and on stable areas. Prior approval is required before construction of landings in riparian management areas. Landings must be located on firm ground above the high water level of any stream, and must not be placed on unstable areas, on steep side hill areas, or where excessive excavation is needed.

Operators must design and construct roads which are no wider than necessary to accommodate the immediate anticipated use. Operators must design and construct stream crossing structures (culverts, bridges and fords) to: minimize excavation of side slopes near the channel; minimize the volume of material in the fill; prevent erosion of the fill and channel; pass the 50 return interval peak flow without ponding; and pass both adult and juvenile fish.

Operators must design roads to drain naturally by outsloping and through grade changes wherever possible. Where outsloping is not feasible, they must use roadside ditches and culverts. Dips, water bars, and cross drainage must be installed on all temporary roads. Drainage culverts should be placed above stream crossings so that water can be filtered through vegetative buffers before entering waters of the state.

Use of suitable materials to surface roads planned for all-weather use to support truck traffic is required through the general maintenance rule which requires that maintenance of active and inactive roads shall be sufficient to maintain a stable surface, to keep the drainage system operating, and to protect the quality of the waters of the state.

Prior approval is required for any road construction operation which presents a risk of material entering waters of the state. This includes, but is not limited to, roads across high risk (landslide) sites. Written plans are normally required before prior approval is granted. Approval of written plans is often based on consultations with the departments geotechnical specialists.

Planning is required to comply with any of the design and location rules, for both roads and landings. The department finds it most efficient to require written plans only when there is a significant potential for operations to damage protected resources. Plans usually address only those portions of the operation which have the greatest risk to resources. Regardless of whether the department requires a plan, or whether the plan covers only a portion of the operation, the operator must comply with all rules. Failure to adequately plan an operation will result in rule violation(s).

Alternate plans may be used by an operator when the standard rules are inappropriate for the operation. The operator must show that the alternate practices will provide equal or better protection of resources (water quality). Alternate plans are rarely used. The standard of review for such plans includes consultation with the Department of Fish and Wildlife, Department of Environmental Quality, sometimes other agencies; and with ODF technical specialists as necessary to ensure that equal or better re-

source protection is provided.

The construction rules also require operators to deposit end-haul and other excess material in stable locations above the high water level where it will not enter waters of the state. Placement at the high water level would be a violation of this rule since higher flows could erode that material.

The 50-year peak flow information for forest streams was placed on a large map of Oregon. "Iso" lines of equivalent 50-year peak flows were then drawn on the map. Peak flows are based on all available gage data from smaller forest streams. Both conventional gage data and crest gage data were used in this analysis. Recurrence interval values were developed using the Log Pearson III distribution.

The department has developed a memorandum for evaluating fish passage through stream crossing structures. A larger project, working with experts from other western states, is developing more formal guidance for fish passage. We anticipate this project taking a year or two.

The rules require operators to also install water crossing structures where needed to maintain the flow of water and passage of adult and juvenile fish between side channels or wetlands and main channels. Operators must construct all stream crossings to result in minimum disturbance to banks, existing channels, and riparian management areas and must remove all temporary crossing structures promptly after use. Operators must keep machine activity in beds of streams to an absolute minimum and restricted to low water levels, and must install drainage structure promptly.

Design and spacing of road drainage is judged on the effectiveness and ability of that drainage system to control sediment delivery to streams. If the design is not effective, road maintenance rules will be used to improve road drainage. Operators must provide drainage structures above all live stream crossings to filter sediment. Operators must also stabilize exposed material which is potentially unstable or erodible by use of seeding, compacting, riprapping, benching, leaving light slashing, or other suitable means.

Maintenance of active and inactive roads must be sufficient to maintain a stable surface, to keep the drainage system operating, and to protect the quality of the waters of the state. Therefore, roads must not be used when the surface is thawing unless use can be accomplished without causing the surface to become unstable.

Landowners are encouraged to vacate roads. Rules require vacated roads to be posted closed, blocked to prevent continued use by vehicular traffic, and left in such a state as to provide for adequate drainage and soil stability.

The rules require temporary crossing structures to be removed promptly after use. Operators must plan applications and apply road oil or other surface stabilizing material in such a manner as to prevent their entry into waters of the state.

Most importantly, operators must maintain and repair active and inactive roads as needed to minimize damage to waters of the state. Operators must also maintain fish passage through water crossing structures. In addition, all reconstruction must comply with the road design and construction rules. If a fill washes out, the new structure must pass the 50-year flow and also pass adult and juvenile fish. Inspections are essential if

a landowner is to comply with the road maintenance rules. The road maintenance rules are bottom line oriented. If unfiltered sediment or a major erosion source is observed on a active or inactive road, and maintenance could have prevented such a problem, a violation of these rules exists and the operator will be issued a citation.

Harvesting, Disposal of Slash

Harvesting

For each landing, skid trail, or fire trail, operators must provide and maintain a drainage system that will control the dispersal of runoff water from such exposed soils, and that will minimize the entry of muddy and turbid water into the waters of the state. Operators must leave or place debris and re-establish drainage on landings after use to guard against future soil movement.

Landings must be of minimum size and located on stable areas. Landings must not be located in riparian management areas without prior approval. The department will only grant prior approval if such a landing is the least impact alternative. Landings must be located on firm ground above the high water level of any stream, and must not be placed on unstable areas, on steep side hill areas, or where excessive excavation is needed.

Debris, overburden, and other waste material associated with harvesting must be placed in such a location as to prevent its entry by erosion, high water, or other means into waters of the state. Waste from logging operations, such as crankcase oil, filters, and grease and oil containers, must be removed from forest lands, and must not be placed in waterways. Operators must take adequate precautions to prevent leaks or spills of petroleum products that may enter waters of the state and also take immediate and appropriate action to stop and contain any leaks or spills of petroleum products.

Uphill cable yarding is recommended. Operators must use a yarding system that will minimize soil disturbance when downhill yarding or when yarding across high risk sites. Operators may use yarding corridors through retained streamside trees as long as the numbers and widths of yarding corridors are minimized. The RMA must contain the required conifer and hardwood trees after use of corridors.

Many rules are directed at protecting the sediment filtering function of soils near streams. For example, operators are required to fell, buck, and limb trees in ways that minimize disturbance to channels, soils and retained vegetation in riparian management areas, streams, lakes and all wetlands greater than one-quarter acre. Operators can not operate ground-based equipment within any stream channel except as allowed in the rules for temporary stream crossings. The rules for temporary stream crossing structures provide very specific standards for construction, use, and removal of such structures. Machine activity near (generally within 100 feet) streams, lakes, and other wetlands greater than one-quarter acre must be conducted to minimize the risk of sediment entering waters of the state and preventing changes to stream channels.

Operators must minimize the amount of exposed soils due to skid trails within riparian management area, and not locate skid trails within 35 feet of Type F or Type D streams, and must also provide adequate distances between all skid trails and waters of the state to filter sediment from runoff water. Operators must avoid tractor or wheel skidding on unstable, wet, or easily compacted soils, and on slopes which exceed 35 percent, unless operations can be conducted without causing deep soil disturbance or accelerated erosion.

Site preparation and forest regeneration

When mechanical site preparation is necessary in riparian management areas or near waters of the state, operators must conduct the operations in a way that sediment or debris does not enter waters of the state. Operators must provide adequate distance between disturbed soils and waters of the state to filter sediment from run-off water, and must not use mechanical site preparation in riparian management areas: on slopes over percent, with the exception of excavator-type equipment used during dry periods; or on sites with evidence of surface or gully erosion; or where exposure or compaction of the subsoil is likely to occur.

During mechanical site preparation, operators shall not place debris or soil in waters of the state or where it may enter waters of the state. This includes all windrows. Operators must also dispose of or disperse unstable slash accumulations around landings to prevent their entry into streams. The integrity of even the smallest channels is protected by OAR 629-660-040.

Any forestland which is capable of annual wood production of at least 20 cubic feet per acre at culmination of mean annual increment (Cubic Foot Site Class VI or better, anything lower is arid-desert) is subject to the requirements of the reforestation rules. Landowners must increase tree stocking to a level that meets the applicable productivity-based stocking standards whenever the post-operation free to grow tree stocking in all or a portion of the operation area is below the applicable stocking standards and: trees or snags of acceptable species are harvested; or free to grow tree stocking is reduced as a result of the operation.

Fire management

Prescribed burning is a tool used to achieve reforestation, maintain forest health, improve wildlife habitat and reduce wildfire hazard. Prescribed burning is to be done consistent with protection of air and water quality, and fish and wildlife habitat.

When planning and conducting prescribed burning, operators must:

- Lay out the unit and use harvesting methods that minimize detrimental effects to riparian management areas, streams, lakes, wetlands, and water quality during the prescribed burning operation.
- Fell and yard the unit to minimize accumulations of slash in channels and within or adjacent to riparian management areas.
- Minimize fire intensity and amount of area burned to that necessary to achieve reforestation, forest health or hazard reduction needs.

- When burning within 50 feet of Type F and Type D streams, within 1,100 feet of large lakes, and within 300 feet of significant wetlands, describe in the written plan how detrimental effects will be minimized within riparian management areas; especially when burning on highly erosive soils, for example decomposed granite soils and slopes steeper than 60 percent.

During prescribed burning operations, operators must protect components such as live trees, snags, downed wood, and understory vegetation required to be retained by OAR 629-635-310 through OAR 629-650-040. Operators must not salvage trees killed by prescribed fire in a riparian management area if the trees were retained for purposes of OAR 629-635-310 through OAR 629-655-000.

Operators must provide and maintain a drainage system on all fire trails that will control the dispersal of runoff water from such exposed soils, and that will minimize the entry of muddy and turbid water into the waters of the state.

Revegetation of disturbed areas

Landowners or operators must stabilize potentially unstable or erodible soils within harvest units by seeding or other suitable means, and must also stabilize exposed surfaces on roads that are potentially unstable or erodible by use of seeding, compacting, riprapping, benching, leaving light slashing, or other means.

When reforestation is not required or planned, the landowner must ensure sufficient revegetation of the site to provide continuing soil productivity and stabilization within 12 months of the completion of the operation. Revegetation required by this rule may be planted or naturally established, and shall consist of trees, shrubs, grasses, or forbs suitable for soil stabilization and productivity protection. Landowners are encouraged to revegetate the operation area with native plants.

Streamside management areas that are disturbed to the point where revegetation is required are probably in violation of one or more rules. Revegetation in such cases would be required under the repair order issued with the citation

Application of Chemicals

The Oregon Forest Practices Act's chemical rules regulate the use of herbicides, insecticides, rodenticides, fertilizers, and adjuvants on forestlands. The purpose of the chemical rules is to regulate the handling, storage, and application of chemicals in such a way that the public health and aquatic habitat will not be endangered by contamination of waters if the state.

The rules address equipment condition, chemical mixing, chemical applications, and cooperative monitoring of applications by landowners and community water system managers. Among other regulations, the rules specifically require 100 -foot untreated buffers along domestic-use streams when fertilizers are applied and prohibit direct application of fertilizer to any waters of the state. Operators must protect RMA leave vegetation when applying pesticides, and must leave at least a 60-foot buffer on each side of Type F or D streams when applying chemicals.

The rules emphasize adherence to the product label requirements, which are enforced by the Oregon Department of Agriculture. The types and amounts of pesticide to be applied, loading and calibration of equipment, and appropriate weather conditions are regulated through the legally binding product label wording. The department also has established additional weather limitations (temperature, wind, relative humidity, precipitation, etc.) that are enforced through the rules.

In addition to the administrative rules, there is a statutory requirement for the department to send copies of notifications of operations involving chemical applications free of charge to any persons within ten miles of the chemical applications who holds downstream surface water rights, if copies of notifications have been requested in writing.

Water Classification and Protection

Refer to Summary of the New Water Protection Rules attached as a reference.

Reforestation

Refer to Reforestation Forest Practices Note # (revised) dated December 1994, attached for reference.

Special Resource Sites

- Threatened and endangered species sites
- Sensitive bird nesting, roosting, and watering sites
- Significant wetlands
- Biological sites, ecologically and scientifically significant

  Refer to Division 56 rules attached for reference.

Suggested Field Exercises

- Visit various sites of ecosystem management activities and determine whether there is a need to notify the State Forester and meet Forest Practices rules.
- Determine the size and type of a stream by visiting a Department of Forestry office and locating the site on their master stream classification map.
- Determine the riparian management area (RMA) for a stream-side site and mark the RMA boundaries and trees that can be harvested.
- Visit recent operation sites with a Department of Forestry Forest Practices Forester and list the rules or BMPs that were applied.

Resources for further information, training, and certification

Publications for reference

Available from any office of the Oregon Department of Forestry

Oregon Forest Practice Rules and Statutes

Forest Practices Notes

- Reforestation
- Waterbars
- Road Maintenance
- Ditch Relief Culverts
- Civil Penalties
- Spotted Owl
- Osprey

Water Protection Rules Video

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1127 25th Street SE
PO Box 12339
Salem, Oregon 97309-0339
(503) 364-1330

SUMMARY OF THE NEW WATER PROTECTION RULES
OREGON DEPARTMENT OF FORESTRY
December 2, 1994

PURPOSE
The purpose of this summary is to give you a broad framework to understand the water protection rules that took effect on September 1, 1994. If you want to know protection requirements for a particular stream please attend one of our training sessions or contact your local Oregon Department of Forestry office.

WHY DO WE HAVE NEW WATER PROTECTION RULES?
Stream protection was one of the concerns discussed in the 1990 Forest Practices Forum held by the Oregon Board of Forestry. Then, in 1991, the Oregon Legislature passed a law requiring the Board to review current stream rules to see if protection was adequate, and revise the rules if the review showed it to be necessary. At the direction of the Board, the Oregon Department of Forestry worked with technical specialists, landowners, operators, state agencies, environmental groups, and the public to produce a set of water protection rules, which the Board approved.

GOAL OF THE NEW RULES
The overall goal of the new rules is to allow growing and harvesting of timber, while protecting fish and wildlife habitat, and water quality. The rules direct that this goal will be met by growing and maintaining vegetation along streams to establish mature forest conditions in streamside stands. Growing and keeping large conifers along streams is especially important.

DEFINITIONS
There are a few definitions that you need to know to understand the rules:

- Basal area--the area in square feet of the stump surface of a tree if it were cut off about chest high. The standard target is a live conifer basal area figure listed in the rules for different stream classifications. If a streamside stand of trees has enough basal area to meet the standard target, it will probably meet the goal of growing large conifers along the stream.

- Domestic use--where people use stream water for drinking or cooking. Protection of a stream as a domestic water source is required only if there is a water use permit registered with the Water Resources Department.

- Stream--has banks, and a bed that runs water during some portion of the year. Includes the bed, banks, side channels, beaver ponds, and adjacent wetlands.

- Riparian Management Area (RMA)--area along water bodies where the rules require forest components such as trees, snags, and understory vegetation to be left. RMA widths are measured separately on each side of streams, usually in slope distance (horizontal distance on very steep slopes).

STREAM CLASSIFICATION

Streams are classified as small, medium, or large. These sizes refer to average stream flow, which can be estimated by measuring drainage areas and using rainfall measurements for different geographic regions. Most stream sizes have already been determined.

Streams will be further classified by use. Streams used by game fish, or by fish and for domestic use, are **type F**. Streams with domestic use, but no game fish, are **type D**. Finally, streams which have neither game fish nor domestic use are **type N**.

Size and use are combined to get a classification for each stream. For example, a medium sized stream with game fish would be called a "medium F stream." Oregon Department of Forestry offices have maps showing most stream classifications.

RIPARIAN MANAGEMENT AREAS

Riparian management areas, known as RMA's, are areas along streams where the rules require forest components such as trees, snags, and understory vegetation to be protected. This does not mean you must always leave everything within the RMA width; on most streams the rules allow some harvest and management inside the RMA. Table 1 below shows stream classifications and RMA widths.

Table 1 STREAM TYPES AND RMA WIDTHS

	TYPE F (fish, or fish and domestic use)	TYPE D (domestic use, no fish)	TYPE N (no fish, no domestic use)
Large	RMA 100 feet	RMA 70 feet	RMA 70 feet
Medium	70 feet	50 feet	50 feet
Small	50 feet	20 feet	none

STREAM PROTECTION

The rules are designed to adapt to local streamside conditions and landowner objectives. What must be left in the RMA varies by stream classification, geographic region, and conditions in the RMA before harvest. Table 2 on page 3 shows the options a landowner has under different conditions. Pages 4, 5, and 6 summarize the stream protection requirements for each option.

Table 2 HOW DO YOU USE CHOOSE A STREAM PROTECTION OPTION?	
HOW MUCH LIVE CONIFER BASAL AREA IS IN THE RMA? Is it considered "adequate," or not ("adequate" is defined as 1/2 the standard target)?.	
IF STOCKING IS "adequate," Use the General Prescription:	**IF STOCKING IS NOT "adequate",** you need to ask another question:
1. Where stocking is greater than the standard target: Leave enough live conifer basal area to meet the standard target and minimum tree numbers (page 4).	**CAN CONIFERS BE GROWN ON THE SITE?** If they can, your choices are:
On type F streams, you can leave less basal area if you do stream improvement work (Example: place logs in the stream). -OR-	1. Use Alternative Prescription #1 where the stand has been damaged by wind, insects, disease, or fire (page 5). -OR-
2. Where stocking is less than the standard target, leave all conifers up to maximum required numbers listed in the rules (page 4). -OR-	2. Use Alternative Prescription #2 where the stand is dominated by hardwoods (example: mostly alder and very few conifers in the RMA) (page 5).
3. On small N streams there is no RMA, so you don't have to leave merchantable trees (page 4).	**IF CONIFERS CAN'T BE GROWN ON THE SITE, OR IF YOU DON'T WANT TO USE ALTERNATIVE PRESCRIPTION #1 OR #2:** Use the Default Standard of the General Prescription--leave all conifers and hardwoods within distances specified in the rules (page 6).
Note: You can propose your own plan (Site Specific Prescription) for any stream. The Forest Practices Forester will review the plan to see if it meets the protection goals.	

STREAM PROTECTION OPTIONS, GENERAL PRESCRIPTION

GENERAL PRESCRIPTION To be used when there is "adequate" conifer stocking in the RMA. Always do A. and B. then use 1, 2, or 3, whichever applies.

- A. Except for yarding corridors or stream crossings, leave:
  -All trees within 20 feet of the stream.
  -All trees in the RMA that lean over the stream.
  -All understory plants within 10 feet of the stream.
  -All snags and down wood in the channel and RMA (Safety or fire hazards may be felled, but can't be removed).

- B. Leave a minimum number of live conifers in the RMA. Minimum numbers (per 1,000 feet of stream) are: 40 trees for large F streams; 30 for medium F, large D or N; 10 for medium D or N; no minumum for small streams.

- 1. <u>If the amount of live conifer basal area in the RMA is greater than the standard target:</u>

  -Leave a minimum amount of live conifer basal area in the RMA. This minimum basal area requirement is equal to the standard target for each stream classification, and varies by geographic region.
  -For some streams, large hardwoods (except alder) more than 20 feet from the stream and sound snags can count toward a portion of the basal area minimum.
  -For F streams, the basal area requirement can be reduced in exchange for stream improvement work done as part of a plan approved by the Forestry Department.

- 2. <u>If the amount of live conifer basal area in the RMA is greater than the "adequate" level, but less than the standard target:</u>

  -Leave all conifers within the RMA up to the maximum numbers (per 1,000 feet of stream) shown below: 150 trees for large F streams; 100 for medium F, large D or N; 70 for small F, medium D or N; no maximum set for small D; no live conifer leave requirement for small N.

- 3. Within 10 feet of some small year-round N streams, leave all trees less than 6 inches DBH, and all understory vegetation. This varies with geographic region.

STREAM PROTECTION OPTIONS, ALTERNATIVE PRESCRIPTIONS

ALTERNATIVE PRESCRIPTIONS To be used when there is not "adequate" conifer stocking, and the site can grow conifers.

- Intent--protect the stream while growing a new conifer stand.
- Can't be used on small D or small N streams.

Alternative Prescription #1: Catastrophic tree death or damage (wind, fire, insects, disease, etc.) over an entire stand.

- Leave enough of the following to meet minimum basal area amounts specified in the rules:
  -All down trees in the stream. Portions of down trees can be removed if stability of the tree in the stream is not reduced.
  -All live and dead trees within 20 feet of all medium and large streams, and within 10 feet of small F streams.

Alternative Prescription #2: Hardwood dominated sites. Can be used only in western Oregon.

- -Identify sections (minimum 200 feet long) of RMA that have "adequate" conifer stocking; apply the General Prescription on those sections.
- Divide the rest of the RMA into "conversion" and "retention" blocks.
  -Conversion blocks:
    -Leave everything within 10 feet of the stream (plus trees within 20 feet that lean over large streams).
    -The total length in conversion blocks can't be any more than 1/2 the stream length in the harvest unit.
  -Retention blocks:
    -Leave all trees within distances ranging from 20 to 50 feet, depending on the stream classification.

STREAM PROTECTION OPTIONS, DEFAULT STANDARD

DEFAULT STANDARD OF THE GENERAL PRESCRIPTION To be used when there is not "adequate" conifer stocking, and (1) the site will not grow conifers, or (2) the landowner chooses not to apply the alternative prescriptions.

- Except for yarding corridors or stream crossings, leave:
  -All trees in the RMA that lean over the stream.
  -All understory plants within 10 feet of the stream.
  -All snags and down wood in the channel and RMA (Safety or fire hazards may be felled, but can't be removed).

- Leave all conifers within the RMA width for the stream classification.

- Leave all hardwoods within specified distances, which vary from 20 to 50 feet, depending on the stream classification.

OTHER REQUIREMENTS

- Except at approved crossings, operators are not allowed change stream channels (no removal of soil or rock; no filling with soil, slash, or other material; no straightening of the channel). This applies to all stream channels, even very small ones that are dry in the summer.

- Except where necessary for road maintenance, the rules don't allow removal of beaver dams on forest land without prior approval from the Department of Forestry.

- New culverts must maintain adult and juvenile fish passage, and must be designed for the 50 year storm event.

- Except at approved crossings, skid roads must be kept at least 35 feet away from type F or D streams.

LAKES AND WETLANDS

Lakes have year round standing water. Wetlands are areas that have enough surface or ground water to support wet soil vegetation, such as rushes or skunk cabbage. Wetlands may dry out in the summer. Tables 3 and 4 on page 7 show the classifications and protection requirements for lakes and wetlands.

LAKE AND WETLAND PROTECTION

Table 3

LAKE CLASSIFICATION AND PROTECTION		
Classification	RMA	Protection (lake and RMA)
LARGE = greater than 8 acres	100 feet	-Leave understory plants, all snags and down wood, and 1/2 of the trees by species and size -Don't drain lake or cause sedimentation
OTHER, between 8 acres and 1/2 acre, or less than 8 acres and has fish	50 feet	Same as for LARGE
OTHER, less than 1/2 acre, no fish	No RMA	-Don't drain lake or cause sedimentation -If greater than 1/4 acre leave snags and down wood

Table 4

WETLAND CLASSIFICATION AND PROTECTION		
Classification	RMA	Protection (wetland and RMA)
SIGNIFICANT = greater than 8 acres, or estuaries, bogs, or certain Eastern Oregon springs	Varies from 50 to 200 feet	-Leave requirements same as for LARGE lakes -Don't drain wetland or cause sedimentation
STREAM ASSOCIATED = next to a stream	Stream RMA goes around it	-Included in stream RMA
OTHER = less than 8 acres	No RMA	-Don't drain wetland or cause sedimentation - If greater than 1/4 acre leave snags and down wood

Resources for further information, training, and certification

Publications for reference

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FOREST PRACTICE NOTES

DECEMBER 1994 • NUMBER 2 (Revised)

PUBLISHED BY
THE FOREST PRACTICES PROGRAM
OREGON DEPARTMENT OF FORESTRY
2600 STATE STREET
SALEM, OR 97310

REFORESTATION

This *Forest Practice Note* explains the State of Oregon's current regulations for reforesting lands after forest operations. The Oregon Department of Forestry enforces these regulations under the authority of the Oregon Forest Practices Act. This *Forest Practices Note* replaces a previous note on reforestation, dated December 1979.

The requirements discussed in this note apply to all operations completed after January 1, 1995. Operations completed prior to that date remain subject to the rules or statutes in effect at the time of completion. Contact your local Department of Forestry forest practices forester (FPF) if you have questions about reforestation obligations on operations completed before 1995.

Purpose and Summary of the Reforestation Rules

The purpose of the reforestation rules is to ensure that forest tree cover is maintained or re-established after harvest of forest trees. The Oregon Board of Forestry recognizes that optimum tree stocking levels are desirable, but that this objective is best met on private lands through incentives and other cooperative efforts rather than through regulation. Therefore, the rules are designed to require reforestation that ensures stands of trees continue to occupy forest land sites, but at somewhat less than optimum levels. Most landowners should easily be able to comply with these rules by continuing the sound harvesting and reforestation practices they already use.

Reforestation is required on areas where harvest operations have taken place and post-operation tree stocking is below specified levels. These required stocking levels vary by site productivity. The reforestation rules allow either artificial (usually tree planting) or natural methods to be used. The rules also describe time limits in which reforestation must be accomplished. In a significant change from past rules, reforestation requirements apply anytime post-operation stocking is below the levels specified in the rules, even if stocking

How do the rules affect you?

Listed below are the key steps landowners should take to comply with the reforestation rules. The following pages describe each step in more detail.

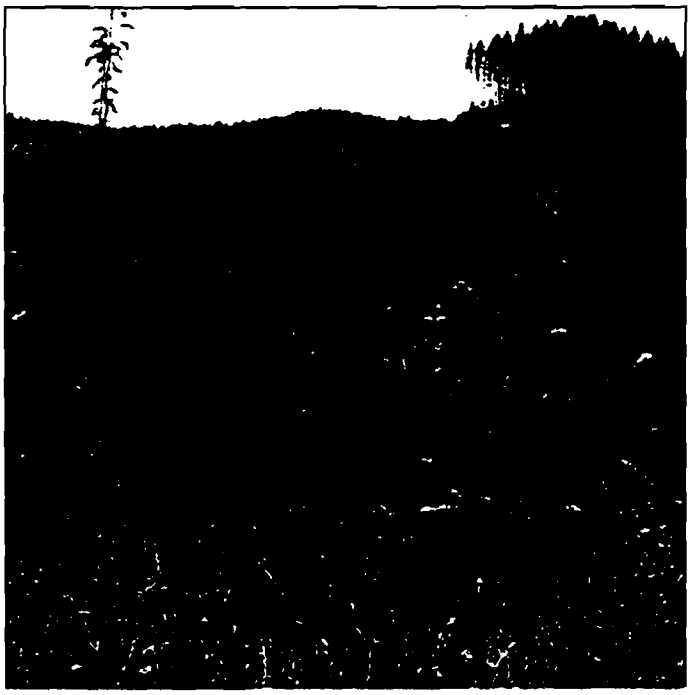
was below those levels before the operation. This means landowners often must reforest following salvage harvests and conversions of underproducing stands. The rules also specify some new procedures for operations involving forest incentive programs, and developing forestlands to non-forest uses.

Landowner Responsibility

The reforestation rules hold landowners, not operators, responsible for reforesting their lands after forest operations. Landowners will be expected to understand and apply the rules. This technical note is designed to help landowners in that task. Local FPFs will be able to offer limited assistance, such as sharing of rule information and some technical information, but landowners needing further help should contact qualified consulting foresters or other professional foresters for advice. Landowners should be aware that ***planning for reforestation before harvesting operations begin*** will be necessary to comply with the rules. In addition, landowners need to know that if the department identifies a reforestation rule violation, the landowner will be ordered to comply with the rules, and may be assessed a civil penalty of up to $5,000.

"Free to Grow" Trees

The concept of a "free to grow" tree or stand of trees is important for understanding the reforestation rules. "Free to grow" means a tree or a stand of well-distributed trees that are of acceptable species, are of good form, and have a high probability of remaining vigorous, healthy and dominant over undesired, competing vegetation.



In general, an FPF will consider a tree "Free to Grow" if:

(a) It is not severely damaged by insects, disease, fire, wildlife, weather or logging;
(b) It exhibits the potential for continued height growth, consistent with the normal growth for the species on similar sites;
(c) It has at least one-third of the tree height in full, live crown; and
(d) It is taller than, and out-competing any grass, shrubs, or other trees growing within a ten-foot radius from the tree.

What Lands are Subject to the Reforestation Rules?

Any land which is rated as Cubic Foot Site Class I, II, III, IV, V or VI forest land is subject to the requirements of the reforestation rules. These are forest lands that are capable of growing at least 20 cubic feet of wood fiber on an acre in a year. In eastern Oregon, very high elevation timber stands or stands dominated by juniper trees probably do not meet this standard. In western Oregon, 94 percent of the privately owned forest lands are capable of growing at least 20 cubic feet per acre per year. Less productive westside forest lands are located primarily in interior southwest Oregon and are often intermingled with more productive lands.

Landowners should become familiar with the productivity of their forest lands. Site productivity may be determined directly by tree growth and stocking measurements throughout the operation area or determined indirectly using applicable USDA Soil Conservation Service soil survey information, USDA Forest Service plant association guides, Oregon Department of Revenue western Oregon site class maps, or other information of comparable quality. Consult a professional forester if you are unsure how to determine the productivity of your land.

Tree Stocking Standards

After a forest operation subject to the reforestation rules is conducted, the landowner must maintain or reestablish free to grow stocking of acceptable tree species to at least levels listed in ***Table 1*** within the time limits set in the rules. Landowners are responsible for determining if reforestation will be required after harvest and determining how many additional trees are needed. Landowners will usually be sent a courtesy letter from the department that informs them of their reforestation obligations.

TABLE 1: Minimum Tree Stocking Standards

Site Productivity	Seedlings (less than 1-inch DBH*)	Saplings and Poles (1 to 10-inches DBH)	Trees 11-inches DBH and larger
Cubic Foot Site Class I, II, and III (Douglas-fir 100-year site index 124 and higher)	200 per acre	120 trees per acre	80 square feet of basal area** per acre
Cubic Foot Site Class IV and V (Ponderosa pine 100-year site index 64 to 108)	125 per acre	75 trees per acre	50 square feet of basal area per acre
Cubic Foot Site Class VI (Ponderosa pine 100-year site index 40 to 63)	100 per acre	60 trees per acre	40 square feet of basal area per acre

* "DBH" means the tree diameter, including bark, at 4.5 feet above the ground (breast height).
** Basal area means the area of a cross section of a tree stem at breast height, expressed in square feet.

The stocking of residual, "free to grow" seedlings, saplings and poles, and larger trees will be weighted to determine stand stocking. Generally, the larger the trees are, the fewer are needed to satisfy the reforestation rules. Regardless of the site productivity of the operation area, 100 seedlings will be considered equal to 60 saplings and poles and equal to 40 square feet of basal area of 11-inches DBH and larger trees when calculating stocking. Expressed as an equation:

$$\text{New Trees} = \text{Rule Standard} - \left[\#\ \text{Seedlings} + \left(\#\ \text{Saplings \& Poles} / 0.6\right) + \left(\text{Basal Area} / 0.4\right)\right]$$

Where: **"New Trees"** means the minimum number of additional free to grow seedlings the landowner must establish per acre

"Rule Standard" means the seedling stocking standard for the site listed in the rules (100, 125, or 200 seedlings per acre)

"# Seedlings" means the number of free to grow seedlings per acre already present

"# Saplings & Poles" means the number of free to grow saplings and poles per acre already present

"Basal Area" means the basal area per acre of free to grow trees 11-inches in DBH and larger already present.

The example on page 4 shows how this equation is used.

Example Using Stocking Equivalents:

A partial cut harvest unit on Site IV forest land contains the following tree stand after the operation:

Average number of seedlings per acre	= 35
Average number of saplings and poles per acre	= 8
Average square feet of basal area per acre of trees 11-inches DBH and larger	= 15

1 seedling = 0.6 saplings and poles = 0.4 square feet of basal area of 11-inch DBH and larger trees; therefore:

8 saplings and poles per acre / 0.6 = 13 seedling equivalents
15 sq. ft. of basal area per acre / 0.4 = 38 seedling equivalents

35 + 13 + 38 = 86 seedling equivalents already present

One hundred and twenty-five (125) seedlings or equivalent larger trees is the minimum stocking standard for Site IV land; therefore, establishment of an additional 39 free to grow seedlings per acre is required on this site [39 =125 - (35 + 13 + 38)].

(Example assumes all trees are healthy, undamaged, and well distributed)

Live conifer trees 11 inches DBH and larger left standing in harvested areas to meet the Forest Practices Act's green tree and snag retention requirements may also be counted towards meeting the tree stocking standards if the trees are free to grow.

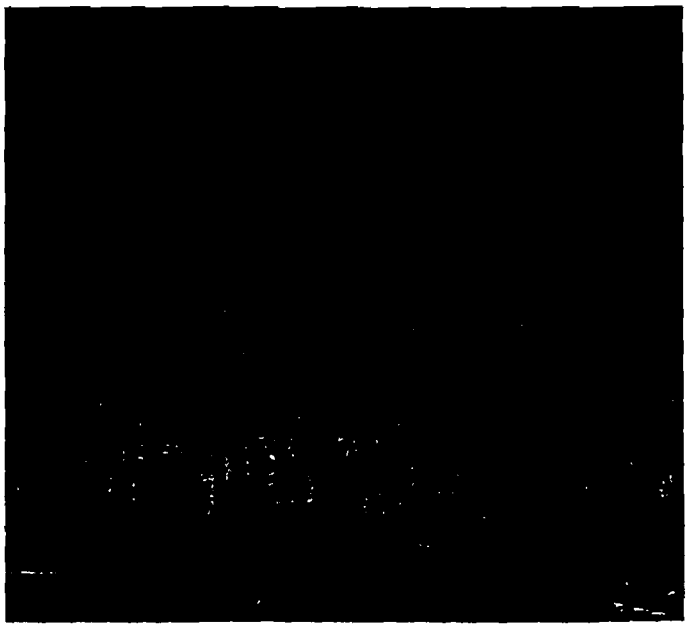
Table 2 provides approximate conversions between trees per acre and tree spacing when evaluating trees less than 11-inches DBH. For trees 11-inches DBH and larger, ***Table 3*** *(opposite)* provides approximate conversions between trees per acre, tree spacing, and basal area per acre.

Landowners should be aware that if planting is planned, the number of planted seedlings will usually need to be higher than the applicable seedling levels listed in these rules because some seedlings may die between planting and the free to grow deadline.

The reforestation rules provide flexibility for forest practices foresters and landowners to tailor reforestation requirements to site-specific situations. Landowners may submit plans for alternate practices that do not conform to the reforestation stocking levels established under these rules. Such plans may be approved if the FPF determines that there is a high probability that the purpose of the reforestation rules will be achieved.

TABLE 2: Relationship Between Trees Per Acre and Average Tree Spacing

Trees per acre	Average spacing between tree centers (in feet)
200	15
125	19
120	19
100	21
75	24
60	27



Using Natural Reforestation Methods

Natural reforestation methods may be the best means to meet a variety of resource management objectives on some forestlands. Successful natural reforestation requires careful, flexible, site-specific pre-harvest planning and post-harvest monitoring. On Cubic Site Class VI forestlands and in wetlands, the use of silvicultural systems that promote natural reforestation and the

Table 3: Relationship Between Basal Area Per Acre and Tree Spacing for Different Tree Diameters

Average DBH of trees 11-inches and larger	Average trees per acre for 80 sq. ft./ac. basal area	Average spacing between tree centers for 80 sq. ft./ac. basal area (in feet)	Average trees per acre for 50 sq. ft./ac. basal area	Average spacing between tree centers for 50 sq. ft./ac. basal area (in feet)	Average trees per acre for 40 sq. ft./ac. basal area	Average spacing between tree centers for 40 sq. ft./ac. basal area (in feet)
11	122	19	76	23	61	26
12	102	21	64	26	51	29
14	75	24	47	31	37	34
16	58	27	36	35	29	39
18	46	31	28	39	22	44
20	37	34	23	44	18	49
22	31	37	19	48	15	54
24	26	41	16	52	13	58
26	22	44	14	56	11	63
28	19	48	12	60	10	68
30	17	51	11	63	8	73
32	15	54	9	69	7	78

retention of good quality residual trees after operations often have a higher probability of success than artificial reforestation methods.

When natural reforestation methods are planned, landowner must first obtain written approval by the forest practices forester of a written plan which describes how reforestation will be accomplished. Information in the plan must include:

(a) A description of the seed sources that will be used;
(b) Site preparation and vegetation competition control methods;
(c) An estimate of the time needed to obtain an adequately stocked free to grow stand;
d) How progress towards natural reforestation will be evaluated; and
(e) Alternative strategies that will be used if natural reforestation does not progress as planned.

The written plan must be submitted no later than twelve months after tree stocking is reduced.

Forest practices foresters will closely review any plans that rely on naturally regenerated hardwood species to meet the reforestation requirements. In some cases, such as cottonwood and quaking aspen groves, natural reforestation with the same hardwood species is probably the best option. However, written plans proposing natural reforestation on conifer sites with species such as red alder will generally not be approved unless strong evidence is provided that establishes a high probability of reforestation success.

Landowners may not need to submit a new written plan every time natural reforestation methods are used if an approved plan already exists and future operations on the ownership will take place under similar conditions. However, approval will still be required.

Time Line for Completing Reforestation Activities

The time period for compliance with the reforestation rules begins at the completion of the operation or 12 months after tree stocking has been reduced, which-

ever comes first. "Completion of the operation" means harvest activities have been completed to the extent that an operation area will not be further disturbed. FPFs may require reforestation on a logical portion of a harvest unit even if activities on other portions of the operation are continuing.

Once the compliance period begins, the landowner must begin reforestation, including any necessary site preparation, within 12 months. If artificial reforestation is planned, the landowner must complete planting or seeding within 24 months. By the end of the sixth full calendar year, the landowner must have established an adequately stocked, free to grow stand of trees.

When natural reforestation methods are planned, the time limits for evidence of successful germination and for establishing a free to grow stand of trees, which meets or exceeds the minimum stocking level required for the site, will be established in the approved written plan.

If reforestation cannot be accomplished within the specified time due to circumstances determined by the forest practices forester to be beyond the landowner's control, the time to accomplish reforestation may be extended. Examples of such circumstances include:

(a) Nursery failure;
(b) Inadequate seedling availability following salvage harvesting;
(c) Extreme drought;
(d) Insect infestation;
(e) State smoke management restrictions on the burning of slash;
(f) Wildfire or disease damage; or
(g) Severe wildlife damage that could not be reasonably anticipated or controlled by the landowner.

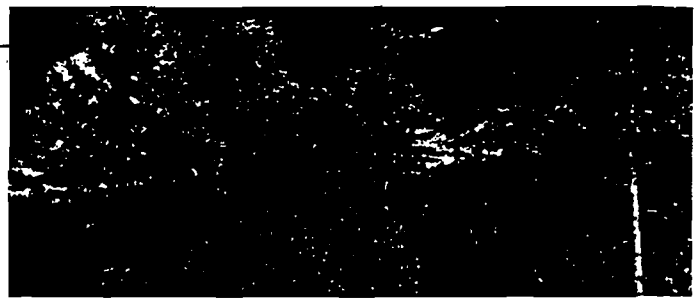
The following situations are examples of where extensions will *not* be granted:

(a) Failure of artificial reforestation efforts is due to landowner's failure to secure appropriate seed or seedlings following the harvest of free to grow trees. Exceptions may be granted for salvage harvests that the landowner could not anticipate.
(b) Natural reforestation failures are due to inadequate seed sources or poor seed crops in the years immediately after an operation.
(c) Failures on harsh reforestation sites resulting from harvest area design or competing vegetation.
(d) Wildlife damage that could have reasonably been anticipated and controlled, such as from mountain beavers.

Tree Species Suitable for Reforestation

Tree species are acceptable for artificial reforestation, natural reforestation, and as residual tree stocking based on all of the following criteria:

(a) The species must be ecologically suited to the planting site;
(b) The species must be capable of producing logs, fiber, or other wood products suitable in size and quality for the production of lumber, sheeting, pulp or other commercial forest products; and
(c) The species must be marketable in the foreseeable future.



Native species will generally be considered "ecologically suited" and the preferred reforestation species.

Up to 20 percent of required tree stocking may be met by using free to grow hardwood trees remaining after harvest. Prior approval by the FPF is required before more than 20 percent of the required stocking may be met with residual, post-operation hardwood trees.

Landowners are encouraged to reforest with a mixture of acceptable tree species where appropriate to reduce the risk of insect and disease losses and to promote stand diversity.

Seedlings or seeds used for artificial reforestation should be from seed sources that are genetically adapted to the growing site. If local seed sources are not available, landowners should not use off-site seeds or seedlings that may result in poor survival. A delay while waiting for appropriate seedlings is preferable to planting off-site stock.

When a landowner intends to plant or seed a tree species not native to the operation area, the landowner must obtain prior approval of a written plan which describes the tree species and how it will be used to meet the reforestation requirements. Information in the plan must include:

(a) The tree species that will be used;
(b) Evidence that the species is ecologically suited to the planting site;
(c) Evidence that the species is capable of producing commercial forest products that will be marketable in the foreseeable future; and

(d) Available research or field test findings which demonstrate the tree species has been successfully used in reforesting sites similar to the operation area.

Written plans for the use of non-native tree species must be submitted for approval no later than twelve months after tree stocking is reduced and prior to planting. For the purpose of the rules, any tree species that has naturally existed and reproduced in the operation area or on similar sites will be considered a native species.

Suspension of the Reforestation Requirements

A landowner may request a suspension of the reforestation rules for the salvage or conversion of low value forest stands. Forest practices foresters will suspend the reforestation rules in such cases if the landowner is approved for funding from a forest incentive program administered by the Department of Forestry and the gross harvest revenues will not exceed the total costs of harvest, taxation, and reforestation. The intent of this suspension option is to allow landowners to fully qualify for federal cost-share funds and state incentive programs.

The suspension of the reforestation rules may be revoked at any time within six years of completing the operation if the landowner fails to establish a forest stand according to the specifications and time lines required under the applicable forest incentive program.

Contact your local Department of Forestry service forester if you wish to apply for this rule suspension.

Revegetation When Reforestation is Not Required

When reforestation is not required, the landowner must ensure sufficient revegetation of the site to provide continuing soil productivity and stabilization within 12 months of the completion of the operation. Revegetation may be planted or naturally established, and must consist of trees, shrubs, grasses, or forbs suitable for soil stabilization and productivity protection. Landowners are encouraged to revegetate the operation area with native plants.

Exemption from Reforestation when Developing Land for Non-Forest Uses

Nothing in the Forest Practices Act or the forest practice rules is intended to prevent a landowner from converting land to a non-forest use. However, when a land use change is planned following a harvest operation, the landowner must take certain steps for the operation area to receive an exemption from the reforestation requirements.

In seeking a reforestation exemption, the landowner must provide written documentation to the Department of Forestry which establishes:

(a) The specific portion of the operation area necessary for the proposed change in land use;
(b) The intended change in land use and the incompatibility of the land use with forest tree cover;
(c) The intended change in land use is authorized under local land use and zoning ordinances, and all necessary permits and approvals have been obtained, or will be obtained within 12 months following the reduction in tree stocking; and
(d) The county assessor and local planning department have been notified in writing of the proposed change in land use.

The Department of Forestry has developed a written plan form for this exemption request.

Reforestation exemptions will only be granted for the smallest land area necessary to carry out the intended change in land use. Reforestation will be required on the portions of operation areas not directly involved in the land use change.

Reasonable progress towards the change in land use, as determined by the forest practices forester, must be made within 12 months of the completion of the operation. The change in land use must be completed and continuously maintained within 24 months of the completion of the operation. Compliance extensions may be granted by the forest practices forester based on written evidence provided by the landowner, that the landowner made reasonable attempts to comply, but was prevented from doing so by circumstances beyond the landowner's control.

To remain exempt from the reforestation requirements the landowner must continuously maintain the land in the new use until at least six calendar years following the completion of the operation.

ODF Field Offices Directory

Northwest Oregon Area

Astoria District
Route 1, Box 950
Astoria, OR 97103
503-325-5451

Tillamook District
4907 E. 3rd St.
Tillamook, OR 97141
503-842-2545

Forest Grove District
801 Gales Creek Road
Forest Grove, OR 97116
503-357-2191

Clackamas-Marion District
14995 S. Hwy 211
Molalla, OR 97038
503-829-2216

West Oregon District
25433 Alsea Hwy
Philomath, OR 97370
503-929-3266

Southern Oregon Area

Douglas District
1758 N.E. Airport Road
Roseburg, OR 97470
503-440-3412

Western Lane District
P.O. Box 157
Veneta, OR 97847
503-35-2283

Eastern Lane District
3150 Main St.
Springfield, OR 97478
503-726-3588

Linn District
4690 Hwy 20
Sweet Home, OR 97386
503-367-6108

Southwest Oregon District
5286 Table Rock Road
Central Point, OR 97502
503-664-3328

Coos District
300 5th St., Bay Park
Coos Bay, OR 97420
503-267-4136

Eastern Oregon Area

Central Oregon District
Route 2, Box 357
Prineville, OR 97754
503-447-5658

Klamath-Lake District
3400 Greensprings Drive
Klamath Falls, OR 97601
503-883-5681

Northeast Oregon District
611 20th St.
La Grande, OR 97850
503-963-3168

Salem Headquarters

2600 State Street
Salem, OR 97310
503-945-7470

OREGON DEPARTMENT OF FORESTRY
FOREST PRACTICES PROGRAM
2600 STATE STREET
SALEM, OR 97310

BUSINESS DEVELOPMENT AND MANAGEMENT FOR ECOSYSTEM RESTORATION AND ENHANCEMENT

INTERPERSONAL SKILLS: BOTTOM LINE PRESENTATIONS

Ellen Palmer

At the end of this section you will be able to:

- *identify the bottom line for your audience*
- *list your/your businesses strengths and weaknesses*
- *identify your businesses strengths that will benefit your audience*
- *present yourself with confidence in an employment interview, to contract sources, and to financial institutions.*

One of the most important aspects of your career can be the moments you present yourself to a prospective employer, contract officer, or bank loan officer. Your ability to sell your ideas in a personal presentation can make a significant difference in your ability to get the job you want, get a loan to start your business venture, or get awarded that prime contract. You and your work will be associated with the quality of your presentation.

Great presenters are not born, they are made. Professional athletes constantly practice basic moves because they know that without practice they will not survive. Professionals in any field know that hours of practicing the basics are the very foundation of success. Presentations are no different.

Learning to be a better speaker is similar to learning any activity. It gets easier as you go. Practice and follow a few common sense steps and you will increase your chances of success. Optimism and sincerity are important. Clearly stated ideas that concisely state specifics, names, facts, examples, and statistics are essential.

Think about what you would want if someone were try to sell you on a concept. A communication style that works for you will probably work for the person you are making the presentation to as well. Tailoring your presentation to your audience's need, preparing well, stating your position concisely, and asking for the commitment will increase your bottom line before long.

B E S T presentation guidelines

B = Bottom Line

Make an interesting introduction— emphasize the benefits the audience will gain.

Make a preview statement—tell them what you are going to tell them

E = Example

Present ideas, know your stuff for credibility—tell them

S = Summary

Reemphasize benefits—tell them what you told them

T = Transact

Transact business—ask for a commitment to the job, loan, or contract

Bottom line

Journalists have long known that the most audience impact is achieved at the beginning and the end of an article they are writing. Audiences also pay more attention to the introduction and conclusions of business presentations—so make the first and last impressions powerful and interesting. Make them really count!

Here's a hint that will make your introductions instantly appealing: *Emphasize the benefits the audience will gain by working with you.* Make your talk obviously and immediately relevant to their concerns. Know before you walk in the door why they should hire you (or loan you money or whatever).

Think carefully about their interests and concerns. Come up with ways your work will benefit them, and make sure they know, right from the start of your presentation what those benefits are. Spark their interest and you will more easily deliver a powerful, persuasive presentation.

Start by briefly stating the point you wish to make in a section or as response to a question (benefits, benefits, benefits) and transition to specifics and examples. Use a signpost phrase like "Example number two is. . . " or "Another advantage our crew has is . . . . "

Activity

1. List the bottom line for your audience

For example:

- If you are looking for a job, list the skills and aptitudes is the employer looking for
- If you are bidding on a contract, list what the contract officer needs to satisfy his requirements?

- If you are applying for a loan, list what a loan officer looks for when loaning money to a business?

2. Know your own strengths and weaknesses

For example:

- If you are interviewing for a job, list your skills, abilities, and aptitudes in one column and then in another column list your weaknesses.
- If you are bidding for a contract, list the strengths your crew exhibits in getting the job done in one column and list their weak points in another column.
- If you are applying for a loan, list your business strengths in one column and it's weaknesses in another column

3. Focus on benefits

Compare the bottom line list you created in number 1 above to the strengths list you created in number 2 above. Circle the items which appear on both lists. The strengths you have circled are the benefits you will focus on when making your presentation. It is also important to take note of your weaknesses and be prepared to discuss how you will compensate for them if asked.

Audience Bottom Line	Your/Crew's Strengths	Your/Crew's Weaknesses

Example

Speak persuasively by stating specific names, facts, examples, statistics, and stories. Gain credibility by giving proof through examples of your ability to perform. Signpost these specifics with a statement like "Examples of my ability are . . . " or "Here are some numbers that will help . . . ." Support key points by describing past situations or expanding on concrete plans for the future.

Summary

Reemphasize the bottom line benefits. Why should they hire you, award you a contract or grant you a loan.

Transact

Ask for a commitment to the job, loan, or contract. To end with a powerful conclusion, transition from the summary of what you have to offer to a resulting action. Express sincere confidence and predict realistic success. Make the very last words you say positive. You might end with a statements like, "I'm looking forward to working

with you. I know we can get the job done right and on time." Or for a loan situation, "I'm looking forward to working with you. This transaction is going to be profitable for both of us."

Follow through

You've made your presentation but your work is not yet finished. The most successful people will tell you that good follow through is the key to landing a job, getting that contract, or getting a loan.

Follow through with each contract presentation or interview by sending a thank you letter. This is an opportunity to show your stuff and stand out in the crowd by going the extra mile. It is also a great opportunity to restate why you would be the best candidate for the job, or contract and to give additional information that you may have left out during your presentation.

If you are starting your own business you will be developing an ongoing relationship with your bank. A follow-up telephone call to a loan officer to be sure they have everything they need and the process is on track saves time if more information is needed and helps establish a cooperative working relationship.

Activity

A thank you letter should be a professional letter brief and to the point. It should include the following:

Company Name and Address

Greeting—if your presentation was informal it is appropriate to use the interviewer/contract officer's first name. If it was formal you will probably want to use Mr./Ms. and their last name. You be the judge.

Opening —for example:

"It was a pleasure to meet with you yesterday to discuss working with Super Company."

Body—Use the this opportunity to stress the benefits of working with you. Mention something discussed in the interview. For example:

"The immediate needs of Super Company seems to strongly favor my experience, skills and the recent training I completed in Ecosystem Enhancement. I would certainly be able to make a substantial contribution to Super Company by . . . "

Closing—make a positive closing statement. Don't be shy now! An example might be:

"The work with Super Company is exactly what I have been looking for. I am looking forward to hearing from you soon."

Salutation—

"Sincerely" or *"Yours truly"*

See the sample follow-up letter for more ideas.

Final tips

You did your homework, prepared your presentation well, followed-up as recommended, and you are still wondering if you got it right. Remember, professionalism and sincerity are more important than making a perfect presentation. Perfection would appear slick. What people like are solid, real human beings who may be fallible, but who have the ability to meet challenges and successfully adapt.

Sample follow-up letter

May 5, 1996

Martha Forest Contractor
Super Company
P. O. Box 101
Mountain City, OR 97439

Dear Ms. Contractor:

Thank you for taking time to interview me for your lead worker position with Super Company.

After listening to what you need done, it seems that my experience organizing and managing forest crews coupled with my recent training and experience in the Ecosystem Enhancement Project could be of immediate benefit to your company. I like the idea of being able to step right in and make the kind of contribution needed to make Super Company more competitive in the forest management field.

Feel free to call my prior boss John Logger at (541) 344-1234 or the crew leader in the Ecosystem Enhancement Project, Jim Faller at (541) 899-4321 as references.

I look forward to working with you.

Sincerely,

Daniel Wantabe
10000 High Road
Plainview, OR 97438
(541) 999-1111

INTERPERSONAL SKILLS: COMMUNICATION SKILLS

Fran Bates
Mollie Owens-Stevenson
Ellen Palmer

Written Communication Skills

This section is designed to give you an overview to business writing. In whatever employment situation you find yourself in you will need to know how to write an effective business letter, and to summarize information into reports. When bidding on contracts you may be asked to document how you plan to accomplish the task that you are bidding on. To do this you need to write in a clear and concise manner that is readable by the person who is reviewing your proposal. If you don't write well you will be at a competitive disadvantage in the marketplace. This section is an overview. If you need more help in writing check into the basic classes offered at your local community college. One of the keys to good writing is to read a lot. If you want to see what effective business writing is all about check out a library book on business writing. There may be good examples of effective written documents that you can copy, or at least use as a model.

The basic business letter has three parts:

1. A beginning where you introduce the reader to the situation that you are writing about.
2. A middle where you provide the information that you want to communicate to the reader. This should be as short as possible, but tell the story completely. One paragraph is best, but use what you need to in order to tell the reader what you want him/her to hear.
3. An ending which identifies the action you want to happen. This is always a separate paragraph.

Here's two tips on writing the business letter: It must pass the reader's "so-what" test. Is this something that the reader cares about, and is readily important to him/her? Why is so much 'junk' mail trashed—probably because it has no meaning to the reader. Same thing works with business communication. The second tip involves a set of 'do's.

- Do not write an angry letter—they often come back to haunt you,
- Do tell the truth,
- Do avoid postscripts—put everything into the basic letter,
- Do make a list of important stuff, if appropriate, and
- Do make it clear, personal, and short.

Exercise #1

Write a business letter to the US Forest Service Supervisor for the Willamette National Forest complaining about the lack of opportunities for small contractors in stream restoration. Be specific and be sure to tell him what your proposed remedy would be.

Have a friend critique it, using the three basic parts and the rules as a guide.

Letters are only one side of business writing. The other side, and the one that many small contractors have less experience with is the report writing side. This may be critical to you if you are bidding on a project, writing a final report on a project, or making a proposal to a private employer whose business you are trying to solicit. A business report has several purposes:

To inform, Influence, propose, or record

As with all writing there are some simple rules to follow that can make your report more effective.

1. **Analyze the audience.** No matter how you came to the point of needing to write this report there may be political or operational constraints on what you are writing and that may affect the writing process. Understand who you are writing this to, and what the environment is you are writing it in.

2. **Limit the problem.** Depending on the type of report you are writing restrict it to a manageable size by fixing the who, what, when, why, and how of the situation. Eliminate unnecessary concerns.

3. **Analyze the whole problem.** Does whatever you are trying to say tie together and address the problem or the situation?

4. **Gather data.** If this is a problems situation, get the data that pertains to the problem together. If you are reporting on the results of a project discuss the entire set of results and what they mean or how they answer the original questions that caused you to start this project.

5. **Evaluate your information.** Is what you are saying accurate, first hand, and scientifically valid?

6. **Organize your information.** Put it into the format that the reader is familiar with or the format that is required of you for the material that you are presenting. This is no time to be creative in presentation. You are writing for the benefit of the reader not for your benefit. If in doubt as to how to organize the material ask the reader how he/she would like to see it.

7. **List possible solutions.** Develop as many solutions as possible if you are presenting a recommendation to someone or making a proposal about a project.

8. **Test the possible solutions.** Give the reader a reason to pick one solution over another by providing him/her with a test of the solutions using data familiar to what the reader is used to seeing. If you are doing a cost proposal, use examples that the reader also uses and keep the units of measure in familiar terms. For example, do not measure something in liters or cubic centimeters, if the reader has no knowledge of the metric system.

9. **Recommend a final solution and list what must be done to implement this solution—an action plan, if appropriate.**

Report writing is not hard, it just takes a lot of practice to become good at it. The basics of writing always stay the same, just the content and format change somewhat from letter to letter and report to report. One of the biggest things you can do to improve whatever you write is to write a DRAFT and revise it frequently. You should share this draft with others and allow, even encourage, editing. The worst thing that can happen in any of your writing is to become so locked into a 'pride of authorship' position that you cannot take constructive criticism of what was written. Remember that as long as you have the pen, you control the final product, but several people working together can usually produce a product that is superior to one person working alone.

In general then writing is an active process that can be learned or improved on through practice and, imitation. It's not hard, just frustrating, and time consuming, but it is so critical to business success and advancement in most organizations that it should be a top priority to any person who wants to advance their economic standing in the marketplace.

One final thought to those who only read the first and last paragraph of a chapter:

To be an effective writer do the following every time:

1. Know who you are writing to, why you are writing, and what the document will accomplish after it's written,

2. Keep things short, clear, and personal, in a format that the reader expects.

3. Write a draft first, read it aloud, have someone else read it, make changes and read it again. If it doesn't make sense to someone else it probably won't to the reader.

4. Practice your writing every chance you get. Read a lot to learn how others write. Have some courage to put your thoughts on paper knowing that someone else may not agree with them.

Oral Communication Skills

Competencies

The person who is competent in the area of oral communications is able to listen, to understand information, perform tasks based on verbal instructions, participate in discussions, actively reflect the content back to speaker. He or she is able to interact effectively with others, to ask questions, to clarify, explain technical concepts and processes, inquire and verify information, defend a statement with supporting information, develop and practice a variety of questioning strategies and techniques, and diffuse stressful situations. A final competency is the ability to use appropriate nonverbal communication, including dress, body language, eye contact, and tone of voice.

Key concepts

Listen

The first key to successful listening is to get ready to listen. Get rid of distractions; be able to **focus** on the speaker. If other things are distracting you, make a date to listen speaker. If other things are distracting you, make a date to listen—it might be in 5 minutes or two days, but do what you need to get rid of distraction.

The second key to successful listening is to actively listen. Once you have focused on the speaker, get ready to understand the speaker. In order to do that, you need to understand the process of communication:

Speaker's intent → Speaker's words → Listener hears words → Listener interprets words.

The speaker's intent may not be what the listener interprets. Therefore, the listener must ask the speaker if what the listener heard is what the speaker meant. For example, if I say that I feel badly about a project that you and I worked on together, you may think that I am disappointed in your work, while I mean that I am disappointed that the person for whom we did it was not as impressed as I thought they should be. You might say, "You said you were disappointed in our work. (Feedback) Do you mean that you thought our work was not good enough?" (Ask a clarifying question)

Active listening implies that I focus on what you said, not my reaction to it. I take pains to make sure that I really understand what you have said before I go on to my reply.

Active listening is a skill. Practice it regularly in everyday situations, so that you will be able to use it when you need it.

Interact effectively

The first key to effective interaction is to understand your communication style. There are several ways to do this; one is to take a style or personality test, such as the Meyers Briggs test, the Gregoric Work Style Indicator, or the Communication Style Profile from *Effective Human Relations in Organizations* by Reece and Brandt, from Houghton Mifflin Co. Most tests profile four types that range from people who focus primarily on

the needs of the people in the group to those who focus primarily on the work to be accomplished, to those who tend to take over and be in charge, to those who tend to be more aloof and observant. Each type both sends and receives communication differently. It is important to understand each style, and learn to flex so that you deliver the information in the most effective manner.

Body language

In order to communicate effectively, we must pay as much attention to what our bodies are saying as our words. When we turn our bodies towards the person we are talking to, and look them in the eye, we are silently communicating that we are paying attention. When we smile and nod, we communicate that we agree. When we frown and look the other way, we communicate that we are unhappy. Can you think of a time when someone's body language did not agree with the words they were saying? What did you think in that situation; was it confusing? If you want your message to be effective, be sure that your body language agrees with your words.

INTERPERSONAL SKILLS: COMPUTER LITERACY

Mollie Owens-Stevenson

Introduction

How does this fit with other topics?

This course will introduce you to the computer: how it operates, what computer systems are, and why software and hardware are functionally worthless by themselves. As you proceed with this training, and begin to drown in data in the field, you will begin to see the value of word processing to keep notes and write reports, spreadsheets to track numbers, and databases to track and manipulate data. This material will introduce you to the computer; for a short, introductory course in software, try FIRSTRAX: The Learning Advantage Wordperfect for Windows, Excel for Windows, and others.

Competency measures

You will:

- have a working knowledge of common computerese talk and terminology
- have gained a functional understanding of popular computer hardware and operating systems.
- understand the importance and complexity of selecting and integrating computer systems
- understand the importance of software selection

What Is a Computer?

A **computer** is an electronic device, operating under the control of instructions stored in its own memory unit, that can accept data (input), process data mathematically and/or logically, produce output from the processing, and store the results for future use.

Data

Raw facts. Data consists of characters; in computerese a character is referred to as a byte. Each byte is made up of 8 bits. A bit is an electronic pulse.

Information

Processed data.

Information processing cycle

Input
Process
Output
Storage

Why are computers thought to be so powerful?

Computers are considered powerful because of the ability to perform the four steps in the Information Processing Cycle very quickly, reliably, and accurately. The rate at which computers operate is measured in MIP. MIPS is an acronym that stands for Millions of Instructions Per Second.

The ability to store vast amounts of data is another reason that the computer is considered powerful.

The wares of computers

Hardware

The equipment, physical components of a system.

Software

A computer program, programs consist of detailed instructions that tell the computer what to do and how to do it.

Firmware

Also known as a ROM memory chip. ROM stands for Read Only Memory. ROM chips are a combination of hardware and software. The chip is hardware that has a program written to it at the time of manufacture.

Jellyware

Although this term is not used much any more, it refers to the knowledgeable computer users.

Vaporware

This term refers to software that has been promised but not produced yet.

Some hardware components

Hardware

The specific equipment that performs the Information Processing Cycle. Hardware consists of:

Input devices: A device with which data is entered into the main memory of a computer.

keyboard
mouse
scanners
light pens
disks

Processor unit: This component contains the electronic circuits that actually cause the processing of data to occur. The processor unit consists of the Central Processing Unit (CPU) and main memory.

Output devices: These devices are used to display data and information or to store information.

CRT
printer
disks

Auxiliary storage devices: Devices used to store instructions, data, and information when they are not being used by the processor unit.

hard disk drive
floppy disks
magnetic tape
compact disks

Each component in the computer system plays an important role. The processing unit is where the actual processing of data occurs. The input devices, output devices, and auxiliary storage units that surround the processing unit are sometimes referred to as **peripheral devices.**

Within a computer case (CPU case) there are several other devices. Within the case are a number of electronic boards or interface cards. The main board is the **motherboard;** the motherboard is fastened to the bottom of the case and holds many of the other case internal components. The CPU chip is plugged into the motherboard. Also, in the case is a speaker, a power supply unit, a fan, floppy drive units, hard drive units, tape drives, CD-ROM units, controller cards for peripheral devices, ROM chips, expansion slots, and more.

There are a variety of expansion slots used in the computer case. The difference between the slots is the amount of bits that the corresponding card can accept or send. This tidbit will be important later. The fastest bus slot is the local bus slot. It is called "local" because it sends the data directly to the device it is controlling.

Controller cards, like expansion cards, are plugged into the motherboard and provide a connection or communication link between the controller device and the CPU or main memory (RAM).

RAM is an acronym that stands for Random Access Memory; in other words the system can access anything in memory in any order. Data is often stored in some sequence, alphabetically or numerically, but the data does not have to be used in that sequence with RAM. Main Memory or RAM is made up of memory chips; today those chips are arranged on a board. These boards usually contain at least one Megabyte of memory, and are called SIMM boards (Single Inline Memory Module).

Hint: It would be very unwise to buy a computer with less than 8 MB of RAM.

RAM is very important to the system. RAM is the working area of the Information Processing Cycle. Data, program, and system software must be in RAM for processing to occur.

ROM is another acronym; it stand for Read Only Memory. ROM is also known as firmware. The ROM memory chip has instructions written to it by the manufacturer and these instructions can not be altered. On the system in our lab the ROM chips contain a bootstrap program which initiates the booting process. Booting refers to turning on the computer system, and ultimately loading the operating system into RAM. The ROM chips in our computers tell the system to check the Basic Input/Output System (BIOS) before loading the operating system into main memory.

Other systems may have other types of instructions written to ROM chips.

Application Software

Kinds of software

There are two categories of software, application software and system software. We will discuss system software later in this term. Application software refers to programs that apply to a specific area. For example word processing software applies to the manipulation of words, sentences, paragraphs, or documents.

General microcomputer applications

In the beginning of computer time, programs were very complicated and difficult to use. That was because programs were written by programmers for programmers. Software is just as complicated today, but not as difficult to use. Programmers still write the software, but now they write it for everyday people, like you and me.

User interfaces have been written into the programs and added to the equipment; user interfaces help make software and hardware **user friendly.**

User interface: methods and techniques that make using an application simpler.

User interfaces

Menus
Function keys
Prompts
User responses
System responses
Icons
A mouse, trackball
Error messages

User friendly programs do not require any special technical skills or ability to use them. These programs do not require detailed instructions from the user. The details have been written into commands that the user types into the computer. Commands are instructions that tell the computer what processing is needed and how to do the processing.

Application software packages, today are often referred to as productivity tools, because using these programs usually increases the productivity of the individuals that use them. Another common term is general application packages; general is used to refer to the wide range of users that these packages are useful to.

Many kinds of general applications are available. Some of the most widely used software includes:

Word processing

WordPerfect
Microsoft Word
Word Star

Desktop publishing

PageMaker
Corel Draw
Ventura
Finesse

Electronic spreadsheet

Lotus 123
Quattro Pro
Excel

Database

Dbase III+
Dbase IV
Paradox

Data communications

Prodigy
Crosstalk
Procomm Plus

Word processing software is a productivity tool that allows you to create, edit, format, print, and store documents. (Ask me about spell checkers, thesauruses, and grammar checkers.)

Desktop publishing software (DTP) allows users to design and produce professional looking documents that contain both text and graphics. (Ask me about clip art and WYSIWYG.)

Electronic spreadsheet software allows you to organize numeric data in a worksheet or table format. Spreadsheets are made up of columns and rows. An intersection of a column and a row is called a cell. The cell is used to store data within the spreadsheet. A cell may contain alphabetic data, numeric data, or formulas. Formulas are used to perform calculations on the numeric data that is stored in other cells.

A database refers to a collection of data that is stored in files. Database software allows you to create a collection of data, and to retrieve, manipulate, and update the data that you store in files.

Information presented in the form of a graph or a chart is commonly referred to as graphics; information presented as graphics can be understood much faster that information presented in writing. Today, many software packages create graphics including spreadsheet packages.

Data communications software is used to transmit data from one computer to another.

When a person purchases a computer today, they often get software with it. Most of the time this is an integrated software package. Integrated software is a combination of several general application tools that operate under the same or similar set of commands. Some examples of integrated software are Lotus Works and Microsoft Works. Both of these are small packages for the PC. There are larger integrated packages such as Symphony 123 (complicated but for the PC also) and Enable, which is usually for a larger system.

Guidelines for purchasing software

1. Read software reviews.
2. Make sure that the software performs the task you desire, and that the software will run on your computer.
3. Make sure that the software is adequately documented.
4. Purchase software from a reputable software developer or software publisher; obtain the best value, remember that the best value might not mean the lowest price.

Commercial general application package

The list of commercial general application software includes the same programs listed above plus a couple of other programs. Electronic mail and project management packages are added to the list. E-mail is not referring to an automated post office but a programs that allows users to send messages to one another (electronic memos). Project management allows users to plan, schedule, track, and analyze the events resources, and costs of a project.

Because of the vast variety of needs of so many different businesses, commercial software is divided into several other categories:

General application software: Useful to a wide variety of users.

Functional application software: Categorized further according to users and functions.

Horizontal application: Used by many businesses but not by everyone within the business. Accounting software is an example of horizontal software.

Vertical application: Written for a specific industry, such as video store management, fast food restaurant, equipment rental, banking industry, etc.

Custom application: Software that has been written for an individual business or person.

Input to the computer

Input refers to the process of entering programs, commands, user responses, and data into main memory or RAM.

Programs are the sets of instructions that direct the computer to perform the necessary operations to produce information.

Commands are key words and phrases that the user inputs to direct the computer to perform certain activities.

User responses refer to the data that a user inputs in response to a question or message from the software.

Data is raw facts; it is the source from which information is produced.

How is data organized

Input is the first most important step of the information processing cycle. The main goal of this cycle is to produce valid, useful information. If the data that the cycle begins with is faulty then the information produced will not be valid. (Garbage In, Garbage Out) GIGO Because this step is so important we go to great lengths to make sure that Data is kept clean and uncorrupted.

Data is defined as the raw facts that are processed by a computer system. The smallest elements of data are characters. Characters come in three varieties, alphabetic, numeric and special symbols.

Characters

Alphabetic (A through Z)

Numeric (0 through 9)

Special (all other keys)

Characters are combined to create data. When using a database program, data is entered into fields. Fields are also categorized within a database program. By labeling the types of fields we can then limit the types of characters that can be entered to the fields.

Field: A unique item of information.

Record: A collection of related fields.

File: A collection of related records.

Database: A collection of related records is called a file. Data is frequently organized in a database. A database provides an efficient way to establish a relationship between data items (fields) and implies that a relationship has been established between multiple files.

To further help keep data valid we have developed some data management strategies. There are three elements of data management:

Data accuracy, which refers to the attributes of data that are a must to maintain the integrity of the data. Data with integrity must be: **A**vailable, **R**eliable, **A**ccurate, and **T**imely.

Data security, security always refers to access and backup. Data is kept secure by using the methods provided within the programs to deny or give access to the data (authorization codes) and by doing consistent , valid backups of the data.

Data maintenance, refers to keeping the data updated. This step of data management is probably the least thought of but by far as important as the other steps. If the data is not maintained it will not be accurate.

Another type of input device

Terminals, sometimes called display terminals or video display terminals consists of a keyboard and a screen. Some older terminals were built as one unit. Terminals are used by mainframes and networks.

Point of sale. Terminals allow data to be entered at the time and place where the transaction with a customer occurs. Point of sale terminals serve as input to either mini-computers located at the place of business or larger computers located elsewhere.

Graphic input devices are used to translate graphic input data such as photos or drawings, into a form that can be processed on a computer. Three major devices that are used for graphic input are **light pens, digitizers** and **graphic tablets. A light pen** (not to be confused with a wand) is used by touching it on the display screen to create or modify graphics. A **digitizer** converts points, lines, and curves from a sketch, drawing, or photograph to digital impulses and transmits them to a computer. A **graphic tablet** works in a manner similar to a digitizer, but also contains unique characters and commands that can be automatically generated by the user.

Voice input allows the user to enter data and issue commands to the computer with the spoken word.

Input devices designed for specific purposes

Scanners include a variety of devices that "read" printed codes, characters, or images and converts them into a form that can be processed by the computer.

Wands. A ward is a device that looks like a pen but is used to read bar codes or other types of codes. The wand will read the characters and translate them into electronic data that the computer can use.

Optical Character Readers (OCR) are scanners that read typewritten, computer-printed, and in some cases hand-printed characters from ordinary documents.

Optical Mark Readers are scanning devices that can read carefully placed pencil marks on specially designed documents.

Laser scanners use a laser beam to scan and read special the bar code printed on store products.

Page scanners can convert an entire page of printed material into the individual characters and words that can be processed by a word processing program.

Data collection devices are designed and used for obtaining data at the site where the transaction or event being reported takes place. If the data collection devices are directly connected to the computer, the data is immediately available for processing. An example is the new computerized clipboards that the UPS people carry now.

User interfaces

A **user interface** is the combination of hardware and software that allows a user to communicate with a computer system. Through a user interface, users are able to input values that will: (1) respond to messages presented by the computer; (2) control the computer; and (3) request information from the computer.

A **prompt** is a user interface. A prompt is a message to the user that displays on screen and provides helpful information or instructions regarding some entry to be made or action to be taken.

Another user interface is the **menu.** A menu is a display on screen that allows the user to make a selection from multiple alternatives.

Alphabetic selection

Cursor positioning

Reverse video

Icon selection

Submenus

Icons are also considered a user interface. An Icon is part of a menu. An icon is a pictorial representation of a processing option on a menu.

Another user interface is a **system response.** System responses are those messages and actions taken by the computer when a user enters data into the computer. A response can be shown in two ways. First, a message can be displayed that tells the user something is happening. A second type of feedback occurs when the screen changes based on the entry by the user.

Data entry for interactive and batch processing

Data can be processed by one of two methods. The two methods of processing are:

Interactive or transaction processing. This type of processing is defined as: Data is put into the computer's main memory and processed immediately. Once processed output is produced. One transaction at a time is processed.

Batch processing. This type of processing is defined as: Data is collected and , at some later time all the data that has been gathered is processed as a group or batch. Large numbers of records are processed periodically.

Data entered in the interactive processing mode generates immediate output. Therefore, data entry for interactive processing is said to be **online data entry,** meaning that the device from which the data is being entered is connected directly to the computer which will do the processing. Transaction processing must use online data entry.

Offline data entry means that the device from which the data is being entered is not connected to the computer that will process it. Batch processing can come from online or offline data entry.

In case you care: *Ergonomics is the study of the design and arrangement of equipment so that people will interact with the equipment in a healthy, comfortable, and efficient manner.*

Output

What is output?

Output is data that has been processed into valid information that can be used by a person or another machine.

Common types of output

Output that is printed on the printer is called **hard copy** and is considered permanent. Output that is displayed is called **soft copy** and is considered temporary.

A **report** is data or information presented in an organized form. Reports may be in the form of text, but a report could be in the form of a pay check, a slide show, an audio tape, etc.

A **multimedia report** is a mixture of all of the above. These reports are usually accomplished with a CD-ROM. CD-ROM kits are often referred to as multimedia packages.

Printers

Due to the many printer choices available and because printed output is so widely used, users must be familiar with the factors to consider when choosing a printer.

How much output will be produced?

Desktop printers are not designed for continuous use. High volume (more that several hundred pages a day) requires a heavy-duty printer.

Who will use the output?

Most organizations want external reports to be prepared on a high-quality printer.

Where will the output be produced?

If the output will be produced at the user's desk, a sound enclosure may be required to reduce the noise of some printers to an acceptable level.

Are multiple copies required?

Some printers cannot use multipart paper.

How are printers classified?

Printers can be classified by how the characters are transferred to the paper. Transfer is accomplished either by **impact** or **nonimpact.**

Impact printers transfer the image onto paper by some type of printing mechanism striking the paper, ribbon, and character together.

Nonimpact printers make the character transfer through several different technologies.

Printer features

Carriage size
Feed mechanism
    Tractor Feed
    Friction Feed
Bidirectional printing
Interfaces
    Serial (can receive one bit at a time)
    Parallel (can receive more than one bit at a time, but must be within a few feet of the sending computer.)

Impact printers

Dot matrix printers have a print head which contains a series of small tubes containing pins that, when pressed against a ribbon and paper, print small dots. The combination of small dots printed closely together forms the character. Dot-matrix printers have a color option package that may be purchased. A 24-pin or higher can produce good quality prints. The cost of replacement ribbons vary from $5.00 to about $20.00. Dot-matrix and ink jet printers are close in price but if you had to use carbon forms the dot-matrix is your only choice.

The **daisy wheel** printer consists of a type element containing raised characters that strike the paper through an inked ribbon.

It is my opinion that these printers are obsolete. These printers do have letter quality print but changing fonts or type styles is limited. Graphics are not supported by this type the daisy wheel printer.

Non-impact printers

Thermal printers use heat to produce fully formed characters on special chemically treated paper. The paper for these printers is very costly. Thermal printers are not used very often today.

Ink jet printers use nozzles that spray ink onto the page, to form a character. The replacement ink cartridges are more costly than replacement ribbons for the dot-matrix, but the quality of print is very high. Ink jet printers can produce high quality color copies if the color component is purchased. Ink jet printers are low enough in price that much of the old dot-matrix market has gone to ink jet technology.

Laser printers. These printers operate in a manner similar to a copying machine; toner is attracted to the paper to form characters. Laser printers offer the highest quality of print. Toner replacement is much more expensive than ink cartridges or ribbons. There are some low cost laser printers on the market, but before you buy you should know that many laser printers will not print designs from Computer Aided Design (CAD) programs. Color is available but the cost of that component is still prohibitive.

Screens

Screen features

Size: Many users use a standard 14" monitor. There are much larger screens available; the largest I have seen is a 21". This size screen is great for working with design programs. Screens today come with a tilt and swivel base for the comfort of the user.

Color: Today's' standard for color is Super Video Graphics Array (SVGA). To buy anything else would be foolish because programs are not written for the older style screens.

Screens used for graphics are called **dot-addressable displays,** or sometimes **bit-mapped displays.** On these monitors, the number of addressable locations corresponds to the number of dots that can be illuminated. Each addressable dot that can be illuminated is called a **picture element** or **pixel.**

With dot-addressable displays, the resolution or clarity of the characters depends on the number of pixels on the screen. The greater the number of pixels, the better the screen resolution.

Devices are currently available that offer very high-resolution graphics. The resolution of these devices is high enough to provide an image that is almost equivalent to the quality of a photograph.

Other output devices

A **plotter** is an output device used to produce high-quality line drawings , such as building plans, charts, or circuit diagrams.

Pen plotters create images on a sheet of paper by moving one or more pens over the surface of the paper or by moving the paper under the tip of the pens. Two kinds of pen plotters are **flatbed plotters** and **drum plotters.**

With an **electrostatic plotter,** the paper moves under a row of wires (called styli) that can be turned on to create an electrostatic charge on the paper. The paper passes through a developer and the drawing emerges where the wires touched the paper.

Auxiliary storage

What is auxiliary storage?

Auxiliary storage, or **second storage,** stores programs that are not being processed. Auxiliary storage is permanent storage because it is non-volatile.

Non-volatile means that the information written to the device is not dependent on the flow of power. The information is safe on that device even when the power is off.

Primary storage, or **RAM** or **main memory,** stores data and programs that are being processed. Primary storage is not permanent because it is volatile.

Volatile means that the data or information will disappear when the power is off.

Auxiliary storage for personal computers

The main storage devices are the 31/2" floppy disk, a hard drive, magnetic tape and CD-ROM drive. The first three can accept information from the user. Although the technology to write to a CD is available, the cost of the writing device is very high and few have invested in this. Today's CD-ROM disks have random access and can hold between one and two gigabytes.

Random access means that information may be accessed in any order. In other words, if you have 10 files stored on a disk you may open file number 8 and then number 4 etc.

Floppy disks and hard drives are the most commonly used storage devices today. Both have random access. In today's' world of large programs it is wise to use your hard drive for program storage and the floppy for file storage. This of course depends on the use and the user. Hard drives can hold more data and has a faster access time.

A **hard disk** consists of one or more rigid metal platters coated with a metal oxide material that allows data to be magnetically recorded on the surface of the platters.

Access time is the time it takes to retrieve data and place it in main memory for processing.

In case you care: Seek time *is the time it takes to position the read/write head over the proper track.* Latency *is the time it takes for the sector containing the data to rotate under the read/write head.* Settling *time is the time required for the read/write head to be placed in contact with the surface of the disk.* Data transfer rate *is the time required to transfer data from disk to main memory.*

Add all of the above together and you get access time!

Magnetic tape is used primarily for back up purposes. Magnetic tape can hold vast amounts of data but can only retrieve that data sequentially. This makes access time very slow; which is why tape is used mainly for back up. **Hint:** If a user had to access the backup often, it would be wise to choose a medium with faster access time.

Sequential access means that you must retrieve material in the order that it was stored in. It is very slow.

Before a floppy can be used for storage, it must be formatted.

Formatting: the process of defining the tracks and sectors on the surface of a disk.

Track: A narrow recording band forming a full circle around the disk.

Sector: A section of track. It is the basic storage unit of floppy disks.

What is the storage capacity of a floppy disk?

The number of characters that can be stored on a disk depends on three basic factors:

The number of sides

Single-sided
Double-sided

The recording density

BPI (How many bits can be written in one inch of track.)

The number of tracks

5 1/4 inch = 0 - 39 (not used much anymore)—40 tracks each side
3 1/2 inch = 0 - 79—80 tracks each side.

How is data stored on a floppy disk?

Regardless of the type of floppy disk or the formatting scheme that is used, the method of storing data on a disk is essentially the same. When a disk is inserted in a disk drive, the center hole fits over a hub mechanism that positions the disk in the unit. The circular plastic disk rotates within its cover at approximately 300 revolutions per minute. Data is stored on tracks character by character, using the same code, such as ASCII, that is used in main memory. Electronic impulses are placed along a track to represent the bit pattern for each character. To do this, a recording mechanism in the drive called the read/write head rests on the surface of the rotating disk, generating electronic impulses representing the bits to be recorded.

How is data stored on a hard disk?

In order to read or write on the surface of the spinning disk platter, the disk drives are designed with access arms, or actuators. The access arms or actuators contain one or more read/write heads per disk surface. These read/write heads "float" on a cushion of air and do not actually touch the surface of the disk.

Wow! Did you know? *The distance between the head and the surface of the disk varies from approximately one millionth of an inch to 1/2 millionth of an inch.*

Head crash: The disk head collides with the surface of the disk, causing loss of data and damage to the disk.

Auxiliary storage for medium and large computers

A wide variety of devices are available for use as auxiliary storage on medium and large computers. As you would expect, these devices provide greater storage capacity and faster retrieval rates than devices used with small systems. Storage devices for medium and large computers are grouped into three categories: Magnetic disks, magnetic tape and other storage devices.

Magnetic disk

Fixed disks

Fixed disks contain nonremovable platters that are enclosed in airtight cases to prevent contamination.

Removable disks

Removable disk devices consists of the drive unit, which is usually in its own cabinet, and the removable recording media, called a disk pack.

Removable disk packs consists of 5 to 11 metal platters that are used on both sides for recording data.

Magnetic tape

Reel to reel tape devices

Magnetic tape consists of a thin ribbon of plastic. The tape is coated on one side with a material that can be magnetized to record the bit patterns that represent data. This storage media can only access information sequentially. Sequential access is very slow.

Other forms of auxiliary storage

CD-ROM

WORM: CD-ROM devices are said to be Write Once Read Many (WORM). CD-Rom devices are written to by lasers that burn microscopic holes into the disk. Therefore the disk may only be written to once.

INTERPERSONAL SKILLS: TEAM SKILLS

Ellen Palmer

The New Workplace/Where Are We Going?

At the end of this section you will be able to:

- *list how change has effected your work life*
- *list the kinds of loss you have experienced or observed in your work life*
- *make note of team traits you have experienced or observed*
- *help your team plan change*
- *help your team solve problems cooperatively*

The workplace does not look the same as it did 20 or 30 hears ago. Management's role once was to plan, schedule and control. The employee's role was to go to work, do as you were told, and let management worry about productivity and profit. Not so today. Traditional processes no longer work. While specifics may vary, change in almost every workplace is happening at a faster and faster rate. It has become obvious that change is not just a fad that will disappear in a year or two. Different strategies are necessary for businesses to survive in an economic environment where constant change is the norm. Team skills are one of those strategies. Modern organizations put a premium on more collaborative work teams and ask each individual to take more responsibility for the end product. Work teams create an organizational structure that has become flatter and less hierarchical.

The pace of change

Traditionally, change was a short burst of disruption followed by a longer rest period of stable operations. Today, there are no longer any rest periods; change is continuous and enormous.

The pace of organizational change is increasing. Recent studies show that:

- In the past decade, 30 million Americans have been dislocated by restructuring.
- Companies expect to cut an average of 15 percent of their workforce.
- Since 1980, the Fortune 500 have shed 3.2 million jobs.
- In the past five years, more than 12,000 U.S. companies and corporate divisions have changed hands.
- 70 percent of mergers end up as financial failures.

- U.S. manufacturing needs to increase productivity dramatically to remain competitive with foreign industry.

from *Managing Change at Work,* 1995. Cynthia D. Scott, Ph.D., M.P.H. and Dennis T. Jaffe, Ph.D.

We are all experiencing change. The timber industry changes in Oregon is only a little different than what is happening in economic arenas all around the world.

Activity

Look at the following list and check all the changes you have experienced in your work environment in the last five years. Jot down how that has effected your work life.

Change	Effects on Work Life
___Technology changes	_____
___Accelerated product cycles	_____
___Merger	_____
___Layoffs	_____
___Company start-ups	_____
___Spin-offs	_____
___Top management change	_____
___Culture change— new policies, values, expectations	_____
___Deregulation	_____
___New regulations	_____
___Reorganization	_____
___New competitors	_____
___Expanded business liability	_____

Understanding Change, Loss, and Transition

Change occurs when anything stops and something different starts. Usually it means moving form the familiar to the unknown. Transition is the evolution that occurs between the two and occurs as people learn to let go of the old and accept the new. The psychological process affects us, even when change is positive. Most of us have a strong response to an change. One of the strongest can be a feeling of loss, along with the struggle to accept a new direction.

When a major change occurs as a result of layoff or shifts within an organization, employees normally experience several types of loss including the loss of security, competence, familiar relationships, sense of purpose, and turf. You may have already experienced some of these feelings yourself. Understanding change and loss may also help you to understand some of the feelings people in the organizations you will be dealing with are experiencing. They may be part of the thousands of Oregonians who have experienced a sense of loss as a direct result of the major changes in the timber industry.

Activity

Check the types of loss you have experienced personally. How may of these types of loss have you observed in those you work with.

__**Loss of security:** People no longer feel in control, feel they have no personal power, know what to expect in their future, or where they stand in regards to their jobs.

__**Loss of competence:** Employees no longer feel they know what to do. They may become embarrassed when they are faced with new tasks and have to admit they don't know how to do them.

__**Loss of familiar relationships**: People may not work with the same old familiar people. Customer, co-worker or supervisor relationships can disappear. People often lose their sense of belonging to a team, a group or an organization.

__**Loss of work identity:** Many people's self-esteem is tied up in their job title. When that title changes or they are unemployed it becomes easy to doubt one's self-worth.

__**Loss of direction:** People get confused about their careers; where they are going and why they are going there. Meaning and mission often become unclear.

__**Loss of turf:** It's not easy to give up old territory. This can be psychological turf like job responsibilities or physical turf like workspace.

Any kind of loss always has an emotional cost. All of the losses mentioned above can trigger an emotional response much like grief. It is important to understand that people are not weak or old-fashioned if they experience loss caused by change. Loss is a normal part of transition. People who do not display feeling loss often save it up and become overwhelmed by a seemingly small transition. It's healthier and more productive to recognize loss when it occurs, acknowledge it and then move on.

Lifelong learning

Lifelong learning can help you through difficult transitions and help you remain more competitive. In a constantly changing world very few skills stay useful forever. Lessons learned in school and skills learned on-the-job quickly become obsolete. Employers in today's ever-changing economic environment report that it's more important for workers to know how to learn than to know a particular set of skills. The most valued workers in the continuously changing job market will become generalists who are flexible, adaptable, and learn quickly. This is especially true of all of you in the Ecosystem Enhancement Project. You truly are experiencing this phenomena first hand. Last week you may have had a job thinning trees, today you are in the classroom, you may be restoring stream habitat tomorrow, clearing brush or planting trees another time. If you expect to remain current, your personal responsibility for learning will not stop at the end of this course.

Managing Change—A Team Approach

Teamwork increases productivity

Teamwork pays off with bottom line results. People who feel a sense of control of their own work lives, feel better about themselves and their jobs, and produce more. For example, a coal mine study compared productive teams with less productive groups and found significant differences.

Twenty coal mines were studied. They were all operating in the same geologic vicinity, employed people from the same labor pool, and operated under the same governmental regulations. Productivity was measured in tons of coal produced per employee per shift.

The results showed that the mine with the highest productivity delivered 242 tons per employee and the lowest which mined 58 tons per employee. Other mines fell somewhere in between.

Conclusions drawn from the study showed teamwork resulted in much higher production. This is what they said:

"The primary difference was the way which company management worked with the employees. The most productive mine provided employees with significantly more individual responsibility and involvement in goal setting and problem setting."

Activity

Most groups have functioned at least partially as a team. Review the following list of team traits and check any you have observed or experienced.

Traits of a functioning team

__ Members recognize their interdependence and understand both personal and team goals are best accomplished with mutual support. Time is not wasted struggling over "turf" or attempting personal gain at the expense of others.

__ Members feel a sense of ownership for their jobs and unit because they are committed to goals helped establish.

__ Members contribute to the organization's success by applying their unique talent and knowledge to team objectives.

__ Members work in a climate of trust and are encouraged to openly express ideas, opinions, disagreements and feelings. Questions are welcomed.

__ Members practice open and honest communication. They make an effort to understand each other's point of view.

__ Members are encouraged to develop skills and apply what they learn on the job. They receive the support of the team.

__ Members recognize conflict is a normal aspect of human interaction but they view such situations as an opportunity for new ideas and creativity. They work to resolve conflict quickly and constructively.

__ Members participate in decisions affecting the team but understand their leader must make a final ruling whenever the team cannot decide, or an emergency exists. Positive results, not conformity are the goal.

from *Team Building: An Exercise in Leadership* by Robert B. Maddux, 1992

Planning Change

As a team member you will likely be called upon to play an active role in planning change. Working through each of the following five steps together will help the team successfully weather change:

Step 1. Laying the Groundwork

Whenever possible analyze the situation, anticipate changes, and help the team prepare.

- Analyze and learn from the team's past experience with change.
- Let the team know what is happening ahead of time.
- Provide information. Describe the change as honestly and completely as you can.
- Make only essential changes. Remember the old adage. "If it ain't broke, don't fix it." The team needs as much stability as possible during change. Prioritize the changes and make them one at a time.

Step 2. Mapping a strategy

Spend the time to make a thorough plan involving the whole team in the process.

- Create a timeline with measurable objectives to chart progress.
- Help team develop individual transition plans for gaining the new skills

- Get team buy-in. Involve team members in discussions from the very beginning. Ask the people doing the job for suggestions.

- Plan for every likely eventuality. It's better to have a backup plan than to be set back because the first plan didn't work.

Step 3. Structuring the transition

- Develop new ways to working together. Appoint an temporary facilitator if necessary. Develop interim guidelines and procedures when appropriate.

- Keep communication channels open. Information is essential. Use all means available to let people know what's happening and why it's important.
- Meet frequently to chart progress, give feedback, and address unforeseen issues.

Step 4. Implementing the strategy

- Empower the team with responsibility for change. Make sure each person is responsible for some aspect of the change.

- Implement the individual transition and training plans developed in Step 3. Adjust plans as needed.

- Allow for differences in individual team members ability to cope with change and the resulting loss. Help people let go of the "old" and embrace the "new."

- Chart and publicize successes. Monitor and analyze progress for desired results. Point out every opportunity created by change. Find out how people are feeling.

- Encourage team to find opportunities to think and act creatively.

- Allow dropouts to return to the folds.

- Collaborate with other work groups when ever possible.

Step 5. Celebrating success

- Publicize success

- Create incentives for special effort.

- Recognize the people who make it work.

Team Roles in Collaborative Problem Solving

Team members will more readily accept change if they all participate in the process. Participation may be group collaboration on deciding how to meet a goal or respond to a new situation. Set a few ground rules in developing a collaborative process. A few of these might be:

- Invite discussion by creating a "Safe Zone" where all opinions are noted without put-down.
- Encourage honest opinions
- Encourage differences of opinion
- Ban judging, criticism, or blame
- Share dilemmas; ask for help from the team

Collaborative problem solving takes time, especially in the first attempts. And not all problems are best solved in a collaborative way. Sometimes when time is of the essence, when one person has the expertise and a great track record or when no key people will be effected a command decision is required. It is important to be clear about whether a the team's role in problem solving will be consulting or collaborative. If it is consultative, feedback will be sought and used as expert advice. After all, people closest to the work are in the best position to make improvement suggestions.

Activity

The following Collaborative Problem Solving Model was developed by Susan and Peter Glaser. This group activity is useful and easy to follow.

Before you begin

- Choose a facilitator who will keep your team on track
- Choose a recorder who will write ideas on a flip chart or black board

Define the problem

- Try using a problem you are wrestling with on one of your work sites or use the process to plan a site work project.

Set the brainstorming rules

- No put-downs for suggestions
- No debating or discussing suggestions

Silently brainstorm

Each individual takes two or three minutes to make a list of ideas or suggestions which you feel would realistically solve the problem.

Share ideas

Going around the group, each member takes turns sharing one suggestion per turn until all suggestions are written by the recorder on the flip chart. Care is taken to be sure that the exact meaning of each suggestion is described. The recorder numbers each suggestion as it is given. As sheets become full the recorder tapes them up so the remain visible to the group.

Advocate and discuss

Ideas are discussed. Group members advocate for the items they want to support. Areas of discussion should include:

- Is this change likely to add to the group's mission
- Is it within the realm of reality? Is this within our group's power to

The facilitator makes sure each advocate has equal time. Duplicate ideas are eliminated and similar items are chunked together.

Prioritize

- The group take two or three minutes to silently think about the options and individually write down their top three priorities.
- Using a different color marker, the group facilitator writes these numbers on the flip chart. The recorder then adds the numbers given to each item and records the groups priority.

Action plan

To develop an action plan for a priority:

- List all tasks be needed to help make this item a reality. (Brainstorm and prioritize.)
- Write down who will be responsible for completing each of these tasks
- Write down the date for each of these functions to be completed

The meeting should be concluded by setting a date and time for the next meeting if one is necessary.

INTERPERSONAL SKILLS: MOTIVATION

Mollie Owens-Stevenson

Competency measures

At the end of this session, each student will:

1. Describe internal and external motivation work skills.
2. Describe the motivational cycle, personal motivators, and what interferes with that motivation.
3. Demonstrates the ability to communicate ideas and information in a positive manner.
4. Understands and practices the skills of working in a team, including setting limits, confronting inappropriate behavior, and figuring out hidden issues or agendas when problems arise.
5. Demonstrates ability to develop goals, plan work needed to meet goal, and complete plan.
   a) Personal
   b) Interpersonal

Key Concepts

Patterns of success

1. Deals well with people they come in contact with. Takes action to resolve personal conflicts.
2. Thinks before making a decision and considers what other things will happen based on that decision.
3. Sets goals, decides on a strategy, develops a plan.
4. Recognizes problems and turns no-win situations into win-win situations
5. Uses different techniques with different people, tries alternatives.
6. Changes style to fit situation, is flexible, and can adapt to new situations.
7. Motivates others under their supervision in positive ways. Sets a good example, and works as a team with management.
8. Manages self through action: "Do something!"
9. Evaluates own strengths and weaknesses, and focuses on strengths.
10. Improves self continuously through reading, classes, seminars, support groups, etc.

What motivates you? People are motivated by many kinds of needs. We have basic needs, like food, clothing and shelter, but we also need acceptance, recognition and self-esteem. Motivation is the result of an internal drive that pushes us to accomplish, and external rewards that someone else gives us for doing those tasks that are a part of work. Internal motivation comes from the satisfaction we feel when we accomplish a task or a duty, and may come from the enjoyment of the task, pride in it, or the demonstration of new skills in doing it, as examples. External motivation is the result of an action of another person. Many of us came out of work systems that assumed we were only motivated by fear of punishment or hope for reward. While those are obviously somewhat important, they are external or outside motivators, and are rarely enough to motivate a person to do a good job on an ongoing basis.

Motivators describe the "why" of human behavior. Understanding the 5 characteristics of motivators can help you understand what motivates you and what motivates others.

1. Motives are personal—people have different needs, so what motivates one person may turn another person off. Take time to understand your motives and those of others.

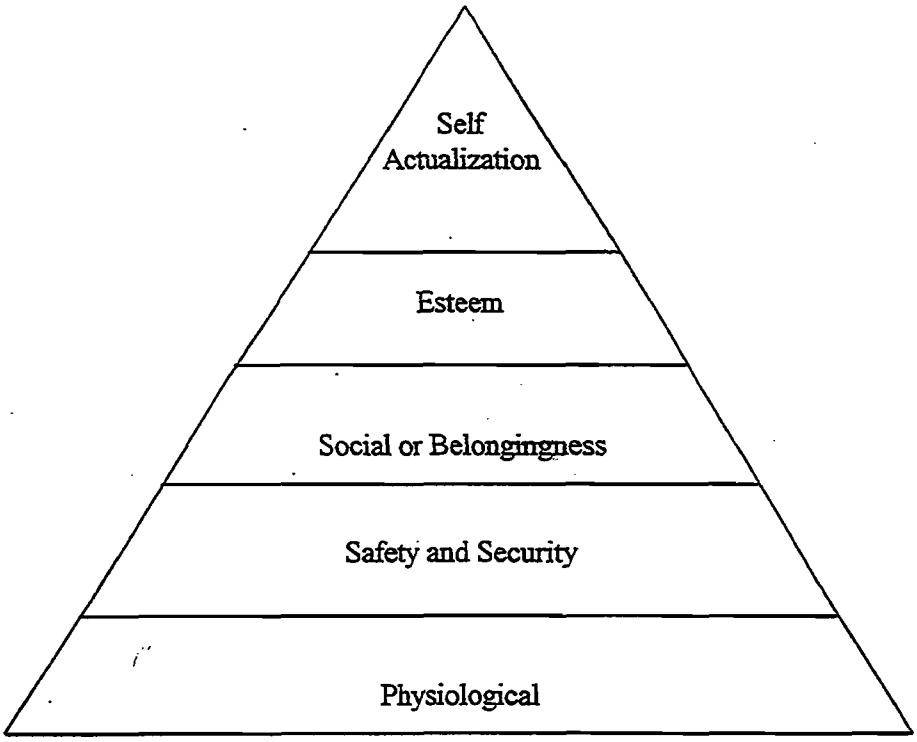
2. Motives change —as we get older, and as our life circumstances change, our needs change. When we are young, we often work for money; at another time, we may work for promotion, or fame, or early retirement.

3. We may not be aware of motives—our inner needs and drives are not always conscious.

4. We may guess at motives of others —we observe each others' behavior, and may guess at what drives them to do what they do. The reasons are often hard to guess. Sometimes the best way to deal with it is to ask.

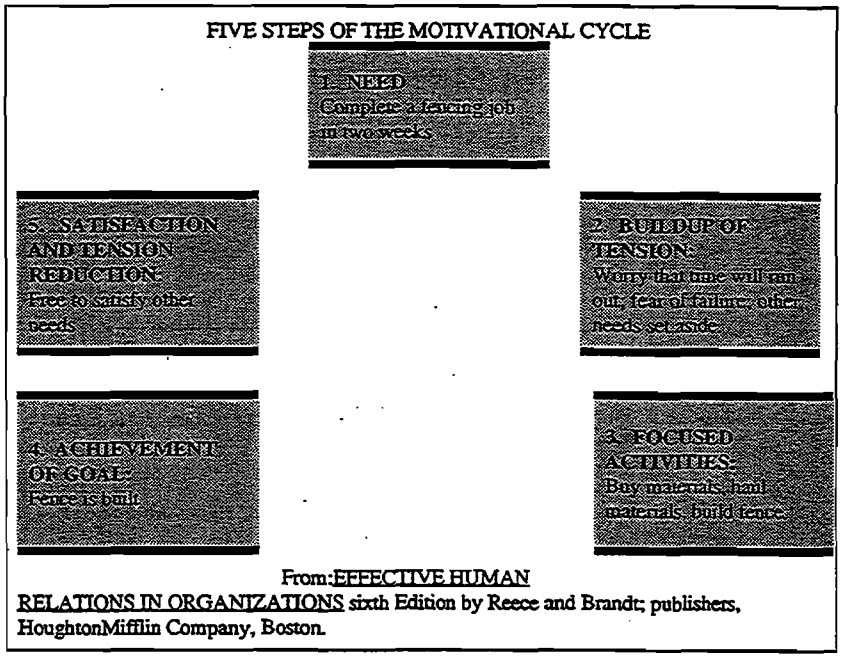
5. Motives are hierarchical—that is, motives for behavior vary in levels of importance. When contradictory motives exist, the more important motive usually guides behavior. Workers might want to move to jobs that are more challenging and rewarding, but if the need for security is stronger, they probably won't move.

Abraham Maslow identified **a hierarchy of needs.** Food, clothing, shelter, and other issues of physical need are a primary motivator; that is, if those needs are not met, a person will not be able to think about other issues. The second need is for safety and security; that is, if I need this job in order to feel secure, I will not risk quitting it to start a new business. The third need is social or for belongingness; if my



Maslow's Hierarchy of Needs

Maslow's hierarchy of needs



From:EFFECTIVE HUMAN RELATIONS IN ORGANIZATIONS sixth Edition by Reece and Brandt; publishers, HoughtonMifflin Company, Boston.

Five steps of the motivational cycle

From *Effective Relations in Organizations,* sixth edition, by Reece and Brandt; publishers, Houghton Mifflin Company, Boston.

physiological and safety needs are met, I will pay attention to my need to belong to a group. The fourth need is for self-esteem; I need to feel good about myself, but only after the other needs are met. The fifth level of need is self-actualization; if I have all the other levels of need met, I then can begin to think about realizing my potential, or realizing my fullest capacities. I can only do this, however, if none of the other kinds of need are missing.

Frederick Herzberg looked at motivation a little differently. He said that there are motivational factors, such as salaries, benefits, working conditions, social relationships and management issues, such as supervision and organizational policies, that we all take for granted as a part of a job, and only notice if they are bad, or missing. Salary does not motivate us, according to this theory, but lack of it may send us looking for another job, or organizing a union. Motivational factors are things like recognition, advancement, status, responsibility, achievement, and the work itself. Others say that Herzberg's theory overlooks those employees who are looking for routine and security, and may want a paycheck in order to pursue other interests outside of work.

The motivational cycle, from *Effective Human Relations in Organizations* by Barry Reece and Rhonda Brandt, describes how people go about satisfying a felt need. If your need is strong enough, such as acute hunger or thirst, you will not be able to concentrate on anything else.

Goal Setting

Key concepts

One characteristic of successful people is that they set goals, develop plans to meet those goals, and work through the plans. There are many processes for setting goals, and many books have been written about the process. One book on the process, *Wishcraft,* suggests that you start by dreaming. Pay attention to what you want, not what others have said you should do. Be sure you recognize and define what the problem really is according to you, not others. When you look at a problem or a decision, know what is important to you, and what you want to attain or achieve.

Then examine the information that you already have, and seek and use new information. Once you have done that, list your options and the potential outcomes, then assess the risks, costs and benefits of each option, as well as how each option would affect you and those close to you.

Then determine how well you like the consequences, good and bad, of each choice. Once you have considered all the information , consequences and feelings, and set a goal, then list all the things that stand in the way of achieving that goal—your "yeah, but..." list. That list of barriers becomes a part of your plan; use it to develop your plan or strategy. Use your friends and workmates to help you develop a plan, and then use them again to hold you responsible for doing what you said you would do. Rather than set yourself up to do several tasks in several hours in one day, assign yourself a small task that takes 15 to 20 minutes every day. Evaluate your

progress weekly or monthly. Take time to assess your goals and plans regularly. Do you still like them? Do they still "feel" right, or are you continuing just because it's easier than changing course?

INTERPERSONAL SKILLS: DIVERSITY

Mollie Owens-Stevenson

Intercultural Communication: Sexual/Racial Harassment Prevention

Competencies

At the end of this session, each student will be able to:

1. Identify some cultural differences that affect me and that affect those of other cultures, and understand the consequences of those differences.
2. Identify the dynamics of difference—what happens when members of 2 diverse groups meet.
3. Understand how prejudiced attitudes are formed.
4. Be able to list some of the various forms of discrimination in the workplace

Key concepts

"Any forest that has only one kind of tree is particularly vulnerable to attack by pest and disease. A healthy ecosystem depends upon a diversity of species. Our country was founded by immigrants from a number of other countries, and became a strong and healthy country because the population was so diverse." In the past, those diverse people were encouraged to assimilate into one "American" way of doing things. Now the trend is to respect and value the individual differences of the workforce, and encourage every worker to make her or his full contribution.

"Organizations that foster the full participation of all workers will enjoy the most competitive edge in today's global economy." *Human Relations in Organizations* by Reece and Brandt.

Dimensions of diversity

Primary dimensions are those elements that cannot be changed: age, race, gender, physical and mental abilities, and sexual orientation. The greater number of primary differences between people, the harder it is to establish trust and respect.

Secondary dimensions are those elements that can be changed or modified: health habits, religious beliefs, education and training, general appearance, relationship status, ethnic customs, communication style, and income. These elements add another dimension to how we see ourselves, and how others see us, and may make it harder or easier to connect or understand each other.

Prejudiced attitudes

To be prejudiced means to prejudge. We prejudge people in light of their primary and secondary dimensions. When we have attitudes in favor of or against people based solely on these traits, these are prejudices or stereotypes. Stereotypes are generalizations made about all members of a particular group, based on widely held beliefs about what that group is "really like". When we have these prejudices in the workplace, we may interpret or devalue a primary or secondary dimension, even after we have been exposed to individual members of that group. It may get in the way of accomplishing work, or may prevent us from seeing the strength of individual workers.

Gender equity issues

Demographics about workforce:

- 1950: 20% of workforce was women
- 1946 to 1964: Baby boom (what does it look like?)
- 1970: Women begin to enter the workforce in larger numbers (get percentage)
- By 2000, white males are 33% of workforce; women are 48%, men are 52%

However, women still make considerably less. What is the impact?

1995 jobs must have 2 1/2 jobs to equal the salary of 1 job in 1970 wages, so in all families, women as well as men must work. What is impact of this? Discuss the feeling about change. What does it do to men? What does it do to women? How has it changed in your family? What has been the impact?

What are men's roles in families today? How is that different from 20 years ago? 40 years ago? (Ask the youngest men to discuss their roles, and their fathers' roles, and how they see them as different. Ask 40+ men about their roles, and how they have changed, how they might differ from young men's roles, from their fathers' roles.) How has the changing workforce affected them? How do they think it has changed for women?

If women have to work outside the home, why would they want to move into more job categories than they previously were involved in? So that causes some issues about knowing how to act: difference between social and co-worker behavior. (Some issues to think about include that men have some role confusion about work vs. social settings, there are no clear rules now, people feel uneasy about being in work groups of mostly men, few women.)

Oral Communications/Cultural Diversity Exercises

Active listening exercise

Groups of at least 3

Materials: 12 paper clips, 2 desks, 2 chairs and a watch; one "sender," 1 "receiver," and 1 "timekeeper"; the rest are observers. The sender and receiver sit back-to-back in their chairs, with their desks in front of them; each has 6 paper clips.

Sender: Align your paper clips randomly (not a straight line), with each clip touching at least one other. Carefully explain to the receiver how to construct a duplicate of your chain, using his or her paper clips. Do not ask the receiver if he or she understands, and do not turn around to check on progress. Just give your instructions.

Receiver: Listen carefully to sender as he or she gives directions for constructing the paper clip chain. You are not allowed to ask any questions or communicate in any way verbally or nonverbally. Just listen and follow directions.

Timekeeper: Record the time it takes for the message to be transmitted.

Observers: Record the successes and frustrations you notice during the one-way communication.

THEN REPEAT THE EXERCISE WITH A DIFFERENT SENDER AND RECEIVER. THIS TIME, SENDER AND RECEIVER ARE ABLE TO ASK AND ANSWER QUESTIONS.

Record the time it takes to complete, and note the successes and frustrations.

Discussion: What were the frustrations in the one-way process? In the two-way process? What were the successes in each process? What was the time difference in the two processes? Why do you think that happened? Do you think that extra time was a good investment?

REPEAT THE EXERCISE A THIRD TIME WITH A NEW SENDER AND RECEIVER; THIS TIME, USE **ziggy** IN PLACE OF **up, zonk** IN PLACE OF **down, where** FOR **right,** AND **who** FOR **left.** AGAIN, RECORD THE TIME, SUCCESSES, AND FAILURES.

Discussion: It takes time for the brain to translate new or "foreign" words into terms we can recognize and then act on. How does this affect the communication process? What are some situations when this might occur on the job? What would have happened if this communication process had been 1-way instead of 2-way? What precautions might you take when communicating with co-workers who are learning new skills or how to work with new equipment? What precautions might you take when communicating with co-workers from another culture or country?

Checklist for working through fears of changing

1. My desired outcome is:
2. What entails the greater risk—moving ahead, or doing nothing? Why?
3. If I move ahead, what's the worst thing that could happen?
4. Am I willing to accept that?
5. If I succeed, what's the best thing that can happen?
6. Am I willing to accept that?
7. Why haven't I taken this risk before?
8. What good did I get out of avoiding this risk?
9. Why do I have more choice now?
10. What am I going to do?

Dealing with barriers

In getting to my goal, one barrier I encounter is:
_____ (example: I lack good transportation). The actions I need to take to deal with it are:
_____(example: I will talk to two mechanics about fixing my car, call a wrecking yard for used parts, and check out three car ads in my price range.) I will complete by _____(date)
Signature_____

Cultural heritage introductions

Select a partner and spend 10 minutes interviewing each other. Discuss the similarities and differences in your responses.

- What are your major identifiers? How would you label yourself when you describe yourself to others?
- What do you consider to be your ethnic and cultural background?
- What do you want others to remember about you?
- What aspect of your job do you enjoy the most?
- How do you view time?

Acknowledging diversity

With a partner, list as many "primary dimension" groups as you can. Under each group, list all the negatives you can think of that you have heard about that group. Now list all the positives. Where do you think these came from? Who do you remember saying those things in your childhood or early adulthood?

Sexual Harassment Prevention Exercises

1. Toy aisle exercise

Visit the toy section of Fred Meyer, Payless, K-Mart, or other variety store. Is there a "girls" aisle? What does it look like: What is the predominant color of the isle? What are the pictures like on the boxes? What kinds of toys are on the isle? Make a list.

Is there a "boys" aisle? What does it look like? What is/are the color(s)? What are the pictures like on the box? Are there any girls on the boxes? What are they doing? What kinds of toys are on the isle? Make a list.

Are there any aisles that seem to be for both boys and girls? What do they look like? What are the colors? What are the pictures like on the boxes? What are boys doing? What are girls doing? What kind of toys are on the isle? Make a list.

*If you do not have time to actually visit the store, talk about it as a group. See what answers you can come up with as a group.

2. Jobs from toys exercise

Using the lists of toys for girls, make a list of skills and jobs that these toys train girls to do. Using the lists of toys for boys, make a list of skills and jobs that these toys train boys to do. Using the list of toys that are for both boys and girls, make a list of skills and jobs that these toys teach children. What do you notice about any of them? Now, next to each job, write the hourly wage.

Discussion question

For 20 job titles, wages in each, why women might want to move into "men's" jobs.

CONTRACTING SKILLS

Jim Beltram

Introduction

Contracting is an effective delivery system for implementation and accomplishment of virtually every function of ecosystems management (science, technical, labor and business). All steps can be efficiently and effectively accomplished by the contracting process. Contracting is integrated in nearly all facets of business management, i.e. records management, labor issues, licensing and permit requirements and bonding procedures.

The Federal Acquisition Regulations provide the direction and guidelines as to how the government will contract all work to meet agency missions. Some of the relevant topics essential to attain understanding of the government contracting process are as follows:

- Contracting methods and their applications
- Types of contracts and their uses
- How to access and obtain bid opportunities
- How to accurately develop a cost estimate
- Key steps to follow in submitting a bid
- Socioeconomic programs, bonding, and important patent information

Contracting skills training will provide students with basic information that will increase their knowledge on the subject of contracting with the Federal Government. Exposure to government contracting practices and procedures will provide students basis to consider becoming an independent contractor. The training will also enhance their ability to compete for employment opportunities within the existing contractor work force.

Trainers will provide a positive learning environment by stressing individual and group interaction through usage of simulated contracting problems. Simulations will be designed from actual contracting examples and experiences. Students will be provided with information materials (lecture and hand-out examples) for their future use and reference.

There are several established support resource programs available that can assist emerging small contractors in the various business, financial, and technical steps that must be followed to successfully contract with the federal government. Business start-up classes are offered through Small Business Development Centers normally found at community colleges throughout the state. The Small Business Administration (SBA) is

a federal agency that manages a business loan program that can provide essential start-up capital to small businesses. Loan officers must be contacted through SBA regional office in Seattle, Washington. (listed in yellow pages) Assistance with technical support concerns can usually be obtained by contacting agency contracting officers at their assigned offices. The Government Contract Acquisition Program (GCAP) maintains a staff of experienced and trained government contracting technical experts that can provide technical guidance and counsel in all facets of government contracting.

GCAP maintains Professional Assistance Technical Centers (PTAC'S) in most regions throughout the state. Established contractor associations can also be a valuable source of technical support. Many associations keep pricing and marketing trend information that can be extremely helpful in development of a realistic and competitive bid. Contractor Associations can be found in most local yellow pages listings

Competency Measures

Upon completion of contracting skills training, students will be able to explain in their own words:

- The three types of contracts and their uses;
- How and why reading the full text of a solicitation is important;
- How to obtain solicitations from government agencies;
- The steps to follow in developing a cost estimate; and
- How to submit a bid.

Contracting Methods and Their Application

Sealed bidding

Sealed bidding is a method of contracting that employs competitive bids, public opening of bids, and awards. The following steps are involved:

(a) Preparation of invitations for bids;

(b) Publicizing the invitation for bids;

(c) Submission of bids;

(d) Evaluation of bids;

(e) Contract award.

Contracting officers shall solicit sealed bids if—

(a) Time permits the solicitation, submission, and evaluation of sealed bids;

(b) The award will be made on the basis of price and other price-related factors;

(c) It is not necessary to conduct discussions with the responding offerors about their bids;

(d) There is a reasonable expectation of receiving more than one sealed bid.

Contracting by negotiation (RFP/RFQ)

Contracting by negotiation means contracting through the use of either competitive or other-than-competitive proposals and discussions. Any contract awarded without using sealed bidding procedures is a negotiated contract. Negotiation is a procedure that includes the receipt of proposals from offerors, permits bargaining, and usually affords offerors an opportunity to revise their offers before award of a contract.

Bargaining may apply to price, schedule, technical requirements, type of contract, or other terms of a proposed contract.

Simplified acquisition procedures

Simplified acquisition procedures means the methods for making purchases of supplies or services using imprest funds, purchase orders, blanket purchase agreements, government wide commercial purchase cards, or any other appropriate authorized method. Simplified acquisition procedures shall be used to the maximum extent practicable for all purchases of supplies or services not exceeding the simplified acquisition threshold ($100K).

Types of Contracts and Their Uses

Service contracts

A service contract is a contract that directly engages the time and effort of a contractor whose primary purpose is to perform an identifiable task rather than to furnish an end item of supply. A service contract may be either a nonpersonal or personal contract. It can also cover services performed by either professional or nonprofessional personnel whether on an individual or organizational basis. Some of the areas in which service contracts are used include the following:

(a) Maintenance, overhaul, repair, servicing, rehabilitation, salvage, modernization, or modification of supplies, systems, or equipment;

(b) Routine recurring maintenance of real property;

(c) Housekeeping and base services;

(d) Advisory and assistance services;

(e) Operation of government-owned equipment facilities, and systems;

(f) Communications services;

(g) Architect-Engineering;

(h) Transportation and related services;

(i) Research and development.

Construction contracts

Construction contracts are for construction, alteration, or repair (including dredging, excavation, and painting) of buildings, structures, or other real property. For purposes of this definition, the terms "buildings, structures, or other real property" includes, but are not limited to, improvements of all types, such as bridges, dams, plants, highways, parkways, streets, subways, tunnels, sewers, mains, power lines, cemeteries, pumping stations, railways, airport facilities, terminals, docks, piers, wharves, ways, lighthouses, buoys, jetties, breakwaters, levees, canals, and channels. Construction does not include the manufacture, production, furnishing, construction, alteration, repair, processing, or assembling of vessels, aircraft, or other kinds of personal property.

Firm-fixed price contracts

A firm-fixed price contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract. This contract type places upon the contractor maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon the contracting parties.

A firm-fixed price contract is suitable for acquiring commercial products or commercial type products or for acquiring other supplies or services on the basis of reasonable definite functional or detailed specifications when the contracting officer can establish fair and reasonable prices at the outset, such as when—

(a) There is adequate price competition;

(b) There are reasonable price comparisons with prior purchases of the same or similar supplies or services made on a competitive basis or supported by valid cost or pricing data;

(c) Available cost or pricing information permits realistic estimates of the probable costs of performance;

(d) Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm fixed price representing assumption of the risks involved.

Cost reimbursement contracts

Cost reimbursement types of contracts provide for payment of allowable incurred

costs, to the extent prescribed in the contract. These contracts establish an estimate of total cost for the purpose of obligating funds and establishing a ceiling that the contract may not exceed (except at its own risk) without the approval of the contracting officer.

Cost reimbursement contracts are suitable for use only when uncertainties involved in contract performance do not permit costs to be estimated with sufficient accuracy to use any type of fixed price contract.

A cost reimbursement contract may be used only when—

(a) The contractor's accounting system is adequate for determining costs applicable to the contract;

(b) Appropriate government surveillance during performance will provide reasonable assurance that efficient methods and effective cost controls are used.

Incentive contracts

Incentive contracts are appropriate when a firm-fixed price contracts is not appropriate and the required supplies or services can be acquired at lower costs and, in certain instances, with improved delivery or technical performance, by relating the amount of profit or fee payable under the contract to the contractor's performance. Incentive contracts are designed to obtain specific acquisition objectives by—

(a) Establishing reasonable and attainable targets that are clearly communicated to the contractor;

(b) Including appropriate incentive arrangements designed to motivate contractor efforts that might not otherwise be emphasized and to discourage contractor inefficiency and waste.

Indefinite delivery contracts

There are three types of indefinite delivery contracts-definite quantity contracts, requirements contracts, and indefinite quantity contracts. The appropriate type of indefinite delivery contract may be used when the exact times and/or quantities of future deliveries are not known at the time of contract award. The various types of indefinite delivery contracts offer the following advantages:

(a) All three types permit government stocks to be maintained at minimum levels and direct shipment to users;

(b) Indefinite quantity contracts and requirements contracts also permit flexibility in both quantities and delivery scheduling and ordering of supplies or services after requirements materialize;

(c) Indefinite quantity contracts limit the government's obligation to the minimum quantity specified in the contract;

(d) Requirements contracts may permit faster deliveries when production lead time is

involved, because contractors are usually willing to maintain limited stocks when the government will obtain all of its actual purchase requirements from the contractor.

Time and materials, labor-hour contracts

A time and materials contract provides for acquiring supplies or services on the basis of direct labor hours at specified fixed hourly rates that include wages, overhead, general and administrative expenses, and profit and materials at cost, including, if appropriate, material handling costs as part of material costs. A time and materials contract may be used only when it is not possible at the time of placing the contract to estimate accurately the extent or duration of the work or to anticipate costs with any reasonable degree of confidence.

Agreements

A basic agreement is a written instrument of understanding, negotiated between an agency or contracting activity and a contractor that contains contract clauses applying to future contracts between the parties during its term and contemplates separate future contracts that will incorporate by reference or attachment the required and applicable clauses agreed upon in the base agreement. A basic agreement is not a contract. A basic agreement should be used when a substantial number of separate contracts may be awarded to a contractor during a particular period and significant recurring negotiating problems have been experienced with the contractor. Basic agreements may be used with negotiated fixed price or cost reimbursement contracts.

How to Access and Obtain Bid Opportunities

Bidder mailing lists are often established by agency purchasing activities. Lists are normally maintained locally by each purchasing office. Bidder mailing lists are typically categorized by product or service so that businesses receive only solicitations in which they are interested. Bidder mailing lists are not mandatory.

Federal bid mailing lists

Within the federal government two methods are primarily used to place names on bidder mailing lists—Standard Form (SF) 129, Solicitation mailing List Application, or the Procurement Automated Source System (PASS).

Standard Form 129, Solicitation Mailing List Application is completed by a business and submitted to federal agencies to provide basic, standardized information to be used by the federal agencies to place the business name on the appropriate bidder mailing list. Within two months of forwarding a SF-129 to an agency a follow up call should be made to the agency to ensure the business name has been placed on the he appropriate list. If the business has not been placed on the list, specific instructions should be requested from the agency on the process to follow to place the firm on the

list.

It is noted that some agencies have developed their own version of a bidder mailing list application. Firms are encouraged to call agencies prior to submitting a SF-129 to ensure the form is the acceptable format, and if not, to secure the correct form.

Procurement Automated Source System (PASS). The PASS system is a database developed and maintained by the U.S. Small Business Administration to inventory small businesses, including woman owned and disadvantaged small businesses, interested in performing federal prime contracts and/or subcontracts. This computerized list of over 250,000 businesses is utilized by federal agencies to identify potential sources for the full range of products and services needed by the federal government. Also, some federal agencies such as, NASA, National Park Service, and the Forest Service of the U.S. Department of Agriculture utilize PASS to prepare bidder mailing lists for individual projects. Placing a business into the PASS system is accomplished by simply filling out an appropriate form that is available from any local office of the U.S. Small Business Administration.

Commerce Business Daily (CBD)

The Commerce Business Daily (CBD) is the public notification media by which U.S. Government agencies identify proposed contract actions and contract awards. The CBD is published in five or six daily editions weeks as necessary. The primary purpose of the CBD notice are to improve small business access to acquisition information and enhance competition by identifying contracting and subcontracting opportunities. Subscriptions to the CBD must be placed with the Superintendent of Documents, Government Printing Office, Washing, DC 20402 (telephone 202-783-3238).

Vendor Information Program (VIP)

The VIP electronic system was designed to allow you access to bid information via computer 24 hours a day, seven days a week. It has the speed and storage capacity to handle multiple bid requests at the same time anywhere inside or outside Oregon. If you have a personal computer at your place of business or home, you can use it to access the system easily. If you do not have a personal computer, you can use one of the computers available at selected "Procurement Centers" throughout the state. These include libraries, community colleges and local businesses that serve trade groups, women, minorities and emerging small businesses. For a list of these sites, call 378-4649 or contact your local library or trade organization.

The Vendor Information Program can be used to:

(a) Look at a list of current **State of Oregon** contract opportunities. Select one that looks interesting to you, review the bid and print a bid summary;

(b) Find your competition. Look at a list of vendors who are your key competitors. Print the list if you like.

(c) Review contract award information., Find out what firms have been awarded contracts, as well as the contract prices. Print copies of price agreements, service con-

tracts and sales agreements to use in preparing future bids.

You may call the Outreach Manager at 378-4649 for more information on the VIP program.

Electronic Data Interchange (EDI)

EDI is the computer to computer exchange of business data in a standardized format. Congress has directed EDI is the way government and industry will do business together now and in the future. Using EDI you will :

- Find out who wants to buy your products/services;
- Get specific bid opportunities;
- Respond to RFQ's from all over the United States;
- Exchange specifications;
- Manage project schedules;
- Place and receive orders;
- Send and receive invoices;
- Send and receive payments.

Implementation of Electronic Data Interchange by federal agencies is currently in progress. Until EDI systems are in place, this method of access to government bid opportunities is not recommended. Further information on the EDI program can be obtained by contacting GCAP technical assistance specialists.

Personal networking

Personal networking is an important tool to utilize in establishing a successful working relationship with federal agency contracting personnel. Periodic and timely visits with agency contracting personnel to discuss future work programs provides the opportunity to glean valuable project information and to establish key personal contacts within the agency.

How to Accurately Develop a Cost Estimate

Definition of a cost estimate

An estimate is a judgment, opinion, forecast, or prediction. A cost estimate is a judgment or opinion of the cost of a specific contract project. It is a prediction or forecast of what a specific contract project will cost. Defined in Webster's New Collegiate Dictionary: "Estimate, the comprehensive term, implies a personal judgment, the significance of which can only be made clear by the context."

Components of an estimate:

(a) **Labor costs.** These may be considered to be the origin of all costs. Labor, usually

stated in hours, weeks, months, or years is performed by individuals with various degrees of proficiency, skill, training and experience.

(b) **Materials, equipment and subcontracts**. Are the tangible items that must be bought or procured to perform the task being estimated. These can be categorized as parts, raw materials, supplies, raw materials, supplies, equipment and tools.

(c) **Travel costs.** These include the reimbursement for personal living expenses incurred by an individual while travelling as well as the costs of transportation and other travel expenses.

(d) **Other direct costs.** All of the above costs (hours, materials and subcontracts, and travel costs) are considered direct costs. That is, they are costs directly incurred in the performance of the contract work itself. Other direct costs also includes such elements as computer services, reproduction services and training.

(e) Labor rates. It is necessary to determine and apply appropriate hourly, weekly, monthly, or yearly labor rates. It is important to know the specific wage requirements that may apply to the contract. For service contracts, the Service Contract Act will generally apply. For construction contracts, the Davis-Bacon Act will apply when the project exceeds $2,000.

(f) Indirect costs. These are those costs not directly attributable to a project but which must be borne by all of the units of an organization, usually consist of labor burden, material burden, and overhead.

(g) Administrative costs. This is usually referred to as G&A expense and it includes corporate or home office expenses. General and administrative expenses usually cover administration, advanced design, advertising, corporate expenses, executive salaries, finance, marketing, personnel, research, training and corporate taxes.

(h) Profit. Profit includes funds that are returned to the company stockholders, used for reinvestment, or expended for capital equipment and facilities.

Skills Required to Develop an Estimate

Business and finance skills are an essential part of preparing the estimate. A knowledge of business practices is necessary to understand and convert staff hour and material figures into a complete government cost estimate.

Technical skills, as reflected in actual on the job experience, are the basis for a sound, competitive, and realistic estimate. Technical skills are just as necessary as business and finance skills in preparing an estimate. A completed estimate must be based on a practical knowledge of the work output as well as all the factors which will affect the price.

How to develop cost information

In some industries, there are guidelines available to determine the amount of labor, i.e. flat rate books for mechanics, guide books for body shop repairs and production rates for equipment operations. However, for many resource type contracts, the estimating is done on the basis of past work experience, observation of how productive previous con-

tractors have been, and some general "rules of thumb" which can be applied. For example, a six person planting crew will plan "x" acres per day. This production rate is adjusted for the steepness of the slope, the quality of site preparation, site access, and weather conditions.

The judgment-experience technique is perhaps the simplest and most widely used method for estimating the man hours required to accomplish most service contract projects. The estimator envisions the job, the work location and the equipment or machines required, and estimates the number of people and skills needed to staff a particular operation. The estimate is usually in terms of a number of people for a given number of days, weeks, or months. From this staffing level, the estimated on-the-job staff hours required to accomplish the work can be computed.

This judgment should be made by an individual who has had direct hands on experience in either performing, supervising or administering similar contract work.

Structure of an estimate

The first step in developing a cost estimate is the development of work elements or a work breakdown. Work elements serve as a framework for collecting, accumulating, organizing, and computing the direct and directly related costs of a project. A structured approach serves several purposes:

(a) Provides a breakdown of small tasks that are easy to identify, including staffing, scheduling, and estimating;

(b) Provides assurance that all required work elements are included in the work output;

(c) Reduces the possibility of duplication, or redundancy of tasks;

(d) Offers a convenient structure for the accumulation of individual costs;

(e) Gives greater overall visibility to the makeup of the required work.

Common pitfalls in developing an estimate

Information is often obtained from past bids on similar type work, performance or similar work by Government personnel, or from data gathered from contractors who have recently performed like work. There are several problems that can result in following this practice. There is a possibility of ignoring or failing to discover inefficiencies in the part or current work. If inherent inefficiencies in performing a specific task are not eliminated, the estimate will have a built-in bias that will make the estimate excessively high or low.

Another pitfall is the failure to adjust the data to the specific conditions of the contract work being estimated. Actual bid data from one contracting unit cannot necessarily be sued for estimating other contract work unless the activities are very similar. Any changes in complexity, quantity, environment, season, location, or delivery schedule could cause significant differences in costs.

Key Steps to Follow in Submitting a Bid

- Visit the work site to review ground conditions;
- Read/comprehend/question solicitation intent;
- Obtain "expert" help in filling out your offer;
- Develop comprehensive work papers that "backup/support" your offer;
- Double check all computations, calculations, and extensions of price;
- Fill out all the required certifications i.e. type of business, tax payer ID number;
- "Sign" your offer in the appropriately designated space;
- Allow sufficient time for offer to reach the designated bid office.

Socioeonomic Programs, Bonding and Pay Information Important to Small Contractors

SBA surety bond guarantee program

The Small Business Administration is authorized to guaranty bid, performance, and payment bonds to qualified small business contractors that are required to obtain bonds in order to secure contracts. The Agency can guaranty up to 80 percent of losses to a qualified surety on contracts valued up to $1.25 million. Eligible contracts include services provided as a prime or subcontractor for government or non-government work. SBA can provide a list of participating surety agents in your area.

Contact:

Small Business Administration
Seattle Regional Office
2615 Fourth Avenue
Seattle, WA 98121
(206) 442-0961

8(a) Business development program

Section 8(a) of the Small Business Act provides the SBA with the authority to enter into contracts with any agency or department of the U.S. Government and subsequently subcontract the actual performance of work to an eligible small disadvantaged business. The exercise of this authority is limited to firms participating in the 8(a) program, a program designed to assist small disadvantaged firms in their business development efforts. In order to be eligible, firms must apply and be certified by SBA.

Contact:

Small Business Administration
Portland District Office
222 S. W. Columbia St., Suite 500
Portland, OR 97201
(503) 326-5101

Assignment of claims

Means the transfer or making over by the contractor to a bank, trust company, or other financing institution as security for a loan to the contractor, of its right to be paid by the government for contract performance.

A contractor may assign moneys due or to become due under a contract if all the following conditions are met:

(a) The contract specifies payments aggregating $1,000 or more;

(b) The assignment is made to a bank, trust company, or other financing institution, including any Federal lending agency;

(c) The contract does not prohibit the assignment;

(d) Unless otherwise expressly permitted in the contract, the assignment—

(1) Covers all unpaid amounts payable under the contract;

(2) Is made only to one party, except that any assignment may be made to one party as agent or trustee for two or more parties participating the financing of the contract;

(3) Is not the subject to further assignment.

Bonds (bid guarantee, payment, performance)

Bonds. A written instrument executed by a bidder of contract (the principal) and a second party (the surety or sureties), to assure fulfillment of the principal's obligations to a third party (the obligee or government), identified in the bond. If the principal's obligations are not met, the bond assures payment, to the extent stipulated, of any loss sustained by the obligee.

Bid bond (guarantee). Bonds typically required for service/construction contracts in excess of a stated regulatory amount. The normal procedure is for a third party to guarantee the bidder's acceptance of a contract. A designated form, the Bid Bond, and a certified check, cashier's check, or money order are often required. The penal amount is at least 20% of the bid price.

Performance bond. A bond which is executed in connection with a contract and which secures the performance and fulfillment of all the undertakings, covenants, terms, conditions, and agreements contained in the contract. The penal amount if 100% of the original contract price unless the contracting officer determines a lesser amount would be adequate protection for the government.

Payment bond. A bond which is executed in connection with a contract and which secures the payment of all persons supplying labor and material in the prosecution of the work provided for in the contract. The penal amount shall equal:

- 50% of the contract price up to $1MM
- 40% more than $1MM and less than $5MM
- 2.5MM if more than $5MM

Agency payment cycles

It is imperative small businesses entering into contracting with federal agencies be keenly aware of "typical" agency payment cycles and procedures. The contractor's cash flow can be greatly impaired due to the government's historically late processing of contract payments. It is not uncommon for a lag time of thirty to forty five days from initial processing of invoices to the receipt of payment by the contractor. It is important to maintain constant follow-up with agency contracting officer's to identify status of pending payments due.

Offering a discount

Contractor's can often expedite the payment process by offering the government a discount on all invoices. Most agency payment systems place emphasis on the taking of discounts; therefore, contractor invoices offering discounts receive priority Processing or discount invoices are accommodated first!! This can result in a faster turn around in payments.

Suggested Field/Classroom Exercises

Classroom

Provide simulation of actual agency solicitation that requires trainees to:

- Read and interpret spec's to determine intent of solicitation;
- Develop a work process and production rate for specified work;
- Develop a cost estimate that considers wage rate, production rate, materials, equipment, profit, and risk.

Field

- Attend a formal agency bid opening to observe the sealed bid system;
- Review a bid abstract and develop follow-up questions for the contracting officer about subsequent award determination decision;
- Fill out and submit a bid for a proposed agency solicitation; have the offer critiqued by the contracting officer.

Resources for Further Information, Training, and Certification

• Certificate of Competency lecture (COC) by SBA	SBA Official
• Acquiring bonds for government contracting	Bonding agent
• Contracting from the perspective of an agency CO	USFS/BLM
• Contracting from the perspective of a contractor	Industry rep
• Construction contracting	GCAP**
• RFP's	GCAP**
• Service contracting	GCAP**
• Contract inspection	GCAP**

** Courses available from private sector firms i.e. NPI and MCI at significant cost. Contact GCAP at 885 South Bend Loop, Powell Butte, OR 97753, (541) 548-5992.

BUSINESS TECHNICAL SKILLS: BUSINESS FORMATION

Tony Laska

Introduction

In this final decade of the 20th century, small business owners continue to demonstrate their extraordinary capacity to mobilize resources and generate new jobs. There are more than 20 million small businesses in the United States, and each year nearly a quarter of a million new ones are started. Small business employs six out of every ten people, accounts for the majority of new jobs, is more flexible than big business in responding to shifting markets and is able to bring new products and services to market much faster than larger companies.

Handbook for Small Business
Service Corps of Retired Executives (SCORE)
Chapter 225
U. S. Small Business Administration

America's future depends on the continued emergence of successful small businesses. To be successful, those who start a new business must be prepared. It is the purpose of this section is to provide information to help you be successful.

Owning a business is the dream of many. Starting that business transforms that dream into reality. The transition between dream and reality can only be filled with careful planning and work. As a potential business owner you will want to avoid every pitfall possible so you can achieve your goals and build a profitable business.

This section will help you assess the depth of your business interest and give you some of the basic information you will need to go into business for yourself. Small Business Development Centers (SBDC) are located at every community college and are very helpful. SBDC experts are set up to guide you step-by-step through starting your business. They usually have well stocked reference libraries to help you get the more in depth information you will need. Thousands of small businesses across America have used the SBDC to their advantage. Utilizing these resources will give you the best possible chance for success.

Deciding to establish your own business is an important step which can have significant long-term implications. While the ultimate decision is yours, alone or with partners, it is in your own best interest to give your plans serious thought and seek out the many sources of assistance and guidance that will help you make an informed decision. And once you have made a commitment to go ahead, you should avail yourself of

readily available kinds of training, counseling and assistance to ease the entrepreneurial shocks and improve your management skills. This section raises some of the important issues that you might consider as you ponder operating a new business. Much of this applies to buying an existing business as well.

Should You Go Into Business or Not?

The business idea you have may be appealing, but is there potential for it developing into a viable business or is it really a hobby or unique skill? What are your products and who are the customers? Can the enterprise generate sales, profits, cash flow necessary for survival? You should answer these questions satisfactorily for yourself by doing a market analysis and preparing a business plan to get a firm handle on what the actual opportunities are likely to be.

You may well have a personal reason for seeking the independence that your own business can bring. Monetary reward can be a real factor; making a contribution is another. You may be weary of making others wealthy through your labor and want a greater stake in your own future.....take ownership of personal success or failure. Business ownership can help one control their own destiny and offers many people a level of community respect and social reinforcement that income alone cannot buy. But, you must be ready and willing to work excessive hours!

How are your managerial skills? Do you have the level of education and actual experience to give you the confidence necessary? If the business is related to your work experience, you probably know whether or not you have the aptitude and technical knowledge to succeed. Do a frank assessment of your actual experience, education and certifications.

Most businesses require start-up capital: investment in tools and equipment, inventory, property, etc. Do you have or have access to sufficient working capital to meet these needs? A good credit rating can be invaluable here! The business must meet income needs and service any debt to "pencil out." In the event that income doesn't meet projection at first, you might need a cushion.

Preparing a business plan relies on answers to the questions listed above.. While a good business plan may have many parts, the most basic aspects are the following:

- Mission statement
- Products and/or services
- Customers and competition
- Positioning the operation
- Marketing strategies
- Promotion and advertising
- Pricing and bidding

What Kind of Business Will You Establish?

There are four forms of business. They are Sole Proprietorship, Partnership, Limited Liability Company and Corporation. Each form of business organization has its advantages and disadvantages.

The Sole Proprietorship is ordinarily owned and operated by one person, who simply obtains the appropriate licenses and begins operations. Formation, flexibility, central control and decision-making are advantages. Among the disadvantages are an unstable business life tied to one person's health, more difficult access to capital and relatively limited viewpoint and experience.

A Partnership is more complex. It typically has a limited life span, co-ownership of the assets, share of management and profits and unlimited liability of at least one partner. A Partnership requires an agreement that covers a range of issues. Among these are the type of partnership (Oregon recognizes four types), employee management, arbitration, method of accounting, sale of partnership interest, etc.

A Limited Liability Company is the newest form of business organization. It allows for an unlimited number of owners. An LLC is like a partnership in that it allows pass-through taxation, yet it offers the limited liability of a corporation. It is a corporation that is taxed like a partnership. Raising capital is easy through the sale of interests. The LLC is a separate legal entity. Among disadvantages are the presence of more administrative duties and the possible cost of business formation.

The State of Oregon recognizes seven types of Corporations. In general, a corporation is a distinct legal entity from the individuals who own it. It is usually formed by the authority of a state government. A corporation has greater relative permanence, can secure capital more readily, in larger amounts from more investors. Authority is usually delegated to hire managers. A corporation has the ability to draw on expertise and skills of more than one individual. Drawbacks of a corporation include greater regulatory control by various levels of government and a phenomenon of "double taxes" in which there is income tax on corporate profit and on individual salaries. Forming a corporation costs money, and managers may have less incentive if they do not share in profits.

An overview of business types wouldn't be complete without a classification by type of activity: Businesses generally are divided into:

- Retail
- Service
- Manufacturing

If a business of any of the above types is of a significant size, it might be divided into the following operational areas:

- finance
- marketing
- production
- human resources
- research and development

Mentoring for Potential Small Business Owners

Resources and people to assist someone contemplating establishing a new business can be found throughout the state of Oregon. Small Business Development Centers (SBDC's) are at 20 locations in Oregon, associated with all community colleges and at certain other sites. Business-related courses and workshops are offered. Their brochures and schedules show when workshops or seminars will be offered, including: Tax Planning, Going Into Business, Effective Marketing, Business Taxes, Record Keeping, Profit Improvement Program, etc.

SBDC's offer customized counseling by experienced, business-trained counselors. One should normally make an appointment for such a meeting, which can often be scheduled for evenings or Saturdays when necessary. Areas covered include assistance with regulations, purchasing a franchise, financing your business, business start-up plans and many other topics of concern to new businesses. SBDC's also maintain an Entrepreneurial Library, with on-line computers for networking and information access. The library should have many volumes from the *Entrepreneurial Binder Series,* which provide guidance on more than 200 businesses, each binder concentrating on a specific business.

Small Business Administration (SBA) offices are found throughout the state, and are committed to provide the kind of assistance you might seek. Chapters of the Service Corps of Retired Executives (SCORE), sponsored by SBA, are found in most major Oregon cities. SCORE volunteers offer free counseling in various business areas including planning, financing, new business start-ups, expansion and procurement. Other SBA programs are ACE and WNET.

The Business Information Center, a service of six state agencies, provides general information on such areas as state business registration and licensing requirements, state taxes, worker's compensation insurance and obtaining a federal tax identification number. The Center makes referrals to appropriate agencies for licensing, business assistance and public sector loan programs, among others. The Business Information Center is located in the Public Service Building, Suite 151, 255 Capitol Street NE, Salem, OR 97310-1327. Their phone number is (503) 986-2222.

Once a person is in business, they can still rely on a number of sources to keep them updated and improving their operations. The Small Business Development Centers (SBDC's), mentioned earlier and associated predominantly with 2-year colleges, maintain libraries and on-line computer services that are readily available. Their workshops are often tailored toward improving one's bottom line; local newspapers usually run ads that help publicize them.

Your local Chamber of Commerce probably has a "LEADS" group which will help steer you toward business opportunities. This networking is an important aspect of the chamber. One can reach other networks through the public library by searching library computer files under associations, organizations. Then go to "Link," "Networking." This can be an efficient way of getting in contact.

BUSINESS TECHNICAL SKILLS: MARKETING

Ellen Palmer

At the end of this section you will be able to:

- *create a simple market analysis and develop a market strategy*
- *analyze your strengths and weaknesses and apply them to business*

Business success ultimately comes from satisfying market needs. Marketing is simply a beneficial exchange process between you and your customers. The essential ingredient in this relationship is your ability to identify what the customer needs. It is up to you to develop the services that will satisfy those needs. The marketing process begins with an analysis of the types of markets that you want to focus on. It continues with the determination of how to get specific clients to purchase your services. How will you get those forest management contracts?

It is essential that people in small business understand and develop marketing programs for their products and services. Your business will not succeed just because you want it to. There must be a market for what you offer or there is no chance of your success.

Market Research and Analysis

Market research tells you what your customers want by systematically gathering, recording and analyzing information related to marketing the services you provide. This information can help you spot potential problems and contract opportunities. It will also be the basis from which you will form your plan of action.

Many small businesses do market research every day and may not be aware of it. They talk to customers, talk to employees, read newspapers and trade journals, look at competitors' and noncompetitors' advertisements and promotional activities, look for information about trends and gather financial and economic information from bankers, foresters, contractors, and trade associations.

Your small business has an advantage over a large business in learning about its customers. Large organizations tend to be ponderous and react more slowly to market demands. Small business owners and managers are more likely to be in direct contact with their customers. They learn quickly about their customers likes and dislikes, and react rapidly to needed changes. They talk to the customers and learn first hand about:

- The services customers like
- How much they are willing to pay

- Where and when upcoming contracts will be let
- How they like the service
- Whether they would recommend the service
- Why they contracted with the business
- The services they would like but your business does not offer

Activity

Before you start your business, you will want to thoroughly investigate your market potential. Any lender will want you to obtain the following information. Fill in the blanks now and get a head start on your own marketing plan.

- Is the service you will be offering one that contractors want? Yes____ No____
  How do you know this?_____

- How may customers will want your services?_____
  How often will they want it? _____

- Who are your potential customers? (names and addresses)
  _____

  _____

  _____

  _____

- Will your business be the right business, at the right time, at the right place?
  Yes_____ No_____ Why? _____

- Can a demand be created for your service? Yes_____ No_____
  How?_____

- How many competitors offer the same service?_____

- How will your business effectively compete in price and quality?
  _____

  _____

Almost everything you need to know for marketing research can be done with easily obtained information. Trade associations constantly report on and analyze pertinent marketing information. Forest management trade association membership fees may be money well spent.

You may want to undertake formal market research. Following are the steps to complete:

- Carefully define the area you want to investigate
- Gather and analyze all the available information
- Organize and interpret the information
- Make decisions and form action plans
- Observe and evaluate the results of the decision

SWOT Analysis

Your success in business depends on knowing your business inside out. Use the SWOT Analysis chart on the following page to identify your strengths, weaknesses, opportunities and threats. Strengths are those things you do well and that set you apart from competitors. Weaknesses are the areas you have to improve upon, especially if you do not want your competitors to capitalize on them. Opportunities include everything that can benefit your business, such as an increased customer base, other businesses closing shutting down, or special services only you can offer. Threats are those things that can hurt your business, like a major competitor coming into your area, regulation changes, or employee costs sky rocketing.

Identify all these characteristics of your business, and anything else that you can think of that affects its operation. Now conduct a SWOT Analysis on your competitors to identify where they are strong, where they are weak, and where you can capitalize on areas that they have left open to you.

Market strategy

Your market strategy will involve identifying customer groups that you can serve better than your competitors can, and tailoring services and promotional efforts to that particular market segment. Look for the market niches that are not being adequately met. By now you know your strengths and can analyze the market capabilities. You should capitalize on what you do best and what is unique about your services. Then focus on that part of the market that needs your business the most. Remember, the most important aspect of marketing is to give the customer reasons to contract with you.

Marketing resources

Other resources available to help you learn more about marketing and create an in depth marketing plan, and make marketing decisions include:

- Local chamber of commerce
- Bankers

- Local business journals
- Public library
- Small Business Development Centers located in every Community College.

SWOT Analysis

Business Name _____

List the strengths, weaknesses, opportunities, and threats in the boxes below

Strengths	Weaknesses
Opportunities	**Threats**

BUSINESS TECHNICAL SKILLS: LICENSING AND PERMITS, BONDING

Nedra Cunningham

The Bureau of Labor and Industries (Bureau) is responsible for enforcing the State Wage and Hour Laws. The Bureau enforces laws dealing with employment of minors; payment of state minimum wage; the payment of overtime for hours worked in excess of 40 per week; general working conditions, including payment of the agreed rate and rest and meal breaks; payment of the State Prevailing Wage Rate for work performed on public works projects and Farm/Forest labor Contractor Laws.

Information Regarding a Farm and Forest Labor Contractor License

This section is designed to provide you with a basic understanding of the licensing requirements necessary to become a Farm/Forest Labor Contractor. This information will help you determine if you need to become a licensed contractor in order to perform the work you are anticipating.

Who must apply

839-15-004(4) Defines reforestation and forestation contractors as:

(a) Any person who recruits, solicits, supplies or employs workers to perform labor for another in the forestation or reforestation of lands; or

(b) Any person who recruits, solicits, supplies or employs workers for an employer who is engaged in the forestation or reforestation of lands; or

(c) Any person who furnishes board and lodging for workers in connection with the recruiting, soliciting, supplying or employing of workers to be engaged in the forestation or reforestation of lands;

(d) Any person who bids or submits contract offers for the forestation or reforestation of lands; or

(e) Any person who subcontracts with another for the forestation or reforestation of lands; and

839-15-004 (3)(c)

Any person who recruits, solicits supplies or employs workers to gather wild forest products. . .

(8)(c)

Other activities related to the forestation or reforestation of lands including, but not limited to, tree shading, pinning, tagging or staking; fire trail construction and maintenance; slash burning and mop up; mulching of tree seedlings; forest fire suppression by contract crew; application of big game repellent by contract crew; herbicide or pesticide application in the forest by contract crew; gopher baiting; gopher trapping and any activity related to the growth of trees and tree seedlings and the disposal of debris from the land.

ORS 658.405 (1)

States that forestation or reforestation lands . . . including but not limited to the planting, transplanting, tubing, precommercial thinning and thinning of trees and seedlings, the clearing, piling and disposal of brush and slash and other related activities or the production of harvesting of farm products; or who recruits, solicits, supplies or employs workers to gather evergreen boughs, yew bark, bear grass, salal or ferns from public lands for sale or market prior to processing or manufacturing.

License Type	**License Fee**
Farm Labor Contractor License	$20.00
Farm and Forest Contractor	$100.00

Licensed as:

1. Sole Proprietor
2. Partnership – Each partner must make application and post a bond
3. Corporation – Corporation and majority shareholder(s) must make application as well as person(s) acting as contractor(s) if different from majority shareholder(s)
4. Cooperative Corporation

Requirements for obtaining a license

Each applicant must submit:

1. Completed Application
2. Appropriate license fee
3. Proof of Financial Responsibility
4. Form WH-87 Certification of Compliance
5. Certificate of Insurance issued by your auto insurance carrier which lists the Bureau of Labor and Industries as Certificate Holder and provides a 30-day cancel-

lation notice, for all vehicles used in the operation of this business and used to transport workers.

6. Certificate of Insurance used by your Worker's Compensation carrier and which lists the Bureau of Labor and Industries as Certificate Holder and provides a 30-day cancellation notice. This applies to application for Farm/Forest Labor Contractor license.
7. Three (3) colored passport photographs, 2" x 2".
8. In order to qualify for an Oregon farm/forest labor contractor license, you must demonstrate that you have filed and paid all taxes due. Your license will not be issued before this IRS information is received.

All assumed business names and corporations MUST be registered with the Corporation Division in Salem PRIOR to a license being issued.

Proof of financial responsibility

Proof of financial responsibility is a corporate Surety Bond of a company licensed to do business in Oregon, or a cash deposit. The proof of financial responsibility shall be in the following amounts based on the maximum number of employees employed at any one time during the license year. The bond or deposit shall be:

$10,000.00 if employing no more than 20 employees;

$30,000.00 or such sum as may be authorized by the commissioner pursuant to Oregon Laws, Ch. 73, Sec.4(1995) and OAR 839-15-230.

When a licensee or holder of a temporary permit employs more than 20 employees, the licensee or permit holder shall immediately increase the amount of the bond or deposit to $30,000.00 or such sum as may be authorized by the commissioner as stated above. When the contractor elects to make a cash deposit as proof of financial responsibility, the cash deposit is required to be:

1. Issued payable to the "Commissioner, Oregon Bureau of Labor and Industries" exclusively; and
2. Be immediately payable to the Commissioner upon demand; and
3. Held in trust through the current license year, PLUS six months

Exemptions from licensing

The following persons are not required to obtain a farm or forest labor contractor's license:

1. A permanent employee of a farmer, nursery owner, or processor of farm products, or a permanent employee of an owner or lessee of land intended to be used for the production of timber so long as the employee is engaged solely in activities which would not require the employer to be licensed if the employer were performing the activity.
2. A person engaged only in the solicitation or recruitment of workers for agricultural day-haul work and not engaged in arranging for board or lodging for migrant workers and not performing as an employer of the workers.

3. A platoon leader.
4. A crew leader, with certain exceptions.
5. A person performing work of a mental, technical, professional or managerial nature.
6. An individual who collects tree seed cones or an individual who buys tree seed cones from other individuals. This section applies to individual only and not to persons who are otherwise defined as farm or forest labor contractors.
7. Persons who recruit, solicit, supply or employ workers to perform labor under a contract or agreement solely for the following activities, provided that the person performs no other activities which would require licensing:
   (a) Stream or creek debris removal:
   (b) Provision of security services:
   (c) Any activity which does not have the primary purpose of forestation or refor estation of lands, the gathering of wild forest products or of production or harvesting of farm products.

The above is only a partial list of exemptions. For a complete list, please see OAR 839-15-130(1) to (20).

Exemptions from financial responsibility and record keeping requirements

Applicants for a Farm Labor Contractor License who will be engaged in forestation/ reforestation activities may request an Application for Exemption from Bond. For this exemption the applicant must be: a sole proprietor; engaged in forestation/reforestation contracts for under $25,000.00; and employ two or less individuals in the performance of work on all contracts performed in the license year. (SEE ORS 658.418)

Applicants who are granted the above exemption will not have to post a bond and will not have to submit certified payroll.

Forms prescribed by the commissioner

Forest Labor Contractors engaged in the forestation or reforestation of lands must, unless otherwise exempt, submit a certified true copy of all payroll records to the Wage and Hour Division when the contractor on contractor's agent pays employees directly. The certified true copy of payroll records shall be submitted at least once every 35 days starting from the time work first began. Every contractor must furnish each worker with a statement describing the terms of their employment. Every contractor must also furnish each worker with a statement describing the worker's rights. The statements must be in

English and any other language used to communicate to the worker. The statements must be given to the workers at the time they are hired, recruited or solicited by the contractor. New statements must be given at the beginning of each new contract/project.

License renewal

The license shall be good for one year from date of issue. Renewal applications are sent to all licensed contractors prior to the expiration of the current license.

Temporary permit

A temporary permit may be issued prior to taking the exam. It shall be valid for 60 days, how ever, arrangements must be made to schedule and take the exam within 45 days of issue. It shall be the contractor's responsibility to contact the Portland office to arrange for an appointment to take the exam. It is suggested that you do not wait until the end of the 45 days to schedule your exam in the event you fail the exam and need to reschedule. The permit may not be extended beyond 60 days. A contractor is allowed only one temporary permit within any 12-month period.

The permit will be granted only if all materials required for license are submitted in one package and it is complete. Otherwise, your application will be returned to you for completion. No action will be taken until you submit a complete application.

Issuance of license

A license will not be issued prior to the receipt of:

1. Completed application
2. License fee
3. Proof of Financial Responsibility
4. IRS Tax Compliance Certification
5. Oregon Dept. of Revenue Compliance Certification
6. Form WH-87 Certification of Compliance
7. Vehicle Certificate of Insurance (if applicable)
8. Worker's Compensation Certificate of Insurance (if applicable)
9. Three (3) colored passport photographs, 2" x 2"
10. Applicant must take and pass a written examination

The Bureau of Labor and industries will assist you in any way possible in order to complete the licensing process. Please contact any office of the Bureau if you have any questions.

Farm/Forest License Unit (503) 731-4074 ext. 229.

BUSINESS TECHNICAL SKILLS: FINANCIAL RECORDS MANAGEMENT

Ellen Palmer

At the end of this section you will be able to:

- *Analyze your business start-up costs*
- *Gather the information needed to get financing*
- *Explore financing with several potential funding sources*
- *List 15 recordkeeping tips*
- *Contact appropriate tax agencies for forms*
- *Find needed expert advice*

Good accounting records decrease the chances of failure and increase the likelihood of staying in business. Financial statements are an important management tool. When correctly prepared and properly interpreted, they contribute to an understanding of the current financial condition, problems, and possibilities of a company. Assurances of good financial management will be an important aspect of what every lender will look for. They can also be valuable resources when setting up your system.

Ways to Finance Your Business

We have all heard the horror stories about the large number of small businesses fail each year (more than eight out of ten). There are many reasons for these failures, but one of the most common reasons is insufficient funds. Too many try to start and operate new businesses without enough capital (money). To avoid this dilemma, you can review your situation by analyzing these three questions:

1. How much money do you have?
   List all your assets and subtract your liabilities.

2. How much money will you need to start your business?
   Start-up costs are all the expenses you will have before you open for business and begin having an adequate income.

3. How much money will you need to stay in business?

When you can answer these questions then you will be ready to look for financing.

Some of the ways to finance your business follow:

- Your own money
- Family
- Friends
- Savings & Loans
- Banks
- Credit Unions
- Small Business Administration
- Life Insurance Companies
- Finance Companies
- Venture Capital

Financing tips

Financing tips that could save you time and money include:

1. Open a separate business checking account

2. Develop a working relationship with your banker

3. Do your homework when applying for a loan:
   - Know how much money you will need, what you will do with it, and how you plan to repay it (refer back to "Bottom Line Presentations" in this handbook)

   - Gather your current financial information (business and/or personal):

     Bonds
     Value of cars
     Monthly income
     Stocks
     Bank account balances
     Real estate
     Loans
     Business equipment
     Credit card balances

   - Have a written, detailed business plan. You can get an outline at the library and/or guidance from your local Small Business Development Center (SBDC).

   - Make monetary requests realistic

4. Compare options for financing—shop around

5. Discuss your loan proposal with a SBDC counselor before you go to the bank.

6. After you receive a loan, keep the lender informed about your business progress.

Adapted from Getting Started Series: Issues and Resources, Lane Community College Business Development Center, 1995

Recordkeeping

After you've gotten your loan, it is essential to set up good financial and recordkeeping systems immediately. An adequate record keeping system, implemented right from the start, will help increase the chances of survival and reduces the probability of early failure. Similarly, for the established business owner, it has been clearly demonstrated that a good recordkeeping system increases the chances of staying in business and of earning large profits. Record keeping is so important that it is best to get expert help. You can get advice and take classes with other new business owners at the Small Business Development Center. You can also hire and accountant or a bookkeeper to help you set up your books, and/or keep your records up-to-date.

Your recordkeeping system serves two primary functions: one, it will provide information for analyzing and running your business, and two, it will provide information for tax preparation and audits.

Lane Community College's Business Development Center publication *Issues and Resources* (1995) gives the following advice:

Recordkeeping tips

1. Open a separate bank/checking account for your business and do not mix personal and business finances.

2. Make all payments with a business check. Make a note on check to document the purchase.

3. Keep all records, receipts, tax returns, and cancelled checks indefinitely.

4. Keep all receipts. Describe the purchase on the back.

5. Include an accountant as part of your business team. An accountant will help set up your records as well as assist at tax time.

6. Use your records not only for tax purposes, but to set goals and make business decisions. Your records are the statistics for your business.

7. Keep your records up-to-date. Set aside a regular time to do your bookkeeping—at least once a month.

8. If you charge business expenses on a charge card, open a separate business charge account: do not use your personal VISA or MASTERCARD.

9. If you request immediate payment, your recordkeeping will be simplified.

10. Keep a travel log (diary) indicating date, destination, purpose of trip and miles driven.

11. Document entertainment expenses: date, purpose, location, and other persons included.

12. Log long distance phone calls.

13. To qualify for home business deductions, the IRS states that part of your home must be set aside Regularly and Exclusively for the business. The space must be used either as:
    - your principal place of business, or
    - a place to meet and deal with patients, clients, customers in the course of doing business.
    - Also, you could use a building next to your home such as a shop, studio, garage, barn, etc. (Check with the IRS for the latest regulations.)

14. Single-entry recordkeeping books are available at stationery stores.

15. To simplify the recordkeeping process, you can separate the following into separate books:

    - Cash Receipts Journal—money paid to you
    - Cash Disbursements Journal—money you paid for supplies, etc.
    - Accounts Receivable—money owed to you
    - Accounts Payable—money you owe to suppliers, creditors, etc.

* The SBDC class Getting Started: Intro to Business Records will give you more detailed information about business records. Your accountant will also help you.

Tax and employee information

All businesses must file some form of business income tax to both the IRS and the state of Oregon. The type of form used depends upon the legal form of organization you choose. For more information contact the following agencies. Be sure to tell them the type of tax information you need.

Agency	Type of Tax	Phone #
Federal/IRS	Business Income and Self Employment Taxes	1-800-829-1040
State of Oregon	Business Income Taxes	378-4988

If you hire employees you will also be responsible for a variety of payroll taxes and reports. You will need to register with and will be given identification numbers from both the IRS (Employer Identification Number/E.I.N.) and the State (Combined Employer Registration #). You will be required to file reports and payments to both entities on a regular basis. This registration and reporting is necessary only when you become an employer. Contact these agencies for more information when you are ready to hire employees. (Sole owners are not employees.)

Agency	Type of Tax	Phone #
Federal/IRS	Withholding; Social Security (FICA), Federal Unemployment Tax (FUTA)	1-800-424-1040
State of Oregon	Withholding State Unemployment(SUTA)	378-4988 686-7797

Also check for local city taxes.

Workers' compensation insurance: All employers are required to have some form of workers' compensation insurance for their employees. This requirement is monitored by the state and available from a variety of insurance companies, including SAIF. For more information call the State Insurance Commission, SAIF, or your insurance agent.

Labor laws: To find out which labor laws affect your business including affirmative action, wage and hour claims, working minors, etc., contact Bureau of Labor and Industries.

Tax guides: Both the state and federal agencies have a variety of tax guides which explain both income and payroll tax requirements. To order: Federal-Tax Guide for Small Businesses Pub. #334 and Business Use of Your Home Pub. #587 call 1-800-829-3676. To order State-Information for Oregon Employers call 378-4988.

This section covers the highlights of a complex subject. If you decide to start your own business, be prepared to spend time researching and learning about all of the latest requirements.

BUSINESS TECHNICAL SKILLS: PERSONNEL RECORDS MANAGEMENT

Ed Sifuentez

The Bureau of Labor and Industries (Bureau) is responsible for enforcing the State Wage and Hour laws. The Bureau enforces laws dealing with employment of Minors, payment of the State minimum wage; the payment of overtime for hours worked in excess of 40 per week, general working conditions including payment of the agreed rate, and rest and meal breaks; enforcement of the Farm/Forest Labor Contractor laws; and payment of the State Prevailing Wage Rate for work performed on public works contracts.

Information Regarding the Employment of Minors

Employers who hire minors must comply with all the child labor laws. Minors are those workers who are between the ages of 14 and 17. The Child Labor Laws consist of age verification; working hours; working conditions, paychecks and agricultural employment.

Age verification

Minors are no longer required to obtain work permits and individual employment certificates are no longer required. Under the new system, employers who hire minors are required to:

1. Verify the age of the minor hired from an appropriate proof of age document such as a birth certificate, passport or driver's license.
2. Maintain a list of all minors hired.
3. Apply for an annual employment certificate with the Bureau of Labor and Industries.
4. Post the validated employment certificate, after approval by the Bureau of Labor and Industries, in a conspicuous location.
5. File a Notice of Change in Duties form and send it to the bureau for approval if a minor's work duties change.

Working hours

For 14 and 15 year olds:

1. Three hours per day on school days
2. Eight hours per day on non-school days

3. Only between the hours of 7 a.m. to 7 p.m.
4. Working is not allowed during school hours.

A. When school is not in session

a. Eight hours per day

b. 40 hours per week maximum

c. From June 1 through Labor day: 7 a.m. to 9 p.m.

For 16 and 17 year olds;

1. Any hours - no daily restrictions
2. 44 hours per week maximum

Working conditions

1. Rest breaks of at least 15 minutes must be provided during each 4 hours (or major portion) of work time.
2. Meals periods of at least 30 minutes must be provided. Fourteen and 15 year-olds must be fully relieved of work duties. Sixteen and 17 year-old employees may work during a meal period, but must be paid for their time.

Adequate work

Adequate work, one half of the scheduled day's earnings, must be provided if the employer requires the minor to report to work.

Paychecks

Minimum wage

Employees must receive at least $4.75 per hour for all hours worked, including preparation time, opening and closing times and required meetings. Employers may not use tips as credit toward minimum wages owed to any employees

Overtime

Employees must be paid time and one-half the regular rate of pay for any time worked over 40 hours a week.

Paydays

Regular paydays must be established and maintained. A pay period may not exceed 35 days.

Deductions

Employers MAY make deductions for the fair market value of meals or lodging provided for the private benefit of the employee provided that the employee has signed a voluntary authorization.

Employer MAY NOT make deductions for the cost of uniforms or tools or their maintenance, breakage or loses.

Final paychecks

If an employee is fired, all wages earned are due not later than the end of the first business day after discharge. If an employee quits with 48 hours or more notice, wages are due the last working day. If any employee quits without 48 hours notice, wages are due in five days or on the next payday whichever occurs first.

Agricultural employment

Who can work

Minors who are 12 years may work on a farm. Minors who are 9 years old may work on a small farm which is operated under state regulations.

Power driven machinery

A certificate of training for a completed program in tractor and farm machinery operation is required to operate, to assist in operating, or to ride in or on power driven farm machinery.

Agricultural machinery

If paid on a piece-rate basis, minors must be paid the same piece rates as adult workers. Piece-rate pay must equal minimum wage of the hours worked.

Hours in agriculture

Contact the Bureau of Labor for information concerning the hours of work that apply to minors working in agriculture.

Information Regarding Minimum Age and Overtime

Minimum wage

Most Oregon employers are subject to both federal and state minimum wage and overtime laws. The effect of this dual coverage is that the employer must follow the stricter standard, e.g., the one most beneficial to the employee when there are conflicting requirements in the laws. For example, state laws requires a higher minimum wage, therefore, all Oregon employers must pay the Oregon rate, unless their employees are exempt by Oregon law.

The current minimum wage is $4.75 per hour.

The following are a few of the minimum wage exemptions:

1. Companions to the elderly or infirm employed in a family home.
2. Managers, Assistant Managers, and Maintenance workers employed by and residing in multi-unit accommodations.
3. Outside salespersons.
4. Executive, Administrative and/or Professional employees.

For a complete list of individuals exempt from the payment of minimum wage See ORS 652.020(1) to (15). You may also contact the nearest office of the Wage and Hour Division.

Overtime wages

Under both federal and state law, the general overtime rule requires that employees be paid one and one-half times their regular rate of pay for any worktime over 40 hours in one workweek (seven consecutive days). Some employers must pay overtime on a daily basis. For example, manufacturing establishments, canneries not located on farms and work on public works projects.

The following are a few of the Overtime exemptions:

1. Domestic employees who reside in the household of the employer.
2. All agricultural employees.
3. Salespeople, parts people and mechanics working in automotive or farm implement dealerships.
4. Salespeople who sell boats, trailers, or aircraft.
5. Employees of motion picture theater enterprises.

For a information regarding overtime exemptions please contact the nearest office of the Wage and Hour Division.

Information Regarding Oregon's Wage Collection Law

All employers who engage the services of one or more employees within the state of Oregon are covered by Oregon's Wage Collection Law, which regulates the payment of wages.

Employee

An employee is defined as anyone who renders services wholly or partly in this state to an employer who pays a fixed rate for time worked, or for the number of pieces or operations completed.

Statute of limitations

Under Oregon's Wage Collection Law, any employee who has back wages due may file a claim. The statute of limitations for wage claims is six years.

Paydays

Oregon law provides that regular paydays must be established and maintained by every employer.

Pay periods

Payment to new employees must be made no later than 35 days from the time their work was begun. Pay periods for all employees may be established more frequently, but may not exceed 35 days.

Final paychecks

When an employee is fired, all wages earned by that employee are due not later than the end of the first business day after discharge. If an employee quits giving 48 hours or more notice, wages are due the last working day. If an employee quits without giving at least 48 hours notice, wages are due in five days or on the next payday, whichever occurs first.

Meal periods

Meal periods of 30 minutes must be provided if the workday is six hours or longer. The employee must be relieved of all duty during this time. If the employee can't be relieved due to the nature or circumstances of the work, then the meal period must be paid. A paid meal period may be as short as 20 minutes if the employer can show an industry practice or custom. The scheduling of meal periods is flexible and depends on the length of the workday.

Rest periods

Rest periods of at least 10 minutes must be provided during each four-hour work period or major portion thereof. The rest period is to be taken approximately in the middle of each work segment.

Proper deductions

In general, deductions from wages are lawful only when one of the following four conditions is present, but there are exceptions under the minimum wage law:

1. The employer is required to do so by law (example: federal and state taxes, social security, workers' compensation, or a garnishment order)
2. The employee has authorized the deduction in writing, the deduction is for the employee's benefit and is recorded in the employer's books.
3. The employee has voluntarily authorized a deduction for any other item, provided the employer is not the ultimate recipient of the money.
4. The deduction is provided for in a collective bargaining agreement.

Employers MAY make deductions for the fair market value of meals or lodging provided for the private benefit of the employee. If the employee does not want the meals, no deduction may be made.

Employers MAY NOT make deductions for the cost of breakage or losses.

Employers MAY NOT make deductions from employees earning the minimum wage for uniforms or tools or their maintenance.

Itemized statements

An itemized statement of deductions made from wages must be furnished to employees on their regular paydays at the time payment is made . The statement must show the

amount and purpose of each deduction. It may be part of the paycheck, attached to it, or may be a separate document.

Withholding wages

Any employer who willfully withholds any portion of an employee's wages may be subject to a penalty of a day's wages for each day the employee remains unpaid up to a maximum of 30 days.

Information Regarding Worker's Compensation Insurance

If you employ workers in Oregon, you probably need worker's compensation insurance. To determine if a worker is subject to workers' compensation coverage requirements, the Workers' Compensation Division of the State of Oregon considers the following questions:

1. Can you hire and fire the worker?
2. What method do you use to pay the worker?
3. Do you supervise the worker?
4. Do you make wage and scheduling decisions?
5. Does the worker have the right to subcontract?
6. Do you provide the worker's tools and equipment?

Exempt workers

There are a number of workers who will be exempt from the requirement of workers compensation coverage. Some of the exempt workers are:

1. Independent Contractors;
2. Sole proprietors don't need coverage on themselves;
3. Partners in a business do not need to be covered except in the construction trade in which most partnerships are limited to two exempt partners.
4. Private residence workers. People working for the resident of a private home, in or around that home do not need worker's compensation coverage. This does not include construction workers on a new home still under construction and not occupied by the homeowner.
5. Casual labor. If total payroll never reaches $500.00 in any 30-day period, your employees are considered casual labor. But if payroll reaches $500.00 within 30 days, workers compensation is required retroactively from day one.
6. Some corporate officers. In all industries except the construction and timber industries, corporate officers do not have to be covered by worker's compensation insurance if they are:

(a) on the board of directors; and

(b) own at least 10 percent of the stock or stock equal to the average held by all stockholders, whichever is less.

7. Most limited liability company members. In the construction trade, member exemptions are limited to two unless all members belong to the same family.

Oregon has a three-way workers' compensation system. This means employers can provide worker's compensation insurance by three different methods.

SAIF corporation

SAIF is a publicly-owned insurance company that exists primarily to provide workers' compensation coverage to Oregon employers.

Private insurance companies

There are over 200 private insurance companies authorized to write workers' compensation coverage in Oregon. Many of these companies sell policies through independent insurance agents.

Self-insured

This type of insurance coverage is practical for only very large employers since it requires special bonding and certification by the Workers' Compensation Division.

In addition to the three methods mentioned above, some employers can insure through group insurance plans. Group plans in workers' compensation are usually called insurance pools.

Association pools

Employer associations can contract with an insurance company to write workers' compensation insurance for their members.

Risk pools

If an employer cannot obtain workers' compensation coverage through other channels, the employer may need to contact the Oregon Insurance Pool. This pool provides a way to buy insurance for employers who cannot buy it on the open market. The insurance pool is administered by NCCI, the National Council on Compensation Insurance

For more information regarding Workers' Compensation insurance you can contact the Oregon Workers' Compensation Division.

BUSINESS TECHNICAL SKILLS: HIRING PRACTICES

Fran Bates

Introduction

Every employee and employer in every employment situation needs to be familiar with certain issues that affect their employment relationship. These include employee rights and responsibilities, the types and impacts of discriminatory behavior including sexual harassment, and issues around hiring and firing. This section is not intended to be a legal primer or substitute for effective legal or professional advise but is intended to provide you with an overview of issues that affect the workplace and can make or break the relationship between employees and their employers.

Employee rights and responsibilities

In general, and this includes a lot of ground, you have the right to be paid fairly and on time, to work free from discrimination, and to work in an environment that is safe and healthy. You have the responsibility to do your job in a manner that is legal, safe, and effective, keeping with employer rules and policies and any state or federal laws that apply.

There are dozens of laws that cover the rights of employees in the work place and that impose restrictions on some employer behaviors. The most prominent of the Federal laws are:

Title VII of the Civil Rights Act of 1964 which prohibits discrimination on the basis of race, color, sex, religion, and national origin,

Equal Pay Act of 1963 which prohibits different rates of pay based on sex, for substantially similar work,

Age Discrimination in Employment Act (ADEA) which prohibits discrimination on the basis of age for people 40 years old and over,

Rehabilitation Act of 1973 (Sections 503 and 504) which prohibits discrimination on the basis of a disability and requires affirmative action in employment for disabled people. This does not apply to all employers,

Americans with Disabilities Act of 1990 which prohibits a wide range of discriminatory actions against people with disabilities

Most of these have employee size minimums of at least 15 employees or contract size limits of $2500 or more, but when the Federal law doesn't apply the state of Oregon often has an equivalent law that does. In general, State law covers the same basic categories of "class" including race, sex, age, and disability status, but there are also provision for injured workers, filing OSHA complaints, use of Family Medical Leave

and several others. An Attachment to this chapter called "What Every Employer Should Know" concerns civil rights law and provides some more insight into these issues.

If Something is Wrong in the Workplace

There are always a range of options for you to try if you feel that something is wrong in the treatment that you are receiving. You can always ignore the action and hope that things change. You can always retain a lawyer and sue. In both cases this is probably bad advise. Most problems can be handled more efficiently and much more effectively in the workplace itself through mediation, arbitration, or most often, by honest conversation. If there is a problem try the following ideas before you involve another party:

Talk it over with the employer. Many times the problem is the result of an oversight, a misunderstanding or a lack of legal knowledge. Be sure that you are ready for this conversation:

Know your rights: Talk to the Bureau of Labor and Industries, read any number of publications, talk to your union, whatever you do know the basic law and how you fit into it before you talk to your employer.

Double check the facts: If its about pay be sure your math is correct, if its about comments made quote them or have someone else who heard them directly ready to support you.

Do not become overly emotional: Present your case and remember that you may have to work in this environment after this situation has passed,

Do not tolerate abuse: But if your job is on the line remember it is easier to find another one while you are still employed,

Be discreet: Have your discussions in private and not in public.

Document your problem: Employers have learned that you must document any situation that may become disciplinary in nature or anything that is out of the ordinary in the workplace. It's for their own protection. You need to do the same. Documentation strengthens your claim if you believe there is a problem. There are several kind of documentation you should collect:

Company policy: Any kind of policy including job descriptions, work rules, personnel pamphlets, etc. that indicate what the policy is on a action that the employer takes,

Written statements by management about the situation you are talking about.

Verbal comments from management that you have heard especially when it is directly related to the situation that you are dealing with.

Legal action should be considered only as a last resort but should always be considered if the actions are serious and you have no other recourse. Talk to several lawyers, and be able to answer the question— What do you want to happen ?

Rights and Responsibilities Regarding Pay Issues

This is a large area of concern for employees and employers. Again, there a number of State and Federal laws that cover the area and are applicable in many different ways dependent on the situation. If you have a question get some information first before demanding a solution for something that you may be wrong about to start with. Enclosed as a resource are a number of questions and answers that the Bureau of Labor and Industries have dealt with over time. They may provide a guide for your discussion. Remember that if you have a specific question, you should get specific advise from BOLI, or other professionals who understand the law. This is not a place for you to be making up an answer if you are not 100% sure of the law.

Sexual harassment

Sexual harassment is prohibited by a number of State, and Federal laws. It is defined as:

- Unwelcome sexual advances, request for sexual favors, and other verbal or physical conduct of a sexual nature when such conduct is directed toward an individual because of that individual's gender and:
- Submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment; or
- Submission to or rejection of such conduct by an individual is used as the basis for employment decisions affecting such individuals; or
- Such conduct has the purpose or effect of unreasonably interfering with an individuals work performance or creating an intimidating, hostile, or offensive working environment.

There are two types of sexual harassment:

Quid pro quo. This occurs when the employer demands sexual favors in exchange for employment benefits, advancement, hire, or continued employment. Under state and federal law employers are liable for this type of harassment by their supervisors.

Hostile work environment. This is when unwelcome conduct of a sexual nature which has the purpose or effect of unreasonably interfering with an individual's work performance or which creates an intimidating, offensive or hostile work environment. Such conduct may be and includes comments which are verbal or physical, embarrassing, suggestive, or degrading to an individual on the basis of his or her sex.

Taking steps to end sexual harassment

Confront the harasser: This is often the best strategy and usually the simplest. While this is not appropriate in every case, particularly when you suffer injuries or are in some physical danger, it works in up to 90% of the cases. Consider confronting if the harassment is at a fairly low level such as off-color jokes, sexist cartoons, repeated requests for dates, etc..

Tell the harasser what you don't want at the time that the harassment occurs or as soon as possible. Keep the conversation brief, don't use humor, be direct, and offer no excuses for the behavior. Put it in writing and give it to the harasser if your first attempt does not work. Attach the company policy if there is one.

Use a company complaint procedure: Employers have a responsibility to stop harassment in the workplace. Use whatever policy the company has to raise complaints and follow it to the end.

File a compliant with a government agency: If the harassment does not end after face-to-face meetings or after using a company complaint procedure consider filing a compliant with the US Equal Employment Opportunities Commission or the Civil Rights Division of the Bureau of Labor and Industries.

Seek out legal help and file a lawsuit. This is a resort that is always available to you regardless of what other steps you have tried to end the harassment.

How to Hire, Interview, and Terminate Legally

NOTE: THE FOLLOWING INFORMATION IS PROVIDED AS A GENERAL GUIDE ONLY. IF YOU HAVE SPECIFIC QUESTIONS PLEASE OBTAIN PROFESSIONAL ASSISTANCE FROM A LAWYER, OR AGENCY SUCH AS THE BUREAU OF LABOR AND INDUSTRIES. DO NOT BASE ANY EMPLOYMENT DECISION SOLELY ON WHAT YOU READ IN THIS SECTION.

Employment at will

The general rule regarding the employer-employee relationship allows the termination of the relationship by either party, at any time, without notice and without cause. There are exceptions to this general rule. In general you cannot hire or terminate people based on the protected class status of an individual. These are the classes mentioned in the section on employment discrimination including, race, sex, age, religion, etc. The basic rule is to hire and terminate based on a person's ability to do the job and keep uncontrollable factors such as their age out of the decision. There is a guide attached to this section called " Keeping it Legal—Hiring and Firing" produced by the Technical Assistance section of the Bureau of Labor and Industries which provides some excellent guidance in the hiring process.

Job analysis and position descriptions

Provide the reason for hiring. You must know what the new person is going to do, and how you expect them to do it. Regardless of whether you are the employer or

employee this must be clear in your head and you must communicate that to each potential employee.

A good resource for a job analysis format is the Timber Operators Council, Inc. in Tigard, OR. They produce a form that you can fill in to help you understand what kind of job you are offering. They also offer a fill in the blanks form for a doctor to sign off on if the position involves a medical clearance before starting.

Interviews

Interviews are often used by employers to find the right person for the job. They can be conducted by an individual or a group of co-workers, managers, or some combination of the two. They provide an excellent source of information, but there are some cautions that you need to be aware of.

Understand your goal

This should be to determine job related qualifications. To avoid discrimination problems, employers should limit questions in the application or interview to job-related subjects only. While you can ask anything you want, it is how you use the information that will be critical and if you ask questions not related to the job you may open yourself up to questions about the intent of the question. The following are a sampling of questions that could lead to problems for you:

a. Have you ever been on welfare?

b. How would you spouse feel about it if you worked nights?

c. Have you ever filed for worker's compensation?

d. What is your marital status?

This list is almost endless. Limit your interview questions to work related subjects and you will stay out of trouble. There is help for you here. There are numerous books published on how to hire people. Every community college offers courses on employment issues and the Small Business Development Centers have information available. The Bureau of Labor and Industries offers a Technical Assistance program for employers. Several employer associations such as the Timber Operators Council offer technical assistance. If in doubt find help. It is usually free and readily available.

Termination

This is usually a traumatic situation. You feel uncomfortable, the employee does too and may be really angry about the situation. Whether the termination is caused by a lack of work, or by an employee who violates a company policy the situation is never easy.

Employers may wish to list some types of offenses which will result in immediate discharge. It is best to choose language which does not prohibit the employer from terminating an employee for a reason that might not be included on the list. For example:

"Although there is no way to identify every possible violation of standards of conduct, the following is a partial list of violations which can result in immediate dis-

missal."

1. Swinging your chain saw at my head,
2. Coming to work intoxicated,
3. etc.....

The attached booklet on ".....hiring and firing" should give you more information on the termination process and how to best accomplish it when necessary.

Final thoughts

Employers and employees have rights in the workplace. Many of these rights are written in a number of employment related laws. Some are in negotiated contracts. Many are common sense, although in a dispute common sense may not win out. Try to remember that being an employer does not make you a dictator with unlimited and unchecked power, and being an employee does not make you a serf with no control over your destiny. You have rights and you have responsibilities to your fellow workers and employer. When in doubt about what those rights include, ask the question to one of the many professional organizations and state agencies that can answer what the facts are or the law is in some situation.

SEMINARS FOR EMPLOYERS

WHAT EVERY EMPLOYER SHOULD KNOW

Civil Rights Law

BUREAU OF LABOR AND INDUSTRIES
Jack Roberts, Commissioner

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

WHAT EVERY EMPLOYER SHOULD KNOW
CIVIL RIGHTS LAW

AGENDA

I. Coverage

II. State and Federal Protected Classes

III. Theories of Law

IV. Burdens of Proof

V. Race and color/National Origin

VI. Age

VII. Religion

VIII. Marital Status

IX. Family Relationship

X. Sex/Sexual Harassment

XI. Injured Worker

XII. Disability Laws

XIII. Leaves of Absence

XIV. Additional Protected Classes

NOTES

I. COVERAGE

A. State law covers all employers operating within the state of Oregon with one or more employees. Six or more employees required in some instances. For cases in which the law has an economic impact on the employer, such as employee leave laws, employers of 25 or more or 50 or more employees are covered.

B. **Federal Civil Rights Law**

1. *Title VII of the Civil Rights Act of 1964 covers employers with 15 or more employees;*
2. *The federal Age Discrimination in Employment Act covers employers with 20 or more employees;*
3. *The Equal Pay Act of 1963 covers employers with 15 or more employees;*
4. *Americans with Disabilities Act covers employers with 25 or more employees effective July 26, 1992 and 15 or more employees effective July 26, 1994;*
5. *The federal Civil Rights Act of 1991 applies to employers covered by Title VII;*
6. *The federal Family Medical Leave Act covers employers with 50 or more employees.*

II. PROTECTED CLASSES UNDER STATE AND FEDERAL LAW

A. **Federal Law**

1. *Title VII of the Civil Rights Act of 1964;*
   - *Race and color*
   - *National Origin*
   - *Sex*
   - *Religion*
   - *Retaliation*
   - *Association with a protected class*
   - *Age 40 or older (20 employees) ADEA*
2. *Americans with Disabilities Act.*

B. **State Law**

- Includes federal protected classes - remember that federal and state law are concurrent
- Age - state law covers 18 or older [ORS 659.030]
- Marital Status [ORS 659.030]
- Physical/Mental Disability [ORS 659.425]
- Injured Workers [ORS 659.410, 659.415, 659.420]
- Opposition to Health/Safety Conditions [ORS 654.062 (5)]
- Expunged Juvenile Record [ORS 659.030]
- Family Relationship [ORS 659.340]
- Polygraph/Breathalyzer [ORS 659.227]
- Genetic Screening/Brain Wave Test [ORS 659.227]

- Smoking [ORS 659.380]
- Medical Release/Continued Employment [ORS 659.330]
- Oregon Family Leave Act (S.B. 464)
- Bone Marrow Donor [ORS 659.358]
- Whistleblower [ORS 659.505 to 659.545]

III. THEORIES OF LAW

A. **Specific intent** discrimination is knowing and purposeful. It is both intentional and specifically motivated by membership in a protected class.

Example: Employer refuses to hire an older applicant for a job because the employer believes that a younger person will have more years of service to offer the company.

B. **Different treatment:** is when the employer treats members of a protected class differently than others who are not members of the protected class. When the employer makes this differentiation because of the individual's protected class and not because of legitimate non-discriminatory factors, unlawful discrimination exists.

Example: Employer disciplines minority employee more harshly than white employee who has violated the same work rule.

C. **Under the theory of adverse impact,** the intent to discriminate need not be present. This theory concerns policies which appear neutral and are applied equally but which have the effect of adversely impacting certain groups because of their protected class.

Example: Employer requires that anyone hired for a particular job must have a high school diploma.

IV. BURDEN OF PROOF AND OF PRODUCING EVIDENCE

A. **The burden of proof** is always on the complainant to prove, by a preponderance of evidence, that the employer did discriminate in an unlawful manner.

B. **To establish** a prima facie case a complainant must show a causal relationship between the harm and the protected class. A prima facie case gives rise to an inference of discrimination which must be rebutted by contrary evidence.

C. Once the **"prima facie"** case is established, the employer has the burden of producing evidence to rebut it by articulating a legitimate, nondiscriminatory reason for the action. The complainant then must show that the reason given is only pretextual.

D. **Exceptions/Defenses:** In all exceptions listed below the employer will have the burden of proof:

1. *Bona fide occupational qualification or requirement (BFOQ or BFOR). Both state and federal law provide an exception to the*

prohibition against discrimination in employment when the action was taken on the basis of a BFOQ/BFOR. To prove a BFOQ/BFOR the employer must show that:

a. The BFOQ/BFOR is reasonably necessary to the normal operation of the business;

b. There is factual basis for believing that all, or substantially all individuals of a protected class would be unable to perform the job safely and efficiently; or

c. It would be impossible or highly impractical to screen applicants on an individual basis.

The BFOQ/BFOR defense cannot be justified by mere convenience, custom or preferences of customers.

2. *Affirmative Action Plans - Consideration of protected class status as a factor in employment is allowable under a bona fide affirmative action plan in which the purpose of the plan is to correct a manifest imbalance caused by prior discriminatory practices or an historical exclusion of a class. When discrimination is based on a bona fide voluntary affirmative action plan, it is not unlawful if the plan:*

a. Is a temporary measure;

b. Has the purpose of eliminating the effects of past discrimination;

c. Does not unnecessarily trammel the interests of other protected classes.

V. RACE AND COLOR/NATIONAL ORIGIN (ORS 659.030)

A. **Both state and federal law** prohibit basing an employment decision on race/color and national origin.

1. *Race and color defined: A group of people possessing traits transmissible by descent sufficient to characterize it as a distinct racial, ethnic or cultural group.*

2. *National Origin defined: An individual comes from a particular country, possesses a particular ancestry, heritage or background or his/her name or spouse's name reflects a certain national origin.*

B. **Association:** An employer may not discriminate against an individual because that person associates with members of a particular race or national origin. Similarly, an employer may not discriminate on the basis of an individual's association with a group or organization that is closely identified with a particular race or national group.

C. **Harassment:** The law requires an employer to provide an atmosphere free of workplace harassment based on race, color and national origin.

The employer also has the responsibility to take immediate, appropriate and corrective action as soon as it is determined that an act of racial or national origin harassment has occurred.

D. **English Speaking Requirement**

1. *The degree of fluency in English which an employer may require depends on what is necessary to perform the job duties. An employer should not evaluate fluency on the basis of like or dislike for a particular accent.*

2. *English Requirement: When necessary for efficiency or safety, an employer may require that all employees speak English on the job. However, employees cannot be prohibited from speaking another language during break time or during work time when safety or efficiency are not adversely affected.*

VI. AGE (ORS 659.030)

A. **State Law:** This law prohibits making employment decisions based on the ages of persons 18 years or older.

Example: Employer refuses to hire a qualified younger applicant for a position because the employer wants someone who will "fit in with the crowd," all of whom are over 40.

B. **Federal Law:** The Age Discrimination in Employment Act covers persons 40 years of age or older.

Example: A banking establishment will not consider applicants over forty years of age for teller positions.

C. **Exceptions** to the law are granted for:

1. *Seniority Systems and Benefit Plans:*
State and federal law permit an employer, employment agency, or union to observe the terms of seniority systems and benefit plans such as insurance, pension, and retirement plans as long as such plans are not a subterfuge to avoid complying with the law. Employers may not use the existence of such plans as a reason for not hiring an individual because of age.

2. *BFOQ*
Employer must show that a BFOQ based on age is reasonably necessary to the business operation and that individuals in the excluded age group lack the ability necessary to perform the job.

VII. RELIGION (ORS 659.030)

A. **This law prohibits discrimination based on religion unless such discrimination results from a <u>bona fide occupational requirement</u>** reasonably necessary to the normal operation of the employer's business.

Example: A Seventh Day Adventist Church could require that all full-time teaching positions in its church school be filled only by Seventh Day Adventists.

B. **The definition of religion is very broad.** For the purposes of civil rights law, religion is defined as a "sincerely held religious belief based on man's nature and his relation to the universe." A traditional church or deity is not required. Brown v. Dade Christian School 356 F. 2d 310, 324 (5th Cor 1977)

C. **Reasonable Accommodation**
Once an employee or applicant has articulated an employment related conflict with a sincerely held religious belief, the employer must try to make reasonable accommodation to the individual's religious needs. If an accommodation results in undue hardship to the business, the employer is not required to make the accommodation.

VIII. MARITAL STATUS (ORS 659.030)

No employer in Oregon may discriminate against an employee or prospective employee because of that individual's marital status.

Example: An employer refuses to employ an individual who is filing for divorce.

IX. FAMILY RELATIONSHIP (ORS 659.340)

A. **Oregon law prohibits** an employer from discriminating against an individual "solely because another member of that individual's family works or has worked for that employer."

Example: Employer has a long-standing policy of not hiring family members.

B. **Exception:** An employer is not required to hire or employ a family member if it would:

1. *Cause an employer to violate state or federal law;*
2. *Cause an employer to violate the conditions of eligibility for financial assistance from federal or state government;*
3. *Cause an employer to disregard a BFOQ/R;*
4. *Place a family member in a position of exercising supervisory, appointment or grievance adjustment authority over another family member.*

Example: The employer would not have to consider either the husband or wife for a promotion which would require one to supervise the other.

X. SEX/SEXUAL HARASSMENT (ORS 659.030)

State law and Title VII prohibit discrimination in employment based on sex in hiring, compensation, terms or conditions of employment, and termination.

Example: An employer refuses to hire females for sales positions because the employer believes that women are less capable of aggressive salesmanship.

A. **Equal Pay**

1. *Both state and federal laws prohibit discrimination in pay on the basis of sex where the jobs performed:*
   a. Are of equal skill, effort and responsibility; and are
   b. Performed under similar working conditions.

Note: Equal means "substantially similar."

Example: An employer pays male orderlies a higher wage than female nurses' aides. There is no evidence the orderlies perform any extra duties and both jobs require equal skill, effort and responsibility.

B. **Disability based on pregnancy** should be treated by an employer the same as any other temporary physical disability. The policies and procedures which relate to employees who have broken a leg, had minor surgery, etc. will also apply to a pregnant employee, including fringe benefits, such as medical insurance coverage. The pregnant employee may also have additional protection under the pregnancy leave law.

C. **Sexual Harassment:**

Definition: Any unwelcome sexual advances, request for sexual favors; and/or other verbal, physical, or visual conduct of a sexual nature; [29 CFR 1604.11 (a)] constitutes sexual harassment when:

1. *Submission to such conduct is made an explicit or implicit term or condition of employment;*
2. *Submission to or rejection of such sexual conduct becomes a basis for an employment decision affecting the person; or*
3. *Such sexual conduct has the effect or purpose of unreasonably interfering with the person's work performance or creates an intimidating, hostile or offensive work environment.*

XI. INJURED WORKER (ORS 659.410, 659.415, 659.420)

A. **Covered Employers:** Those who employ six or more persons on a full-time, part-time or seasonal basis at the time of injury, or at the time the worker makes demand for reinstatement/re-employment, or at the time of the alleged violation of ORS 659.410.

B. The three statutes which protect injured worker rights are:

1. *ORS 659.410 - Prohibits retaliation against a worker who makes application for, gives testimony in connection with, invokes or uses the workers' compensation system.*

Example: A worker reports a job related injury to the employer and is subsequently terminated.

2. *ORS 659.415 - Applies only to employers with 21 or more employees and protects workers who are fully released and able to perform their former jobs. Workers must be reinstated to their former jobs, if they exist. If the job has been eliminated due to business necessity, the worker must still be reinstated to a job which is available and suitable.*

3. *ORS 659.420 - This statute protects workers who are "partially released" but physically able to perform certain work. Worker must be reinstated to the first suitable job that becomes available (vacant).*

NOTE: As as result of changes made during the 1995 legislative session returning injured workers who are only able to do partial duties may now lose their reinstatement rights for the same reasons as those released for full duty.

XII. DISABILITY LAWS

A. State Law: Employers who have six or more employees may not discriminate against a person who has a mental or physical disability when that particular disability does not prevent the performance of the job occupied or sought.

Under Oregon law, a disabled person is defined as a person who has a mental or physical impairment which substantially limits one or more major life activities or has a record of such an impairment or is regarded as having such an impairment.

1. *Ability to Perform: To assert a violation of ORS 659.425, the disabled person must be able to perform the duties of the position occupied or sought or is able to do so with reasonable accommodation. Able to perform means the individual has the necessary training, experience and skill normally required by the employer for that job and the worker is able to perform the job safely and efficiently and without present risk of probable incapacitation to himself/herself or enhanced risk to others.*

2. *Reasonable Accommodation: The law further requires that an employer reasonably accommodate an individual's disability unless it creates hardship on the employer.*

Example: Employer provides a mobility impaired employee with a reserved parking space close to the work site.

B. **Federal Law:** The Americans with Disabilities Act prohibits discrimination against any qualified individual with a disability in regard to any term, condition or privilege of employment. This law became effective July 26, 1992 for those employers with 25 or more employees. Coverage for employers with 15 or more employees will be effective July 26, 1994.

Under the ADA, a disabled person is defined as a person who has a physical or mental impairment which substantially limits one or more major life activities or has a record of such an impairment or is regarded as having such an impairment.

1. *Qualified Individual with a Disability: A disabled individual is qualified for a job if he/she:*
    a. Has the requisite skill, experience and education required for the job and;
    b. Can perform the essential functions of the job with or without reasonable accommodation.
2. *Direct Threat: The employer may require, as a qualification standard that an individual not pose a direct threat to the health and safety of himself/herself or others.*
3. *Reasonable Accommodation: An employer is required to provide a reasonable accommodation to a qualified applicant or employee with a disability unless it creates undue hardship on the employer.*
4. *Medical Examinations and Inquiries: Employers may not ask job applicants about the existence, nature or severity of a disability, but they may ask if they can perform the essential functions of the job. After an offer of employment has been made, an employer may require a medical examination. All entering employees in the same job category must be subject to the examination. Tests for illegal drugs are not medical exams under the ADA.*

XIII. LEAVES OF ABSENCE

A. **Oregon Family Leave Act**

The Oregon Family Leave Act passed by the 1995 legislature requires employers with 25 or more employees to provide eligible employees with up to 12 weeks of leave during any 12-month period for:

1. *Birth of a child*
2. *Adoption or foster placement of a child up to 18 years of age, or older than 18 years if the child is incapable of self care*
3. *The care of a spouse, child, parent or parent-in-law with a serious health condition*
4. *Employee's own serious health condition*
5. *The care of a child with an illness or injury other than a serious condition*

* An employee may use any accrued paid vacation time during family leave.

* Employees taking leave for the birth, adoption or foster placement of a child may use paid sick leave in addition to vacation leave.

* Employees must be reinstated to positions they held prior to the leave. If the position has been eliminated as a result of a legitimate business necessity, an employee may be reinstated to any available, equivalent job.

* When employees return to work, they must be reinstated with the same benefits they would have enjoyed had they not taken the leave.

NOTE: The commissioner has issued administrative rules interpreting the Oregon Family Leave Act. These rules were effective on September 9, 1995.

B. **Federal Law:** The Federal Family Medical Leave Act became effective August 5, 1993 for employers with 50 or more employees. Coverage for unionized employers became effective February 5, 1994.

The Act provides eligible employees a leave of absence of up to 12 weeks in any 12 month period for:

a. Birth of a child, or placement of adopted or foster child under the age of 18 years; or

b. The care of a spouse, parent or child of the employee with a serious health condition; or

c. Employee's own serious health condition.

The employee is entitled to continued health insurance coverage while on leave and must be reinstated to the former or an equivalent position.

XIV. ADDITIONAL PROTECTED CLASSES

A. **Opposition to Safety and Health Conditions**
No person may discharge from employment or otherwise discriminate against an employee or a prospective employee because he/she has opposed unsafe or unhealthy working conditions or has made a complaint or assisted in a proceeding under state law. (ORS 654.062)

B. **Expunged Juvenile Record**
State law authorizes the expungement of a person's juvenile record after a hearing by the juvenile court. Records expunged in this manner may not be used to disqualify an individual from an employment opportunity. Once a record has been expunged, the individual's record shall be treated as if it never existed. (ORS 659.030)

C. **Polygraph/Psychological Stress Test/Breathalyzer**
It is an unlawful employment practice for an employer to subject an employee or prospective employee to a breathalyzer test, a polygraph test or a psychological stress test except under the following circumstances:

1. *A polygraph may be administered if the individual consents and it is administered during the course of a criminal or civil judicial proceeding in which the individual is a party or witness;*
2. *A breathalyzer test may be administered if the employee consents or the employer has reasonable grounds to believe that the employee is intoxicated;*
3. *A blood alcohol test may be administered by a third party if the employer has reasonable grounds to believe the employee is intoxicated. (ORS 659.227)*

D. **Genetic Screen/Smoking**

1. *It is unlawful for an employer to subject any employee or prospective employee to genetic screening or a brain wave test. Employers can conduct such testing with the employee's informed consent as long as the test assists in determining a BFOQ. (ORS 659.227)*
2. *It is unlawful for an employer to require as a condition of employment that any employee or prospective employee refrain from using lawful tobacco products during non-working hours except when the restriction relates to a BFOQ or when an applicable collective bargaining agreement prohibits off-duty use of tobacco products. (ORS 659.380)*

E. **Whistleblower Law**
It is an unlawful employment practice for an employer to discharge, demote, suspend or in any manner discriminate or retaliate against an employee who has disclosed information concerning wrongdoing in public agencies. (ORS 659.505 to 659.545)

F. **Bone Marrow Donor**
It is an unlawful employment practice for an employer to deny a leave of absence to an employee who donates bone marrow, or to deny the use of accrued paid leave during such leave of absence. (ORS 659.010, ORS 659.358)

ON-SITE CONSULTATION

Technical Assistance will also train your managers and employees at your place of business. We tailor our presentations to fit the particular needs of your company. We cover a wide range of topics including:

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Civil Rights: *Overview of Equal Employment (EEO); protected classes; reasonable accommodation; family leave; polygraphs; sexual harassment; family relationship; marital status; retaliation; and federal family medical leave.*

Documentation, Discipline & Discharge: *Rule setting; progressive discipline; documentation; layoff; attendance; rewards; and termination.*

Policy Writing: *Oral agreements; changing policies; issues with disabilities; vacation; sick leave; work rules; leaves and dress codes.*

Harassment in the Workplace: *Sex; age; religion; EEOC guidelines; Title VII; state law; court cases and liability.*

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Portland, OR 97232

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RRCR:Revised 10/95

SEMINARS FOR EMPLOYERS

KEEPING IT LEGAL
Hiring and Firing

BUREAU OF LABOR AND INDUSTRIES
Jack Roberts, Commissioner

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

KEEPING IT LEGAL - HIRING AND FIRING

AGENDA

I. Employment at Will

II. Exceptions to Employment at Will

III. Job Analysis and Position Descriptions

IV. Recruiting and Recruitment Methods

V. Hiring Questions

VI. Other Issues with Interviews

VII. References

VIII. Testing

IX. Disciplinary Policies

X. Communicating your Policies

XI. Coaching and Discipline

XII. Incorporating Work Standards into the Policy

XIII. Progressive Discipline

XIV. The Exit Interview

XV. Guidelines for References

NOTES

PART ONE: A GUIDE TO HIRING PRACTICES

I. EMPLOYMENT AT WILL

The general rule regarding the employer-employee relationship allows the termination of the relationship by either party, at any time, without notice and without cause.

Most employers choose to reserve the right to employ at will with specific language in personnel policies.

Example: "We reserve the right to employ at will. This means that employment can be terminated, with or without cause, and with or without notice at any time, at the option of the company or at the option of the employee."

II. EXCEPTIONS TO EMPLOYMENT AT WILL

A. Civil Rights Laws

Fair employment laws prohibit employers from basing hiring decisions on the protected class status of applicants. The most important are:

1. ***Federal Laws***

Title VII of the Civil Rights Act of 1964 as amended
Coverage: 15 or more employees

- Race/color
- National origin
- Sex (includes pregnancy-related conditions)
- Religion
- Retaliation on the basis of a person opposing a described unlawful employment practice, filing a complaint, or testifying about a possible violation of law Association with a protected class
- Disability
  Age (40 and older)

2. ***State Laws (ORS Chapter 659)***

Coverage: One or more Oregon employees (except where noted)

- All federal protected Classes listed above - federal and state laws are concurrent (ORS 659.030)
- Age - State law covers 18 or older (ORS 659.030)
- Marital status (ORS 659.030)
- Physical/mental disability (ORS 659.425) (six or more employees)
- Injured workers (ORS 659.410 to 659.420) (six or more employees)
- Opposition to health/safety conditions (ORS 654.062(5)(a))
- Expunged juvenile record (ORS 659.030)
- Family relationship (ORS 659.340)
- Polygraph, breathalyzer, genetic screening, and brain-wave tests (ORS 659.227)
- Consumption of lawful tobacco products during non-work hours (ORS 659.380)

- Payment for required medical exams (ORS 659.330)
- Parental leave (ORS 659.360 to 659.370) (25 or more employees)
- Pregnancy leave (ORS 659.389 to 659.393) (25 or more employees)
- Family medical leave (ORS 659.560 to 659.570) (50 or more employees)
- Bone marrow donor leave (ORS 659.358)
- Whistleblower statutes:
  Employees of public agencies (ORS 659.510)
  Employees in private sector (ORS 659.550)

3. ***City Ordinances in Portland, Eugene, Ashland and Corvallis (23.01.050)***

   a. Sexual orientation;

   b. Source of income.

   c. Familial status

4. ***Child Labor Laws***

   (Fair Labor Standards Act) (ORS 653.305, 653.545);

   a. Age limitations;

   b. Hours limitations;

   c. Work permits/employment certificates

   d. Hazardous work.

5. ***Exceptions to Discrimination Law***

   a. Bona Fide Occupational Qualification (BFOQ)/Federal.

   b. Affirmative Action Plans (OAR 839-05-025(2).

6. ***Employment Contracts***

   a. Written or verbal contracts;

   b. Implied contracts.

7. ***Employment-Related Torts***

III. JOB ANALYSIS AND POSITION DESCRIPTIONS

A. Step One: Conduct the Job Analysis

1. _____
2. _____
3. _____
4. _____

B. **Step Two: Identify Essential Functions of the job**

1. *Definition: Fundamental and not marginal job duties.*
2. *Determination of essential functions:*
   a. Employer's judgment;
   b. Written job descriptions which were developed before recruiting and interviewing;
   c. Amount of time spent performing the function;
   d. Consequences of not performing the function;
   e. Terms of collective bargaining agreement (CBA)
   f. Work experience of present and past employees;
   g. Nature of work and employer's organization.

C. **Step Three: Prepare Written Job Descriptions**

Describe task in terms of results to be achieved rather than the method in which they are accomplished.

IV. RECRUITING AND RECRUITMENT METHODS

A. **No specific recruitment methods are required** by civil rights laws. However, all methods used may be subject to legal scrutiny.

B. **The Recruitment Goal**

1. *Attract a broad cross-section of the relevant labor market;*
2. *Mesh with non-discriminatory hiring practices;*
3. *Result in a workforce which is representative of the general population.*

C. **Commonly Used Recruitment Methods**

1. *Word of mouth/walk-ins/perference for relatives of employees.*
2. *Nepotism (Preferring relatives of employer or relatives of managers and supervisors).*
3. *Referrals.*
4. *In-house promotions/direct appointment.*
5. *Advertising.*

D. **Ways to Increase the Scope of Recruitment**

1. *Newspapers of general circulation;*
2. *State Employment Division job service;*
3. *BOLI Apprenticeship & Training programs;*

4. *Agencies or organizations that represent women and minorities:*
5. *Posting in minority neighborhoods:*
6. *Community service radio and TV announcements;*
7. *Publications directed to women and minorities:*
8. *Trade journals;*
9. *Minority schools:*
10. *Others.*

V. HIRING QUESTIONS

A. Applications

B. Interviews

C. Questions: What can I ask?

To avoid discrimination problems, employers should limit questions in the application or interview stage to job-related subjects. Evaluate the following questions.

1. *Describe all experience relevant to the position for which you are applying.*
2. *Date of birth.*
3. *Where does your husband work?*
4. *Is there any reason that you would be unable to be on the job consistently from 8:00 am to 5:00 pm, Monday through Friday?*
5. *How would your most recent (current) supervisor describe your work?*
6. *Have you ever been on welfare?*
7. *Are you able to travel?*
8. *Are you able to work nights?*
9. *How would your spouse feel about it if you worked nights?*
10. *If you were just starting your current job, what would you do differently?*
11. *Describe your current (most recent) supervisor's management style.*
12. *If you have children. what child care arrangements have you made?*
13. *Do you own your own home?*
14. *Whom should we notify in case of emergency?*

15. *Describe actions of co-workers that you have found particularly annoying.*
16. *What action have you taken when co-workers annoy you?*
17. *Are you planning a family?*
18. *Have you ever used drugs or alcohol?*
19. *How has your previous work experience prepared you for greater responsibility?*
20. *To what clubs or organizations do you belong?*
21. *Have you ever been treated for a mental disorder?*
22. *What did you like most/least about your last job?*
23. *What was your best accomplishment on your most recent job?*
24. *Can you work weekends?*
25. *What are your career goals?*
26. *How does this job fit within your career goals?*
27. *What did you like best about your last job?*
28. *Why did you leave your last job?*
29. *Have you ever filed a workers' compensation claim?*
30. *Are you a citizen of the United States?*
31. *Have you ever been arrested for a sexual or violent crime?*
32. *What is your height and weight?*
33. *Have you ever been refused credit?*
34. *Are you a college graduate?*
35. *Why did you leave your last job?*
36. *What skills do you possess, other than job experience, which will help you perform this job?*
37. *Have you ever been hospitalized within the last five years?*
38. *Are you subject to a court order requiring child support?*
39. *How many days were you absent from work because of illness last year?*
40. *Do you have any physical limitations which may affect your performance in this position?*
41. *Do you live alone?*

D. **Other Issues with Applications**

1. *Content of applications*
    a. Minimum educational requirements.

b. Certification or licensing requirements.

c. Optional self-screening language.

2. *Screening applications*

a. Use standard non-discriminatory criteria.

b. Screen out incomplete applications:

c. Screen out applications which are messy, illegible or which contain misspellings.

E. **Unsolicited Applications**

1. *Unsolicited applications increase the potential for unlawful discrimination.*

2. *Reject all unsolicited applications and resumes.*

VI. OTHER ISSUES WITH INTERVIEWS

A. **Conducting the Interview**

1. *Interview panels;*

2. *Ask same set of job-related questions;*

3. *Use hypothetical situations and ask candidate to develop solutions;*

4. *Encourage the applicant to do most of the talking, using open-ended questions;*

5. *Deviations;*

6. *Outside agencies;*

7. *Accessibility.*

VII. REFERENCES

A. **Tips for checking references**

1. *Use a release and waiver;*

2. *Ask for only job related information;*

3. *Document;*

4. *To avoid negligent claims exercise reasonable care.*

VIII. TESTING

While testing is an appropriate screening device, employers should ensure that their testing procedures do not run afoul of the discrimination laws.

A. **Testing and the ADA**

B. **Tests of Specific Skills**

C. **Physical Strength and Agility Tests**

D. **Medical Screens and Examinations**

PART TWO: SETTING POLICIES AND WORK RULES

IX. DISCIPLINARY POLICIES

A. **Without a policy**

1. *Inconsistency in the treatment of employees which can result in the perception of discrimination.*
2. *Practice may become binding policy.*
3. *Confusion and misunderstanding in the workplace may cause poor morale.*
4. *Verbal statements by managers and/or supervisors may be inconsistent with the employer's intentions.*

X. COMMUNICATING YOUR POLICIES

1. *Provide employees with updated policy manuals.*
2. *Have a training session.*
3. *Open-door policy.*

XI. COACHING AND DISCIPLINE

A good supervisor takes the time to develop a coaching relationship with employees. Not only can this help motivate employees to achieve maximum performance, but it may also help to minimize discipline problems.

XII. INCORPORATING WORK STANDARDS INTO THE POLICY

Examples:

A. Tardiness and Attendance Rules.

B. Dress Codes.

C. Smoking rules.

D. No moonlighting Rules.

XIII. PROGRESSIVE DISCIPLINE

Progressive discipline is a process in which the penalty becomes greater for each succeeding infraction of the same or similar rule.

If an employer chooses to use progressive discipline, policies must be carefully written to allow for unexpected circumstances. For example, some actions by employees might warrant immediate dismissal, and employers should retain their right to bypass the steps of progression or to begin discipline at any step of the process.

Example - The progression of discipline for tardiness might be:

A. **Verbal warning (first minor infraction).**

1. *State. "This is a verbal warning."*
2. *State the violation.*
3. *State expected performance.*
4. *State a time line and consequences.*
5. *Document.*

B. **Written warning (one or more).**

1. *State, "This is the first written warning."*
2. *Refer to verbal warning.*
3. *State the violation.*
4. *State expected performance.*
5. *State time line and consequences.*
6. *Both employee and employer sign and date the document.*

PART THREE: TERMINATION

A. **Immediate Discharge**

Employers may wish to list some types of offenses which will result in immediate discharge. It is best to choose language which does not prohibit the employer from terminating an employee for a reason that might not be included on the list.

Example:

"Although there is no way to identify every possible violation of standards of conduct, the following is a partial list of violations which can result in immediate dismissal."

B. **Termination Checklist**

- ☐ Was employee warned?
- ☐ Did employer investigate?
- ☐ Did employer follow procedures?
- ☐ Was the investigation fair?
- ☐ Did the investigation produce proof of violation?
- ☐ Were the rules applied evenhandedly?
- ☐ Is termination really the appropriate action?
- ☐ Does the discipline unlawfully impact a protected class?

XIV. THE EXIT INTERVIEW

The exit interview is overlooked in many organizations because it is not felt to be important. However, this interview can be a valuable tool for upper management to use to identify and eliminate problems within the organization that would otherwise cause employee turnover and costly lawsuits.

A. **Preparation for the Exit Interview**

1. *Has the employee's personnel file been reviewed?*
2. *Was the employee discharged or did the employee resign?*
3. *If discharged, does the documentation in the file justify the discharge?*
4. *Check to see if all employees are discharged for this (or these) infraction(s)?*
5. *Have company policies and/or contract procedures been followed in the disciplining (coaching) and discharge of the employee?*
6. *Is there evidence that the employee was forewarned of the possible disciplinary action?*
7. *Was an investigation conducted prior to administering discipline and/or discharge?*
8. *Was the investigation fair and objective?*
9. *Were the facts supported with evidence?*
10. *What corrective action/progressive disciplinary steps were used?*
11. *Is there substantial and compelling proof the employee violated the applicable standards?*

XV. GUIDELINES FOR REFERENCES

A. *Route all requests* for references to one or two key personnel employees who understand the legal issues raised by references.

B. *Give no information by telephone* (a written request verifies the identity of person seeking information)

C. *Give only specific documented facts*, not subjective opinions.

D. *All information given must be job-related.*

E. *Develop a consistent response* to all reference requests.

F. *Get signed releases* before giving written responses.

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Portland, OR 97232

The fee is $15.00 for an individual book and $5 for the Leave Guide.

Hirefire: 6/95

APPENDIX

APPLICATION FOR EMPLOYMENT

Company Name) _____ is an equal opportunity employer. We do not d[redacted]nir
on the basis of age, race, religion, color, sex, national origin, marital status, physical or mental disability or arr[redacted]reco

All portions of this application must be completed. Incomplete applications will not be considered for employment.

Please print	Date
Name	
Address	Phone
	Alternate phone

THIS APPLICATION IS CONSIDERED CURRENT FOR ____ DAYS ONLY.

If hired, you will be required to submit identification in accordance with Immigration and Naturalization Serv requirements.

EDUCATION

SCHOOL	ADDRESS	# OF YEARS	DEGREE
HIGH			
COLLEGE			
OTHER			

LIST ANY SPECIFIC SKILLS YOU POSSESS WHICH YOU FEEL ARE RELEVANT TO THE POSITION FOR WHICH YOU ARE APPLYING (SEE ATTACHED JOB DESCRIPTION)

EMPLOYMENT RECORD (PLEASE LIST MOST RECENT POSITION FIRST)

DATES	NAME & ADDRESS OF EMPLOYER	JOB TITLE	SALARY	EXACT REASON FOR LEAVING
From:			From:	
To:	Telephone:	Supervisor:	To:	
From:			From:	
To:	Telephone:	Supervisor:	To:	
From:			From:	
To:	Telephone:	Supervisor:	To:	
From:			From:	
To:	Telephone:	Supervisor:	To:	
From:			From:	
To:	Telephone:	Supervisor:	To:	
From:			From:	
To:	Telephone:	Supervisor:	To:	

I understand that consideration for employment is contingent on the results of a reference and background check. I authorize (company name) _____ to investigate the truthfulness of all statements made on this application and to contact my former employers, other listed references, or any other persons who can verify information. I further authorize (company name) _____ to discuss the results of any investigation with all of their employees who are involved in the hiring process. I further authorize all contacted persons and former employers to provide information concerning this application, my background and suitability for employment and I release each such persons and former employers from liability for providing such information.

Signature _____

Date _____

I certify that the information contained in this application i correct to the best of my knowledge, and understand tha falsifications and/or omissions in any detail is grounds fo disqualification from consideration for employment or hired, for dismissal from employment. I further understan that if hired, my employment and compensation can b terminated, with or without cause, and with or witho notice, at any time, at the option of either myself or th company. I further understand that no recruiter or inte viewer or other representative of (compan name) _____, other tha _____, has any authority enter into any agreement for employment for any specifie period of time.

Signature _____

Date _____

app.pm

Release and Waiver

To: _____

I request and authorize you to disclose to _____ any documents or information that it may request. I have authorized _____ to inquire concerning my background in connection with an application for employment. I agree to hold you and your agents and employees harmless from all liability which could relate in any way to the disclosure of private information or an assessment or opinion of my suitability for employment which may be provided.

Dated this _____ day of _____, 199 .

Signed _____

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

TRAVEL TIME Q & A

1. **Q. Does an employer have to pay an employee for regular home-to work/work-to-home travel?**

   A. No, unless your policy or employment contract calls for it. The federal Portal-to-Portal Act of 1947 and Oregon law say that normal home-to-work/work-to-home travel does not have to be compensated.

2. **Q. Must an employer pay an employee for the time it takes to travel from one job site to another in the course of a day's work?**

   A. Yes, if the employee must travel to accomplish the day's work. Examples would be landscape maintenance employees or appliance repairpersons who travel from site to site.

3. **Q. If an employer allows an employee to take a company vehicle home, does the employer have to pay for travel time from home to the job site and vice versa?**

   A. No. As long as the employee performs no work duties until reaching the first work site this is considered normal home-to-work/work-to-home travel and the time is not compensable.

4. **Q. If an employer sends an employee on a temporary assignment to another city and the employee does not spend the night, must the employer pay travel time?**

   A. Yes. The employer would pay for the time spent in travel to the place of business outside the home community.

5. Q. **When must an employer pay travel time to a worker who travels away from home overnight?**

   A. All the time the employee spends traveling as a passenger during normal work hours must be compensated. In addition, the employee must be paid for any weekend travel that falls within his/her normal working hours.

   Example #1: If the employee's regular schedule is 8:00 a.m. to 5:00 p.m. Monday through Friday and the employee travels outside the hours of 8:00 a.m. to 5:00 p.m. as a passenger, no travel time hours need to be paid to that employee.

   Example #2: If the employee's regular schedule was to work 3:00 p.m. to 11:00 p.m., then travel within the hours of 3:00 p.m. to 11:00 p.m., seven days a week, would be paid as hours worked.

6. **Q. Must the driver be compensated for travel time?**

   A. In all cases when an employee is required to drive, the time is compensable.

7. **Q. What about employees who are offered transportation but elect to drive during trips which require overnight stay?**

   A. In this instance, the employer may pay either the actual drive time or pay only travel hours which occur during the employees normal work hours (see question 5).

8. **Q. If the employer pays per diem and/or mileage to employees, must the employer still pay travel time?**

   A. Yes.

9. **Q. Does the employer pay travel time if the employer arranges for a company vehicle to pick up employees and deliver them to the job site?**

   A. No. This would still be considered normal home-to-work/work-to-home travel. The driver of the company vehicle would be the only person actually performing work and travel time would be due to that employee.

10. **Q. Can the employer pay a different rate for travel time than for hours worked at the employee's regular rate?**

    A. Yes, as long as the employer does not pay below the minimum wage for all hours worked.

11. **Q. Do travel time hours have to be included when calculating overtime?**

    A. Yes.

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Portland OR 97232
(503) 731-4073

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THIS INFORMATION IS AVAILABLE IN AN ALTERNATIVE FORMAT

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

HOURS WORKED: PREPARATORY AND CONCLUDING ACTIVITIES; WAITING TIME AND ON-CALL TIME Q & A

There is much confusion in the area of what constitutes actual compensable hours of work. To aid you in understanding this concept the Technical Assistance Unit of the Bureau of Labor and Industries has prepared this series of informational handouts for your "educational" needs. Other handouts of this topic include:

"Answering Your Questions on Hours Worked/Lectures, Meetings and Training Programs"

"Answering Your Questions on Hours Worked /Travel Time"

The law has defined employed to be anytime an employee is "suffered or permitted to work." Work time is *all* time an employee is required to be on the employers premises, on duty, or at a prescribed work place and includes all time spent in performing a principle job activity or performing an activity which prepared an employee for performing that principle activity for the benefit of an employer.

There is no requirement on the part of the employee for mental or physical exertion nor is there a requirement for an employer to either authorize or be aware of such activity on the part of an employee in order to be liable for compensation.

This area of law is complex and you are probably wondering what the above definition means to you as an employer. For clarification the following list of most asked questions and their answers have been compiled for your convenience.

Preparatory and Concluding Activities:

1. **Q. If I require an employee to report anytime before their scheduled shift in order to facilitate a smooth transition, do I have to pay them for the time?**

   A. Yes. In this case the requirement to report to work on your premises would serve a clear business purpose as it would benefit you as an employer and would be necessary for the smooth operation of the business.

2. **Q. I ask my employees to be at their work station to be ready to perform their jobs at a prescribed time. In order to do this they must perform certain activities to enable them to be ready to begin work. Do I have to pay them for the time spent in preparation?**

   A. Yes, if the preparatory time is an integral part of their principle work activity. Some examples of preparatory activities are:
   1. A waitress setting up a work station, i.e., preparing coffee , filling condiment jars, etc.
   2. A machinist cleaning and oiling the machinery in a plant prior to beginning a shift.
   3. A bankteller counting a till before the business opens to the public.

   In other words, the job could not be accomplished without these preliminary activities.

3. **Q. I require my employees to wear uniforms on the job and some of them, for their own convenience, prefer to keep the uniforms at my place of business and change for work on the premises. Do I have to include this time when computing hours of work?**

A. No. There is no need to compensate for activities performed for the employee's convenience.

4. **Q. I have certain employees that arrive early and/or stay late due to transportation problems. They insist on working as they do not like to remain idle and claim they will volunteer the time. Am I liable for payment even though they are volunteering the time?**

   A. Yes. The law states that an employer must compensate an employee for *all* hours worked whether those hours are authorized or unauthorized.

   In order to avoid liability for payment it is management's duty to promulgate and enforce rules prohibiting unauthorized work. If a worker insists on not following your work rules, discipline would be in order. However, an employers must pay for those hours even if unauthorized.

5. **Q. Can an employee also act in a volunteer capacity for my organization?**

   A. In order for an employee to qualify as a volunteer,
   1. the work must be at the employee's initiative
   2. the work must be outside normal or regular work hours
   3. the employee must be performing a religious, charitable or other community service without contemplation of payment,
   4. and the employee must be performing a task outside of the regular job functions performed for the same employer.

   Only if the above four criteria are met could a volunteer status be applied.

6. **Q. I require my employees to attend monthly meetings to aid them in understanding company policy and new procedures. Do I have to pay them for these meetings?**

   A Yes. When the employer requires the employees' attendance that time must be counted as time worked, even though the employees may not be performing their usual duties.

MOST COMMONLY ASKED QUESTIONS CONCERNING WAITING TIME:

7. **Q. I'm in a business which requires me to ask a certain number of employees to report to work, but the number I require to actually perform work depends on the business that day. If I ask the employees to wait on the premises until I can be sure of the work availability do I have to pay them for the time?**

   A. Yes. The law requires that time spent in waiting to perform work for the benefit and at the request of the employer be paid.

8. **Q. If I send someone out on a job and they have to wait for a customer or equipment to arrive, do I have to pay them for the time spent waiting?**

   A. Yes. Unless you specifically relieve the employee from duty and the time period is sufficiently long enough for the employee to use the time for his or her own purposes. For example, a trucker waiting six hours to pick up a load has sufficient time, but a stenographer waiting 15 minutes for dictation does not. If a regular part of a person's duties concerns waiting, that time will *always* be considered work time.

MOST COMMONLY ASKED QUESTIONS CONCERNING ON-CALL TIME:

9. **Q. I employ people to be on-call during certain periods of the workweek. Do I have to compensate them for this time?**

   A. Yes if you require them to wait ON YOUR PREMISES to be called to duty.

EXAMPLE: Fireman waiting to respond to an emergency.

No, if you require an employee to CARRY A BEEPER or LEAVE A NUMBER where he/she be reached in case of emergency during specified hours. In this case, the employee is able to use the time effectively for his/her own purposes, even though there is a slight limitation. Payment must be made for all time the employee is called upon to perform work.

Please be advised that IF THE CALLS ARE SO FREQUENT OR THE CONDITIONS SO RESTRICTIVE than an employee cannot use the time effectively for his/her own benefit they may be considered as "engaged to wait," in which case the time spent waiting will be compensable.

If you wish to purchase a ***"Handbook of Oregon Wage & Hour Laws,"*** a ***"Handbook of Oregon Civil Rights Laws,"*** or a ***"Guide to Employee Leaves in Oregon,"*** these publications may be obtained by mailing a check or money order to:

Technical Assistance for Employers
Bureau of Labor and Industries
800 NE Oregon Street #32
Portland OR 97232
(503) 731-4073

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

LECTURES, MEETINGS AND TRAINING PROGRAMS Q & A

1. Q. **When an employee needs on-the-job training, can the employer establish a "training period" during which it would not be necessary to pay the minimum wage and overtime?**

   A. No. The law does not recognize unpaid on-the-job training time. Nor can the employer pay a subminimum wage for such work. "Training time" is considered a cost of doing business for an employer.

2. Q. **If employees are required to attend monthly staff meetings outside regular work hours, is it compensable time?**

   A. Yes. Whenever an employer requires an employee's attendance that time must be considered as hours worked, even though the employee may not be engaged in a productive work activity.

3. Q. **If an employee is required to attend a company-paid class or seminar to aid job performance, are all hours spent in class compensable?**

   A. Yes. Attendance is required, the hours spent in class must be paid.

4. Q. **When is training not compensable?**

   A. An employer does not have to pay for time spent in lectures, meetings or training programs if all of the following four criteria are met:

   (1) Attendance is on employee's own initiative (voluntary in nature);
   (2) Attendance takes place outside an employee's regular work hours;
   (3) The training provided is not directly related to an employee's current job;
   (4) An employee does not perform any productive work during the course of the training. (See 29 Code of Federal Regulations, Part 785) and OAR 839-20-044.

5. Q. **Is it possible to encourage training by offering financial assistance without incurring liability for payment of wages for hours spent in class?**

   A. Yes. Federal and state law recognize special situations in which the criteria listed in Question 4 above would not have to be met in full. One of those recognized situations is an employer established program of instruction which corresponds with a program offered by an accredited institution of higher learning, such as a community college. Voluntary attendance by the employee, outside of their working hours need not be compensated as hours worked.

6. Q. **If an apprentice is hired, is it necessary to pay for hours that the employee is required to spend in class under the apprenticeship agreement or program?**

   A. No. Time spent in classes of supplemental instruction required under a "bona fide apprenticeship agreement" is not considered compensable time if no productive work time is performed by the apprentice.

A bona fide program is one which is recognized by and meets the standards of the Bureau of Apprenticeship and Training of the U.S. Department of Labor in conjunction with the Apprenticeship and Training Division of the Bureau of Labor and Industries.

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Meetings:8/94

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

MINIMUM WAGE AND OVERTIME IN AGRICULTURE Q & A

Employers are not required to pay overtime to employees who are engaged in work which meets the definition of "Agriculture." In addition there are several exemptions from minimum wage. This information is provided to clarify minimum wage and overtime requirements in agricultural employment.

Definition of Agriculture: "Agriculture" includes farming in all its branches and among other things includes the cultivation and tillage of the soil, dairying, the production, cultivation, growing, and harvesting of any agricultural or horticultural commodities, the raising of livestock, bees, fur-bearing animals, or poultry and any practices performed by a farmer or on a farm as an incident to or in conjunction with such farming operations, including preparation for market, delivery to storage or to market or to carriers for transportation to market. "Agricultural employment" is employment in "agriculture" as so defined. OAR 839-20-004(3)

1. *OVERTIME*

Q. Is it ever necessary to pay overtime to farm workers?

A. Yes. Only workers engaged in agricultural employment for 100% of the work week are exempt from overtime. Workers are not engaged in agricultural employment in any weeks in which they work on products which are not grown by their own employer. Examples: Selling gift items in a retail shop operated by a nursery or packing fruit grown by a neighboring farmer. Farmworkers who perform these tasks must be paid overtime if they work more than 40 hours in the same workweek.

Q. Does the overtime exemption apply to the office staff or farmers?

A. As long as the responsibilities of the office staff are limited to duties integral to the farming operations of their employer, they are also exempt.

2. *MINIMUM WAGE*

Q. Are employees on small farms exempt from minimum wage?

A. Both federal and state laws provide minimum wage exemptions for "small" farms, however the criteria is different for each. Employers in small farming operations must take care to be sure that they are exempt under each law before deciding not to pay minimum wage.

Federal Criteria: If the employer did not employ more than 500 man-days of agricultural labor in any calendar quarter of the preceding calendar year, the minimum wage exemption applies for all agricultural employees for the entire following year. A man day is any day during which an employee performs agricultural labor for at least one hour.

State Criteria: If the employer did not employ more than 500 piece rate work days in any calendar quarter of the preceding calendar year, the employer's hand harvesters and pruners who are paid on a piece rate basis are exempt from minimum wage for the entire following year.

Q. Is it necessary to pay minimum wage to minors in agriculture:

A. Oregon law provides a minimum wage exemption for all hand harvesters aged 16 and younger as long as they are paid on the same piece rate basis as older workers. Federal law requires that the parent or person standing in place of the parent also be employed on the same farm.

Q. What is the "commuter" exemption?

A. Hand harvesters who commute daily from their permanent residence, regardless of age, are exempt if they are paid on a piece rate basis and if they have been employed in agricultural less than 13 weeks in the previous calendar year.

Q. Are there any limitations on the payment of "piece rates?"

A. For the purposes of the minimum wage exemptions the payment of piece rates must be "in an operation generally recognized as piecework in the region of production."

Q. Are there any exemptions for ranchers?

A. Yes. Workers who spend more than 50% of their time in the range production of livestock are exempt from minimum wage. To be exempt Oregon workers must be paid on a salary basis of not less than $825 per month.

FURTHER READING:

Agricultural Employment Under the Fair Labor Standards Act - WH Publication 1288
Contact U.S.D.O.L. - (503) 326-3057

Child Labor Requirements in Agriculture Under the Fair Labor Standards Act (Child Labor Bulletin No. 102) - WH Publication 1295
Contact U.S.D.O.L. - (503) 326-3057

Oregon Wage & Hour Laws - 1994 Edition
Cost - $15.00
Send check to BOLI
Technical Assistance for Employers
800 NE Oregon St., #32
Portland, Oregon 97232
(503) 731-4073

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

DEDUCTIONS FROM WAGES Q & A

The following is a list of questions and answers regarding deductions from wages compiled for your convenience by the bureaus Technical Assistance for Employers program staff.

Most Commonly Asked Questions Concerning Deductions From Wages:

1. **Q. What can an employer legally deduct from the wages of employees?**
   a. Deductions required by law; (i.e. taxes)
   b. Deductions, such as insurance premiums, which are authorized in writing by the employee, are for the employee's benefit, and are recorded in the employer's book.
   c. Deductions, such as charitable contributions, for which the employee has voluntarily signed an authorization. In such cases, the employer may not be ultimate recipient of the money withheld. All such deductions must also be recorded in the employer's books;
   d. Deductions authorized by a collective bargaining agreement to which the employer is a party.

   This applies to all employers within the state of Oregon (except federal government employers) who have at least one employee.

2. **Q. Can an employer deduct for till shortages and bad checks taken contrary to company policy?**

   A. No. An employer may not charge an employee for the normal cost of doing business because it is for the employer's benefit, not the employee's. (For further clarification please see 13 below.)

3. **Q. What can an employer do if an employee continually experiences till shortages or accepts bad checks even though company policy clearly forbids the practice and procedures have been provided regarding the practice?**

   A. In a case such as this, an employer may choose to take disciplinary action against the employee. Caution should be taken that the discipline fits the violation and is meted out uniformly and consistently, to avoid possible civil rights problems.

4. **Q. If an employee is negligent and destroys company property, can an employer deduct the value of that property from his/her wages?**

   A. No. This deduction is not for the employee's benefit and the employer would be the ultimate recipient of the money, both of which are prohibited by statute. In this case, the employer may elect to take disciplinary action according to company policy and/or, the employer could pursue reimbursement for damages through Small Claims Court.

5. **Q. What if an employee admits to negligence or stealing and agrees in writing to pay the money back through deductions from wages can I then make the deduction?**

   A. No. Even with a signed authorization the above agreement represent a prohibited deduction. Since this activity is prohibited by statute, signed even a authorization would be workers.

6. **Q. Can an employer deduct for the purchase of uniforms?**

   A. No. This deduction is prohibited by statute. An employer may not deduct for the cost of uniforms or for their laundering.

7. **Q. Can an employer require an employee to purchase a specific uniform for work from a third party?**

A. MINIMUM WAGE EMPLOYEES: Minimum wage employees may not be required to purchase uniforms. The only exception to this rule is the requirement of a "generic uniform" which a minimum wage employee may be required to provide. An example of a generic uniform is a black skirt/pants and a white blouse/shirt.

OTHER THAN MINIMUM WAGE EMPLOYEES: If an employer wishes to have employees purchase uniforms, purchasing a uniform can be made a job requirement. This means that the employee must be made aware that buying a specific uniform is a "condition of the job." However, the purchase of the uniform CANNOT TAKE the employee WAGES BELOW THE MINIMUM WAGE in the pay period in which it is purchased. Also, the price of the uniform cannot be averaged over more than one pay period. Remember that employees, unless otherwise exempt, must be paid at least minimum wage for all hours worked.

8. **Q. Can an employer deduct the cost of meals and lodging from the employees wages?**

A. Yes. Provided the employee wants the use of the benefit, an employer may deduct the fair market value of meals and lodging from wages. This deduction may even be taken from minimum wage employees. However, if the lodging is not for the private benefit of the employee, a deduction may not be made from the minimum wage. OAR 839-20-025(6)

9. **Q. Whom does an employer contact for information regarding specific statutory deductions other than wage and hour deductions?**

A. The following agencies can help:.

Oregon Department of Revenue	378-4988
Department of Workers' Compensation	373-7434
U.S. Internal Revenue Service (tax collection)	221-3960
Social Security Administration (rates only)	1-800-772-1213
Dept. of Human Resources - Payroll Tax	378-3524 (from Salem)
(from outside Salem)	1-800-624-7908

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

OVERTIME Q & A

The payment of overtime is required by both federal and state laws. The general overtime rule for most employers requires payment of overtime at the rate of 1.5 times the regular rate for all hours over 40 in the workweek. Special overtime rules apply to government agencies, hospitals, canneries and manufacturing establishments. Refer to the Oregon Wage and Hour Laws handbook for more information about special overtime requirements for such entities.

1. **Q. What is a workweek?**

   A. A workweek is a regularly recurring period of seven consecutive 24-hour periods. It may begin on any day and hour the employer chooses as long as it repeats on a regular basis. Workweeks may not be randomly changed.

2. **Q. Can pay periods be different from workweeks?**

   A. Yes. Pay periods and workweeks frequently differ. Pay periods may be established for any period which does not exceed 35 days. When pay periods differ from workweeks, overtime must be paid on the regular payday for the period in which the workweek ends. For example, if payday is on the 15th and the workweek ends on the 17th, the amount of overtime will not be known for that workweek until the following payday.

3. **Q. How is the regular rate of pay determined?**

   A. If the employee is paid on an hourly basis, that amount is the regular rate. The regular rate may not be less than the minimum wage. If the employee is paid a salary, based on a 40-hour workweek, the regular rate is determined as follows:

      a. Multiply the monthly salary by 12 = annual salary;
      b. Divide the annual salary by 52 = weekly salary;
      c. Divide the weekly salary by 40 = regular rate.

   The result is the rate used to compute overtime. Payroll records must reflect overtime pay of 1.5 times that rate for hours over 40 in a workweek.

4. **Q. Do bonus payments increase the overtime obligations?**

   A. Yes. Federal law requires that all amounts, including nondiscretionary bonuses be included in the regular rate when calculating overtime.

5. **Q. Are any amounts excluded from the regular rate of pay?**

   A. Yes. Examples are expense reimbursements, premium pay for Saturday, Sunday, or holiday work, discretionary bonuses, and gifts for special occasions.

5. **Q. When is overtime required for salaried employees?**

   A. All salaried employees must be paid overtime unless they meet the test for exempt status as defined by federal and state laws. **CAUTION:** Misclassification of salaried employees as exempt creates liability for unpaid overtime. It is the employer's burden to prove exempt status of employees. Obtain WH Publication 1281 from the U.S. Dept. of Labor (503-326-3057) and consult the Oregon Wage and Hour Laws Handbook (503-731-4073) for more information.

7. **Q. Must vacation, sick leave or holiday hours be included in the overtime calculation?**

   A. No. Only actual hours worked are counted as overtime.

8. **Q. Is it possible to award compensatory time instead of the payment of overtime?**

   A. Government agencies are permitted to use "comp" time but employers in the private sector are not.

9. **Q. How is overtime calculated when employees work at different rates of pay in the same workweek?**

   A. The average rate of pay is used to compute overtime. **EXAMPLE:** If an employee worked 16 hours at $6.00 per hour and 30 hours at $47.00 per hour the total straight time amount earned is $306.00. That amount is divided by total hours worked (46) and the average hourly rate is $6.65. Since the employer has already paid the straight time rates for all hours worked, only an additional 1/2 times the average hourly rate is due (1/2 x 6.65 x 6 hours = $19.95 overtime).

10. **Q. If employer policies forbid working overtime without prior authorization and an employee works overtime without authorization, is the employer still required to pay overtime?**

    A. Yes, an employer is still required to pay overtime. Even though employers are required to enforce their policies, the mere adoption of a policy is not enough to protect the employer from the liability. Employees who fail to follow instructions regarding overtime may be disciplined, but they must be paid.

11. **Q. Are there any limitations on the number of hours employees can work?**

    A. Yes, in manufacturing establishments employees must not work more than 13 hours in a day and overtime must be paid after 10. In addition, there are daily overtime requirements for local government agencies, mining operations, canneries and some hospital employees. For more information see the Oregon Wage and Hour Laws Handbook.

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

WHAT CONSTITUTES A "SALARY BASIS" FOR EXEMPT EMPLOYEES Q & A

There is much confusion as to whether there are any allowable deductions that an employer may take salaries of employees without jeopardizing their exempt status. Technical Assistance for Employers Program of the Bureau of Labor and Industries has prepared this informational handout to help you understand the complex regulation that govern this area.

1. **Q. What does it mean when an employee is "exempt"?**

   A. If an employees are exempt from the payment of overtime, they are classified as "exempt employees."

2. **Q. How do you determine who is exempt from overtime?**

   A. There are five different tests that must be met in order to be classified as exempt. You may get a copy of those tests by requesting a copy of our handout "Executive, Administrative, and Professional Exemptions from Federal Minimum Wage and Overtime."

3. **Q. I understand that a basis for determining whether an employees are exempt is that they are paid on "a salary basis." What does that mean?**

   A. In general, an employee is considered to be paid on a salary basis if he/she receives a predetermined amount (salary) for the pay period, and that amount is not subject to reduction in any week in which he/she performs any work, regardless of the number of days or hours worked.

4. **Q. Does this mean no deduction is ever allowed from the salary?**

   A. No. Deductions **may be made** in the following situations:

   (1) An employee need not be paid for any work week in which they performs no work;

   (2) Deductions may be made when the employees are absent from work for a day or more for personal reasons; and

   (3) Deductions may be made when the employees are absent from work for a day or more for sickness or a disability if the employer has a bona fide plan, policy or practice of providing compensation for loss of salary occasioned by both sickness and disability.

5. **Q. Does this mean that if an employer does not have a paid sick leave plan that covers both sickness and disabilities, the employer could not deduct for such sickness and/or disability?**

   A. Yes. If there is no plan, policy or practice of providing compensation for such sickness or disability the deduction would be disallowed if the employee were to remain exempt.

6. **Q. May I deduct for a day or more of sick leave if the employees have not been with my company long enough to qualify for compensation under my sick leave plan?**

   A. YES.

7. **Q. If an employee has used all accrued sick leave, may I deduct for periods of less than a day?**

   A. No. Deductions may only be made for a day or more.

8. **Q. What kinds of deductions would not be allowable if the employer wants to regard the employee as being paid on "a salary basis"?**

   A. Deductions may not be made for:

   (1) Time when work was not available;

   (2) Absences occasioned by the employer or by the operating requirements of the business;

   (3) Absences caused by jury duty, attendance as a witness or temporary military leave. (Note: the employer may, however, offset any amounts received by an employee as jury or witness fees or military pay for a particular week against the salary due for that particular week without loss of the exemption.); or

   (4) Absences of less than one day.

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

THE EMPLOYMENT RELATIONSHIP: EMPLOYEE OR INDEPENDENT CONTRACTOR Q & A

When does an employment relationship exist?
When is a person considered an independent contractor?

The Technical Assistance Unit of the Bureau of Labor and Industries has prepared this handout for your general information. This information should be used as a general guide only.

1. **Q. What is an employee?**

   A. An "employee" must be involved in "work" or its equivalent for an employer. The U.S. Supreme Court established the elements of work as the following:
      (1) Physical or mental exertion (whether burdensome or not);
      (2) Controlled or required by the employer;
      (3) Pursued necessarily and primarily for the benefit of the employer and the business.

2. **Q. What factors are significant in determining if an employment relationship exists?**

   A. According to the U.S. Supreme Court and the Oregon courts the following elements are the most significant:

      (1) The nature and degree of control by the principal. Did the worker have the right to determine the method by which the work would be performed, and was the recipient of services interested only in the ultimate result? The more control that exists, the more likely it is that the worker would be considered an employee.

      (2) The extent to which the services in question are an integral part of the employer's business. If the worker's services are the same as or similar to work done by regular employees, it is more likely to be perceived as an employment relationship.

      (3) The permanency of the relationship. The longer the job lasts, the more likely it could be thought of as an employment relationship.

      (4) The amount of the worker's investment in facilities and equipment. Contractors will usually furnish their own equipment, tools, and materials, and will have much more of an opportunity for profit and loss than do employees.

      (5) The amount of initiative, judgment, or foresight in open market competition with others required for the success of the independent enterprise.

      (6) The ability to hire others to help complete work. While employees generally cannot hire others on their own initiative, contractors are usually free to employ their own assistants.

      (7) The extent to which the worker performs work for others while working for the employer. If the worker only has one "customer," it is more likely to be perceived as an employment relationship.

      (8) The ability of the worker to set his/her own schedule and determine his/her own hours. The more control the worker has over this, the more likely it is to be perceived as an independent contractor relationship.

      However the above list is not complete. When determining if an individual is an independent contractor or an employee the courts view the facts on a case by case basis.

3. **Q. Does it matter if an individual signs a contract stating that he/she is an independent contractor?**

   A. It is not necessarily binding. In all cases, the courts and agencies will "look behind" the contract and use the above listed criteria to determine if an employment relationship exists.

   NOTE: Oregon has a law ORS 670.600 which outlines the requirements for independent contractors for purposes of personal income tax, workers' compensation, unemployment compensation, and registration of builders. A copy of this statute is attached.

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

EMPLOYMENT RELATIONSHIP AND INDEPENDENT CONTRACTORS

Characteristics that Distinguish Independent Contractors from Employees

(Not all of the following factors need to be present to establish employment)

Employment Relationship (no independent contractor relationship)	**Independent Contractor** (no employment relationship)
1. An employer has the right to fire.	1. The employer has no right to fire.
2. The employer furnishes equipment.	2. The independent contractor furnishes his/her own equipment.
3. An employer directs the employee's work and establishes the employee's working hours.	3. The independent contractor may hire his/her own employees, and does not work hours established by the employer.
4. The employer has control over the manner in which the work is performed.	4. The independent contractor works under no control from employer except insofar as the employer accepts or rejects the results of the work.
5. The employer may unilaterally determine the rate paid for the work.	5. The independent contractor negotiates the price to be paid for the work.
6. The employer's business operations regularly require the services in question.	6. The independent contractor provides a service or skill which is not normally found in the employer's business operations.

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TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

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MANAGERS: EXEMPT OR NONEXEMPT?

"The following are some examples of duties which are managerial when performed by the employee in managing a department or supervising other employees.

Interviewing, selecting and training employees.
Setting and adjusting pay rates and work hours.
Directing work.
Keeping production records of subordinates for use in supervision.
Evaluating the employees' efficiency and productivity.
Handling the employees' complaints.
Disciplining the employees.
Planning work.
Determining techniques.
Distributing work.
Deciding on types of merchandise, materials, supplies, machinery, or tools.
Controlling flow and distribution of merchandise, materials, and supplies.
Providing for safety of employees and property.

Examples of nonexempt duties:

Performing the same kind of work as the employees supervised.
Performing any production work, even though not like that performed by subordinates, which is not part of supervisory functions.
Making sales, replenishing stocks, returning stock to shelves, except for supervisory training for demonstration purposes.
Performing routine clerical duties, such as bookkeeping, billing, filing, operating business machines.
Checking and inspecting goods as a production operation, rather than as a supervisory function.
Keeping records on employees not under the executive's supervision.
Preparing payrolls.
Performing maintenance work.
Repairing machines, as distinguished from an occasional adjustment.
Cleaning around machinery, rearranging displays, taking an employee's place at the workbench, or on the sales floor.

Caution: Job titles are insufficient as a measure for qualifying an employee for the overtime exemption. Remember, it will be the duties performed by the employee, not the title they carry within your organization, which will govern the exempt or nonexempt status.

(U.S.D.O.L. - Employment Standards Administration - Wage and Hour Division - WH Pub. 1363)

DETERMINING EXEMPT EMPLOYEES

When determining that an employee is exempt from the payment of overtime, it is important to first fully examine the actual duties of the position. You may decide to ask the employee to help you in writing the job description.

The following example could be used as a model for writing your job description. Once you have completed the description, you should be able to determine if your employee is exempt or not. Percentages indicate percent of work time spent.

Position:	Name:	Salary:
Duties:	Exempt:	Nonexempt
Totals:		

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THESE MATERIALS WERE PREPARED AS A GENERAL SUMMARY AND TEACHING GUIDE. THE TECHNICAL ASSISTANCE UNIT ANSWERS QUESTIONS TO INFORM THE PUBLIC REGARDING THE POLICIES AND PROCEDURES OF THE BUREAU OF LABOR AND INDUSTRIES AND TO GENERALLY INFORM THE PUBLIC REGARDING THE LAW OF EMPLOYER-EMPLOYEE RELATIONS. THE TECHNICAL ASSISTANCE UNIT MAY NOT AND DOES NOT GIVE LEGAL ADVICE. IN ORDER TO DETERMINE THE LEGALITY OF ANY MATTER OR TO PROTECT YOUR LEGAL RIGHTS, YOU SHOULD OBTAIN THE ASSISTANCE OF A LAWYER. CONSULT THE YELLOW PAGES OF YOUR TELEPHONE DIRECTORY OR CONTACT THE OREGON STATE BAR LAWYER REFERRAL SERVICE AT 684-3763 OR 1-800-7636.

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1. EXECUTIVE, ADMINISTRATIVE AND PROFESSIONAL EXEMPTIONS FROM FEDERAL MINIMUM WAGE AND OVERTIME

a. *Executives, Managers, Supervisors*	b. *Administrative Exemptions*	c. *Professional Exemptions*
To be exempt, all of the following tests must be met:	To be exempt, **all** of the following tests must be met:	To be exempt, **all** of the following tests must be met:
1) Employee must supervise 2 or more employees, **and**	1) Employee must perform responsible non-manual work directly related to management policies or business operations, or responsible work in the administratin of a school, **AND**	1) Employee must perform work requiring an advanced type of knowledge usually obtained through a prolonged course of study, **or**
2) Must have hiring/firing authority or be able to make recommendations that carry weight, **and**	2) Employee must regularly assist an executive, **or** perform work under only general supervision	2) Work that is original or creative in an artistic field, or work as a certified teacher or registerd nurse.
3) Must regularly exercise independent judgment and discretionary power, **and**	3) Same as a. 3.	3) Same as a. 3.
4) Employee's primary duty (over 50% of work time) must be management of the enterprise or a department, **and**	4) Same as a. 4.	4) Employee's primary duty (over 50% of work time) must be professional as set out in a) or b) above.
5) Must be paid on salary basis and meet either of the following: Salary must be at least $155.00 per week and employee spends not more than 20% of the workweek (if retail, 40% of the workweek) performing non-exempt tasks; **or** Salary must be at least $250.00 per week	5) Same as a. 5.	5) Must be paid on a salary basis and meet either of the following: Salary must be at least $170.00 per week and employee spends not more than 20% of the workweek performing non-exempt tasks; **OR** Salary must be at least $250.00 per week.
NOTE: The percentage tests on non-exempt work do not apply if employee is in sole charge of an independent establishment or a physically separated branch		***NOTE:*** The salary tests do not apply to licensed or certified doctors, lawyers, degreed medical interns or residents, and certified tachers.

An employee who is performing a combination of exempt tasks from 2 or 3 of the above groups will meet the exemption if the remainder of the tests are met.

NOTE: For more detailed information on exemptions, contact the Federal Wage/Hour Division 326-3057 in Portland.

CAUTION: ORS 653.010 (10) defines salary as no less than the current Oregon minimum wage times 2080 divided by 12 (monthly); or (divided by 52 for a weekly salary).

TECHNICAL ASSISTANCE FOR EMPLOYERS PROGRAM

Bureau of Labor and Industries, 800 NE Oregon St. #32, Portland OR 97232

LAWS REGULATING REST AND MEAL PERIODS

Except for the U.S. Government, all Oregon employers are subject to ORS Chapter 653 which governs conditions of employment in Oregon. While most Oregon employers are also subject to the federal Fair Labor Standards Act (FLSA), employers are required to apply the stricter standard where applicable. Federal law (the FLSA) does not require rest periods or meal periods. In this case, all Oregon employers must follow the stricter state standard which requires employers to provide employees with appropriate rest and meal periods. (ORS 653.261) The Wage and Hour Commission promulgated rules defining appropriate rest and meal periods for adults and minors as follows:

REST PERIODS FOR ADULTS

Oregon employers must provide a rest period of at least 10 minutes for every four hours or major part thereof worked. In other words, a rest period must be provided for any work period that is over two hours in length. This rest period must be paid - the time cannot be deducted from the employee's wages.

If feasible, the rest period should be taken in the middle of each work period. The rest period cannot be added to the meal period nor deducted from the beginning or the end of the work period.

Rest periods are not required when all of the following conditions are met:

(1) The employee is 18 years old or older; and
(2) The employee works less than five hours in any 16-hour period; and
(3) The employee is working alone; and
(4) The employee is employed in a retail or service establishment (a place where goods or services are sold to the general public); and
(5) The employee is allowed to leave the work station to relieve body wastes when necessary. (OAR 839-20-050)

REST PERIODS FOR MINORS (under 18 years old)

Rest periods are the same for minors as for adults, except minors must be given a rest period of no less than 15 minutes for every four hours or major part thereof worked. (OAR 839-21-072)

MEAL PERIODS FOR ADULTS

Oregon employers must provide employees with at least a 30-minute meal period for each work period of not less than six hours or more than eight hours during which the employee is relieved of all duties. If the work period is less than seven hours, the meal must be taken between the second and fifth hour worked. If the work period is more than 7 hours, the meal must be taken between the third and sixth hour worked. If, because of the nature or circumstances of the work, an employee is required to remain on duty or to perform any tasks during the meal period, the employer cannot deduct the meal period from the employee's hours worked.

Meal periods are unpaid only if the employee is relieved of all duty. (OAR 839-20-050)

MEAL PERIODS FOR MINORS (under 18 years old)

Oregon employers must provide minors with at least a 30-minute meal period to begin within five hours and one minute after the minor reports to work and during which the minor is relieved of all duties.

If the minor is 16 years old or older and the nature of the work prevents the minor from being relieved of all duties, the employer must provide a paid meal period of not less than 30 minutes and the minor may continue performing duties or remain on call. (OAR 839-21-072)

NOTE: The rules pertaining to rest and meal periods for adults do not apply to employees engaged in agricultural employment, nor to some government employees (see handout on government employees). OAR 839-20-100) Also, the Wage and Hour Commission may for good cause shown exempt an employer or class of employers from the rest and meal period provisions for minors. (OAR 839-21-072(3))

If you wish to purchase a ***"Handbook of Oregon Wage & Hour Laws,"*** a ***"Handbook of Oregon Civil Rights Law,"*** or a ***"Guide to Employee Leaves in Oregon,"*** these publications may be obtained by mailing a check or money order to:

Technical Assistance for Employers
Bureau of Labor and Industries
800 NE Oregon St. #32
Portland OR 97232
(503) 731-4073

The fee is $15.00 for an individual handbook or $5 for the leave guide.

THIS INFORMATION IS AVAILABLE IN AN ALTERNATE FORMAT

BUSINESS TECHNICAL SKILLS: AVAILABLE SUPPORT SYSTEMS FOR SMALL BUSINESSES

Tony Laska

Available Support Systems for Small Business

Once a person is in business, they can still rely on a number of sources to keep them updated and improving their operations. The Small Business Development Centers (SBDC's), mentioned earlier and associated predominantly with 2-year colleges, maintain libraries and on-line computer services that are readily available. Their workshops are often tailored toward improving one's bottom line; local newspapers usually run ads that help publicize them.

Your local Chamber of Commerce probably has a "LEADS" group which will help steer you toward business opportunities. This networking is an important aspect of the chamber. One can reach other networks through the public library by searching library computer files under associations, organizations. Then go to "Link," "Networking." This can be an efficient way of getting in contact.

BUSINESS TECHNICAL SKILLS: HOW TO FIGURE OUT YOUR OWN SKILLS AND HIRE OUT THE REST

Mollie Owens-Stevenson

Overview

How does this topic fit with the rest?

When you are either developing your own business, or working as a part of a team, part of your task is to figure out what you are good at, and communicate that to either your target market or to your team members. The next part of your task is to figure out what else needs to be done in order to do your assigned work or run your business, and whether or not you can do it. Finally, you must either communicate this to the rest of your team and see if any of them can do it, or hire it done.

Competency measures

Student will be able to

a. Discuss the process for identifying skills

b. Write a list of her/his skills

c. Describe, verbally or in writing, as a part of a team, all the discreet tasks that need to be accomplished in order to finish a job.

d. Identify those skills that she/he is not skilled at, and develop a plan for getting those skill needs met.

Identifying skills

By this time in the program, you are probably fairly familiar with which Ecosystem Specialist skills you are good at: Do you like to build fences, or would you prefer to spend your time developing and carrying out monitoring processes? Do you like surveying, or would you rather think? Do you like a variety of tasks, or would you prefer to work at one task at a time for a longer period of time? Are you the person that enjoys looking at a complicated job and figuring out the best way to do the work, or do you prefer to get the tools and equipment together, and talk to subcontractors? One way to do this is to think about a typical day at work, or a project that you felt very good about, and write down all the specific tasks you performed in order to accomplish what you did. Write about 2 or 3 days, or 2 or 3 projects. Or, in a group, take turns so that one person describes a project or a day, while the other group members write down the tasks; group members might also ask questions about the project to help the person

talking get a complete list of specific tasks she/he performed. From those descriptions, work in groups to develop a list of skills for each group member. You might pass your list around to others that you work with, and ask them to add other skills that they observe in you. **Save that list!!**

Analyzing a job

You now own your own business. It is March 15. You have set the next week aside to do your taxes for the year, and make sure that your licenses, bonds, etc., are in place for this next year. You also are shopping around for bonding and worker's compensation insurance. Now you suddenly have been recruited by a private large land owner to bid on and then restore a section of stream 5 miles long that has been destroyed by previous logging practices, including roads, bridges, cleaning the stream, cutting down to the stream's edge, and clearcutting up the hill from the stream. You must do the bid, subcontract out some heavy equipment work, devise a plan for assessment and restoration, etc., while also managing your small business. In small groups, figure out all the work that has to be done. List each discreet task on paper or on newsprint on the wall. Each member of the group then compares her/his personal list of skills with the task list, and identifies those areas the she/he would not be able to or want to do.

As your crew approaches each new project, use the above process to analyze the work to be done. As you match the work to be done to your skills, you can decide to only do the work you are good at, to finish with maximum efficiency in the minimum amount of time. Or you can decide to take more time, learn skills that you may not be good at but need in the future, and thus invest in your future.

Plan for meeting skill needs

After you have taken some time to analyze your own skills, and some time to analyze the skills needed to run a small ecosystem workforce business, identify the skills that you do not have and that you need to be successful. Write a list that includes:

Indispensable (skills you must have to be successful)

Important (skills you should have to be successful)

Useful (skills you would like to have, but could survive without)

From this list, you can prioritize the skills you must either find in someone else or learn yourself. Next, you have to figure out what resources you have to "spend" in order to acquire those skills. Do you have time and aptitude with which to learn the needed skill or skills? If you have just one and not the other, can you still "afford" to try to learn it? Do you have money with which you can afford to purchase someone else's skills and abilities to do the work you can't (or don't want) to do? If you are short on both time and money, what are your options? Can you trade with someone? You trim their trees or build their fence, and in return, they program your computer, do your bids, file your taxes, or whatever it is that you need. Can you get one of your relatives to do the work? Perhaps you can convince your father, your sister, or your husband or wife to perform or learn to perform the work that needs to be done. There may be other options that you can identify. What are they?

As you come to the end of this section, you should be able to identify your own skills and the skills needed to complete a job, then identify the holes. You have identified the resources that you have to spend to get that work done. If you decide that the best way for you to get the job done is to hire someone, you might want to explore subcontracting, temporary agencies, and hiring. Your Small Business Development Center, often located at your local Community College, may be your first best resource. Call them, and discuss the training options and other supports that they might have for you.