THE INFLUENCE OF SCIENCE IN POLICY:

AN EXAMINATION OF RIPARIAN AREA MANAGEMENT

ON OREGON PRIVATE FOREST LANDS

by

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In the Pacific Northwest, land use policies have historically championed economic values over environmental protection. Attempts to balance the commercial value of harvesting on private forestlands with the need to preserve our natural resources have brought about long time controversies between different interest groups. Since 1972, Oregon's forest policies concerning harvesting trees in riparian areas have changed drastically from the initial practices, in efforts to balance economic, political, social and scientific needs. This thesis examines the role of science in environmental public policy creation. In order to determine the degree to which science influences forest harvesting practices, it is necessary to compare the historical development of Oregon's policies to those of surrounding states. My study will look at the developmental history of forest practices on private timberlands in Oregon, Washington, and California to determine how these policies differ, and what role science played in prompting those differences.

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Introduction

This paper seeks to answer to what degree policymakers in Oregon have incorporated scientific findings in the development of management policies for riparian habitats on private timberlands? To complete this inquiry, I first ask and answer a secondary research question: do states, similar in geographic region, federal regulations and ecosystems, have variations in their best management practices for timber harvesting along riparian and aquatic habitats? If so, why do these differences occur? These questions are essential in understanding the interactions of policy influencers on the state-level policy process. Oregon is often looked at as a public policy champion for environmental protections. My research examines if this sentiment stands true for Oregon's riparian protections on private forestlands, compared to our surrounding states.

Oregon has a long and complicated relationship with the timber industry. Forestry products produced by private companies currently make up 6.8 percent of Oregon's industrial outputs, contributing about 12.7 billion dollars to Oregon's economy each year (Oregon Forest Resources Institute, 2013). In the last three decades, this number has waxed and waned, for example, from 2 billion board feet (bf) in 2009 to 4.2 billion bf in 2013 (Oregon Forest Resources Institute, 2013).

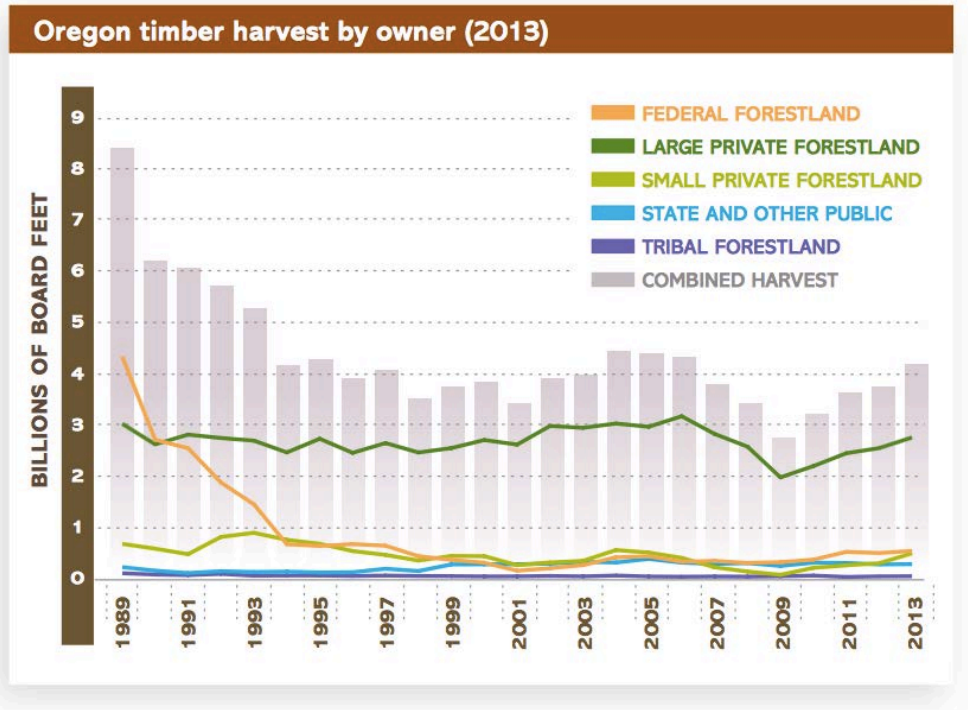

Figure 1: Graph of Timber Harvest by Owner in Oregon (2013)

The colored lines show the breakdown of billions of board feet harvest broken down by land ownership. The bar graphs are the total billions of board feet in supply each year. This figure shows that after 1990 large private forestlands are the largest producer of timber per year compared to federal, small private, state and tribal landowners (Oregon Forest Resources Institute 2015-16).

But even through the Great Recession (2007 to 2009) timber has been one of the biggest economic outputs Oregon has produced. Large private landowners own roughly half of private forests or 20% of total forests. These lands are managed primarily for timber production and have specific policies and regulating forest practices that vary by state. Not long ago, common logging practice in Oregon entailed clear-cutting trees all the way to the edge of the water and then dragging them through the streams to splash dams or haul roads (Richardson et al. 2012). Many practices similar to this continued until the 1970s, and as the industry expanded so did the impact on fish, water, and other wildlife. Being both culturally and commercially valuable, the Pacific Northwest

salmon populations became the impetus for protecting streams and water bodies in Oregon. Beginning in the late 1970s, forest management practices moved in the direction of both reducing and mitigating human disturbances to upland, riparian, and aquatic ecosystems. Current policies meet the demand for commercial timber and also work to preserve other natural resources within forested waterways (Everest & Reeves, 2007).

In response to regulations like the Clean Water Act of 1972 and the listing of salmon species on the endangered species list (in the Pacific Northwest), the impacts of forestry practices on riparian areas have been widely debated both at the federal and state level (Garland, 1996). Riparian areas, the areas of land adjacent to streams, lakes or wetlands, are critical in providing ecological services that aid in energy flow, nutrient cycling, water cycling, hydrologic function and primary production within aquatic habitats (Richardson et al., 2012). The level of legislation protecting them is highly variable in degree, scope, and the spatial area across federal, state, and local land boundaries. State agencies (like the Oregon Department of Forestry or the Washington Department of Natural Resources) are responsible for regulating practices on private forestlands.

Ultimately the goal of this paper is to examine the degree to which politics and science influence Oregon's riparian protections on private forestland. For this analysis, I will summarize the Oregon Forest Practices Act's protections for riparian areas and examine how these best management principles (defined in the Oregon Forest Practices Act) developed since the 1970s, compared to those in Washington and California. I decided to use Washington and California as comparison states because of their

geographic proximity, ecological similarity, and the variation that exists in their forestry rules.

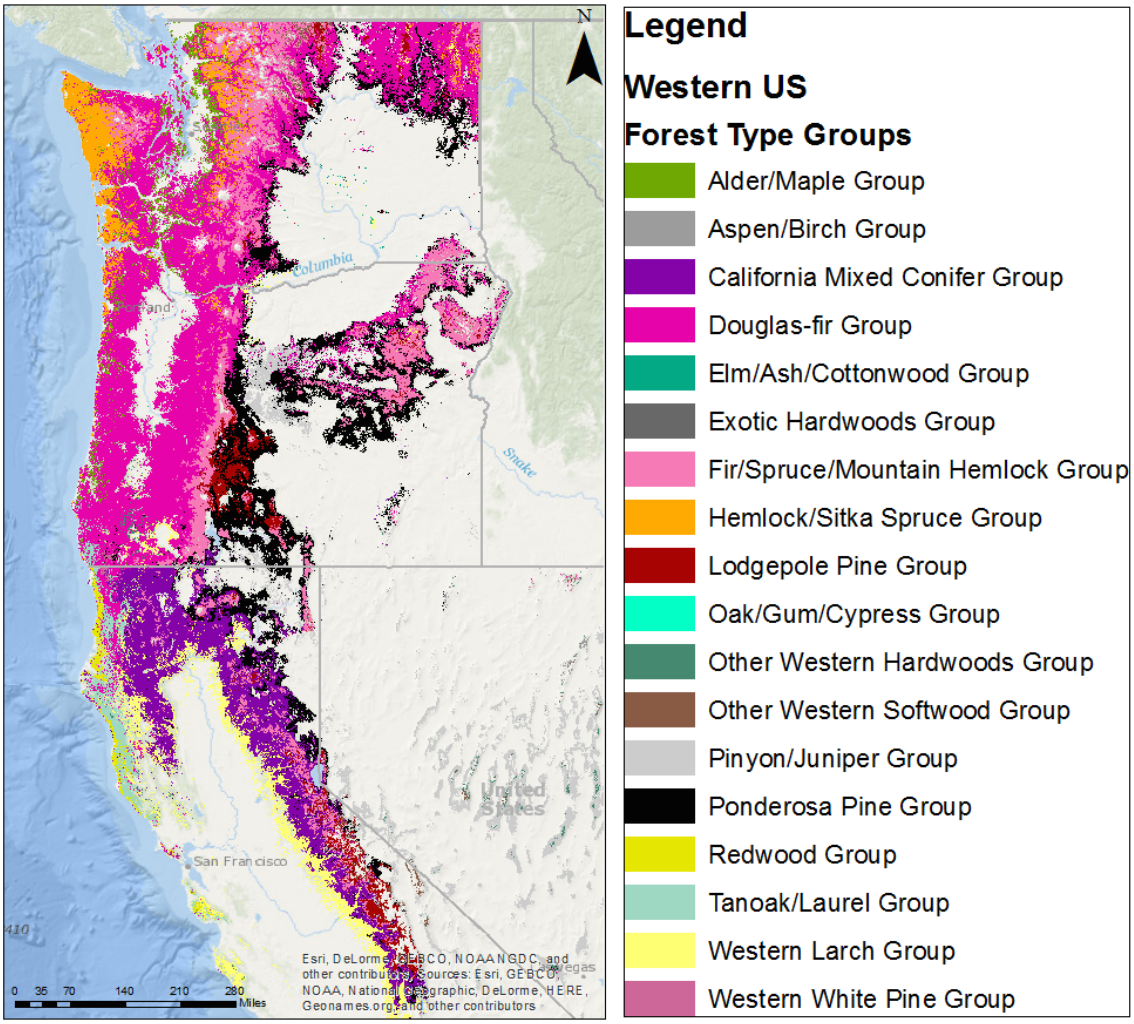

Figure 2: Forest Types in the Western United States (2012)

This figure displays the dominant forest types in Oregon, Washington, and California. One discrepancy is that while Douglas-fire primarily dominates Oregon and Washington forests, a mixed conifer forest dominates Northern California (US Forest Service, 2012).

Before moving into the discussion of state-level harvesting policies in riparian areas, it is necessary to establish background on both the importance of riparian habitats and a framework for what drives science in environmental public policy. I will then

highlight that there are fundamental differences in riparian area harvesting practices across the Pacific Northwest and California. Finally, I will examine the development of forest practices in Oregon, Washington, and California to determine what roles science has played in creating policy differences.

Background

Riparian Ecosystems

Riparian areas are the areas of lands bordering bodies of water[1]. While riparian areas only make up about 2% of the land in the western United States (Everest & Reeves, 2007), they provide the habitat for one-third of the plant species (Broadmeadow & Nisbet, 2004).

Riparian ecosystems are defined either by their *physical* or *functional* attributes (Brosofske, 1996; Ilhardt, Verry, & Palik, 2000; Palone & Todd, 1997). Characteristics and flow of the water body (perennial or ephemeral), the adjacent vegetation, and the terrestrial area whose vegetation and microclimate are influenced by the stream flow are all the basis of a *physical* definition of riparian areas (Obedzinski, Shaw, & Neary, 2001). *Physical* characteristics are highly variable, ranging from meters to kilometers, with slopes from 50% or more on flood plains (Everest & Reeves, 2007).

A *functional* definition of riparian zones includes the interactions between streams, riparian vegetation, terrestrial vegetation, and flood zones. Attributes of the *function* of riparian areas impact water quality, the nutrient and hydrologic cycles, stream flow, channel morphology, and the temporal and spatial distribution of flow (Ilhardt, Verry, & Palik, 2000).

An ecologically healthy stream landscape will contain riparian plant communities and wildlife that depend on the natural hydrologic cycle. In the absence of human impacts, riparian areas support a broad range of ecosystem functions including

[1] The term riparian area can reference the terrestrial lands adjacent to streams, lakes, and wetlands. However, streams will be the focus of this thesis.

recharging aquifers, filtering and buffering water, maintain banks and shorelines, storing water and energy, trapping and storing sediment as well as playing a crucial role in primary production (National Research Council, 2002).

An ecologically sound riparian area has naturally retained nutrients, stabilized local microclimates, and sustained food webs for fish and wildlife species. The removal of streamside vegetation and trees can have a tremendous ecological impact on stream temperature, which is why logging is perhaps one of the biggest contributors to poor water quality and riparian health (National Research Council, 2002).

In the Pacific Northwest, stream temperature is a high concern because of the impacts on salmon development and fecundity (Dunham, Rieman, & Chandler, 2003; McCullough, et al., 2009). However, water temperature also affects stream system productivity (Demars, et al., 2011), metabolic and growth rates in aquatic species (Brown & Hallock, 2002; Leach, Moore, Gomi, & Hinch, 2012), and trophic structure (Groom, Dent, & Madsen, 2011). Stream temperature is a first-order control that determines productivity, oxygen solubility, organic matter decomposition, and nutrient cycling within a riparian ecosystem (Kibler, Skaugset, Ganio, & Huso, 2013).

Past research has linked forest harvesting that removes large wood in the riparian area to increased energy loading to the stream from direct solar radiation, resulting in higher water temperatures (Bladon, et al., 2016). Large woody debris (LWD) is critical in developing bank morphology (Bilby & Ward, 1991; Faustini & Jones, 2003), shade retention and bank stability (Bilby, 1981), and normal movement and transfer of nutrients (Gregory, Swanson, Mckee, & Cummins, 1991). Additionally,

LWD that end up in the stream channel provides habitat for many invertebrates and fishes (Beschta, Bilby, Brown, Holtby, & Hofstra, 1987; Bilby & Wasserman, 1989).

Before the 1970s, management practices included harvesting trees all the way to the water edge. Average stream temperatures increased from the direct sunlight. Harvest plots would then be densely replanted with conifers, causing the plantation trees to outcompete all other riparian vegetation along the bank. These practices would result in unsafe water quality conditions, higher rates of erosion, reduced plant biodiversity, and poor salmon habitat (Broadmeadow & Nisbet, 2004). Public outcry during the 1970s and 80s regarding forest management in the Pacific Northwest resulted in the implementation of many new policies both federally and statewide (Richardson et. al., 2012).

State Policy Influences

There is a consensus among policymakers, interest groups, and the general public alike on the importance of science-based environmental policy at all levels of governance (Johnson, Swanson, Herring, & Greene, 1999; Sarewitz, Pielke, & Byerly Jr., 2000). Assumptions built around the scientific process and the objective nature of scientific information can cause conflict when science is leaned on to resolves issues around of environmental policy making (Mazur, 1981; Frissell, Liss, Gresswell, Nawa, & Ebersole, 1997). Scientific uncertainty (Steel, List, Lach, & Shindler, 2004) or the inability to translate scientific literature to people outside the specialty (Adams & Hairston, 1995) can hamper incorporation of scientific considerations in the policymaking process.

Scientists are considered one of the principal sources of authority for natural resource management processes. In the Pacific Northwest, we place a high value on research providing pertinent information to forest managers and policy makers when making decisions for managing natural resources (Collingridge & Reeve, 1986; Ravetz, 1987).

Since the 1970's, federal statutes for managing natural resources have exponentially placed emphasis on preservation and restoration, over the economic benefits of harvesting (FEMAT, 1993). At the state level, private forestlands typically have less stringent rules compared to their federal counterparts.

Past research attributes a variety of reasons as to why there are differences in harvesting practices between federal and state laws:

- different management goals of federal and state forest management (Ellefson, 1991),
- the influence of economic and political climate (FEMAT, 1993),
- the varying perceptions of the degree of environmental protection needed (Everest & Reeves, 2007).

State legislators and forest managers in Oregon, Washington, and California developed their initial forest practices act in 1972, 1974 and 1973[2] respectively. These policies, overhauled or amended several times since their enactment, are known as best management practices. Best management practices (BMPs) are the combination of policies or rules guiding forestry operations at the state and federal level. The Clean Water Act (40 CFR 130.2 (Q)) defines BMPs as practices that "prevent or reduce the amount of pollution by nonpoint sources to a level compatible with water quality goals" (Clean Water Act of 1987).

[2] California adopted a Forest Practices Act in 1946 that was ruled unconstitutional in 1971

Despite being titled “best management practices,” the rules in practice vary drastically across states. Part of this thesis examines how and why these three states, similar in geographic region, federal regulations and ecosystems (to an extent), have such a variation of policies protecting their riparian and aquatic habitats. The federal government does not have sole jurisdiction over state policies. When it comes to forest policies, state level departments of forestry often create boards filled with a diverse group of people, appointed by the Governor to oversee policy creation and implementation. In 1992 the Oregon Board of Forestry developed a comprehensive document of considerations that are taken into account when creating forest policy. The Oregon Board of Forestry identified several factors that influence forest practices in Oregon: state and federal policies, scientific understanding, and historical legacies (Lorensen, Andrus, & Runyon, 1994). No set guidelines exist for how much each of these factors should influence the creation of forest policies on private timberlands.

We would like to think that sound science is the basis for the majority of our environmental policies, but that often is not the case when economics or politics are involved. Since the 1970s, the purpose of federal lands was for public benefit, and not harvesting timber profit, as they are on private forestlands (Lee, Smyth, & Boutin, 2004). As a result, scientific information can carry more weight than economic considerations on public forested lands.The following sections discuss the current forest practices and the historical development of those policies for harvesting along riparian areas on private forest lands in Oregon, Washington, and California. The purpose is to understand how riparian protections developed in Oregon, to what extent scientific research influence those policies, and how that process compares to neighboring states.

Examining the Intersections of Science and Policy

State Riparian Policies

Forest practice rules in the Pacific Northwest and California utilize riparian management areas as protection measures for riparian and aquatic ecosystems. Riparian management areas (RMAs)[3] are the areas of forestland or vegetation adjacent to a water body; foresters manage these areas differently than other harvested forestland.

> The Oregon Forest Practices Act (OFPA) outlines the goal of RMAs as:
>
> "designated to provide adequate areas along streams, lakes and significant wetlands to retain the physical components and maintain the functions necessary to accomplish the purposes and to meet the protection objectives and goals for water quality, fish, and wildlife" (Oregon Forest Practices Act of 2014).

Riparian management areas are designated in the Pacific Northwest and California, so that foresters can harvest commercially valuable timber along streams and water bodies, without causing significant damage to the riparian and aquatic ecosystem.

Information regarding the forest practices acts in Oregon, Washington, and California in the following section of state riparian forest policies rely on information gathered from the Oregon Forest Practices Act of 2014, the Washington Forest Practices Act of 2013 and the Z'Berg-Nejedly Forest Practices Act of 2016, unless otherwise specified.

Goals for Riparian Protection

The goals for management and protection of riparian and aquatic habitats on forested lands are similar in Oregon, Washington, and California. They all offer a level

[3] These areas may have different names depending on the state but they all represent the same concept, for example, California calls these areas Watercourse Lake Protection Areas

of protection for riparian and aquatic habitats based on one or more consideration such as watershed site needs, projected future growth, stream morphology, and stream beneficial uses.

After several years of monitoring and evaluating forest practices impact on forest and riparian ecosystems, Oregon's current forest practices rules contain broad protections for riparian habitats.

> The overall goal of these protections is:
>
> > to provide resource protection during operations adjacent to and within streams, lakes, wetlands, and riparian management areas so that, while continuing to grow and harvest trees, the protection goals for fish, wildlife, and water quality are met.
>
> The goal for aquatic species protection is:
>
> > to establish and retain vegetation consistent with the vegetation retention objects for streams and lakes that will maintain water quality and provide aquatic habitat components and functions such as shade, large woody debris, and nutrients.
>
> And, the protection goal for water quality is:
>
> > to ensure through the described forest practices that, to the minimum extent practicable, non-point discharges of pollutants resulting from forest operations do not impair the achievement and maintenance of water quality standards.

In Washington, the goals for riparian management are to (1) "Protect aquatic and related habitats to achieve restoration of riparian function" and (2) "maintain the resources provided by riparian habitats." The current rules are extensive, with numerous components to address different watershed specific needs, so only key excerpts and overall functions are mentioned here. For a complete guide to the current rules, refer to Washington Administrative Code (WAC) 222.

The decade-long projected goals call for the current forest practices rules to address (Everest & Reeves, 2007):

- Transitions from an individual forest practice-based program to a landscape based one that recognizes cumulative effects on public resources.
- A refocus of the forest practices rules on outcomes over process or action.
- And for the Timber Fish and Wildlife (TFW) committee to continue to process and coordinate with all stakeholders.

The current Forest Practices Act in California, titled the Z'Berg-Nejedly FPA was enacted in 1973, after a previous plan had been ruled unconstitutional in 1971 (Duggan & Mueller, 2005). Built upon principles that identified "the forest resources and timberlands as among the most valuable of the natural resources of the state" the new regulations declared the "utilization, restoration, and protection" of forest resources were of great public concern (Z'Berg-Nejedly Forest Practices Act of 1973). It placed emphasis on the role of watershed protection in forest resource management.

The goals of these protections are:

> To ensure that timber operations do not potentially cause significant adverse site-specific and cumulative impacts to the beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones; or result in an unauthorized take of listed aquatic species; or threaten to cause a violation of any applicable legal requirements.

Buffer Structure and Considerations for Riparian Management Widths

Oregon's buffer structures along streams differ significantly, compared to neighboring states. Instead of having three zones each with their defined harvest prescription within the RMA, the same harvest prescription applies throughout an entire RMA. Buffers in Washington and California however, are structured to contain three

different zones within the riparian management area. In both states, the core zone[4] has a no-harvest prescription.

In Washington, the inner zone[5] allows a thinning prescription if there is more basal area compared to the desired future condition of the stand. In California, the inner zone has a primary objective of providing large wood, shading and ecological diversity where timber actions are limited.

In Washington, harvesting is allowed in the outer zone[6], with a certain number of riparian leave trees per acre (TPA) left after harvest (also dependent on site class), which may be dispersed or clumped. In California, the outer zone has a primary objective of protecting the inner two zones, with logging allowed in this zone (ODF, 2015).

Unlike Washington and California, Oregon does not require a no-harvest buffer (core zone) along waterways, so if the RMA meets basal area targets, harvesting can occur within 30 feet of waterways.

In all three States, water bodies are classified by beneficial use, or the "purpose or benefit derived from the water body," as designated by the States Department of Water Resources. Examples of beneficial uses are domestic water supply, fishing, industrial water supply, irrigation, aesthetic quality or fish, and aquatic habitat.

Although all three States use a water classification system to determine the width of riparian management area, the water classifications differ across the States.

In Oregon, streams are then broken down into three beneficial use categories:

- Type F streams have fish, and may also be domestic water supply,

[4] Designated zone immediately adjacent to a stream
[5] Designated zone adjacent to, but upslope from the core zone
[6] Designated zone adjacent to, but upslope from the inner zone

- Type D are non-fish bearing streams that are domestic water supply,
- Type N are streams that do not fit into the other two classifications.

Water classes in Washington also depend on beneficial use. However, there are four types of beneficial use:

- Type F streams have known fish, amphibian, wildlife and drinking water use,
- Type S are shoreline streams for large rivers or creeks that require permits for harvesting within 200 feet,
- Type Np streams flow year round but have no fish use; they are protected primarily for downstream fish habitat and water quality,
- Type Ns are streams that do not flow year around but context to other types of streams, there are no buffer requirements on these waterways, but use of heavy equipment is limited to 30 feet on each side of the water.

The California Forest Practices rules break streams down into four classes based on beneficial use:

- Class I streams are domestic water sources where fish are always or seasonally present,
- Class II are fish bearing stream (seasonal or annual) that are not domestic water sources,
- Class III are streams with no aquatic life present but where the watercourse shows a link between these streams and Class I & II streams,
- Class IV streams are human-made watercourses, usually downstream of streams classified for other uses.

The widths of RMAs depend on several characteristics of the harvest area that vary by state. For example, in Oregon RMAs depend on stream size and use, while in Washington they depend on use, site class, bankfull width, and location.

In Oregon, the RMA size depends on stream size and beneficial use. Average annual flow determines stream size:

- Large streams have an average annual flow of > 2 cubic feet per second and a width greater than 12 feet,
- Medium streams have an average annual flow 2 ≥ and >10 cubic feet per second, 7 to 12 feet wide,

- Small streams have an average annual flow >2 cubic feet per second, or drainage area less than 200 acres and are less than 7 feet wide.

The combination of size and beneficial use leads to RMA sizes ranging from 0 to 100 feet along streams.

Stream Size	Type F	Type D	Type N
Small	50'	20'	N/A
Medium	70'	50'	50'
Large	100'	70'	70'

Table 1: Oregon Riparian Management Area widths (for each side of a stream).

Riparian management areas are designated where foresters must apply special riparian habitat prescriptions. Inside these boundaries, harvesting is limited to ensure riparian and aquatic habitat protection. In Oregon, riparian harvesting rules apply equally throughout the entire area.

Washington's riparian management zones (RMZ) [7] differ given the streams beneficial use, bankfull width (BFW), site class, and, location. BFW measures across a body of water, where there is a break in the slope or the erosion line in a steep stream bank caused by the stream on either side. Site classes are the potential growth rating for trees within a given area based upon soil surveys with site class I being the most productive.

Site Class	Western WA Total RMZ Width	Eastern WA Total RMZ Width
I	200'	130'
II	170'	110'
III	140'	90' or 100'*
IV	110'	75' or 100'*
V	90'	75' or 100'*

*Dependent on bankfull width

[7] Riparian management zones are equivalent in definition and function to riparian management areas

Table 2: Washington's riparian management zone widths by site class in Western and Eastern Washington.

Total RMZ width contains the 30 feet or 50 feet required core zone, plus the inner and outer zone sizes, which vary, given the BFW, site class and location of the stream. In Washington, riparian harvesting differs throughout the RMZ, depending on zone (distance from stream).

The width of RMA along streams in Washington vary based on factors for watershed protections, and other site-specific needs to determine the size of designated RMA zone. Oregon takes similar considerations, but they are not as comprehensive as Washington's rules. Washington uses site classes to determine the size of the riparian management area. Previous soil and watershed studies that rank forests along streams for their growth potential are the basis of site classes. Sites with greater potential to grow are given more protections to allow for that growth.

Oregon's consideration of harvest location is comparable to site classes in Washington. However, instead of RMZ size that changes, Oregon uses geographic regions to determine target conifer basal area within RMAs. Average size and number of conifers within old growth stands in each geographic area are the basis for target basal area. Despite the logistical differences, the goal of these two management techniques is for managed stands to reach desired future conditions (DFC).

California defines different Watercourse Lake Protection Zones (WLPZ)[8] for the protection of these waterways based on beneficial use classes, slope class measured from the hillslope edge of the channel zone.

Stream Class	<30% Slope	30- 50% Slope	>50% Slope
Class I	75'	100'	150'
Class II	50'	75'	100'

[8] Watercourse Lake Protection Zones are equivalent in definition and function to riparian management areas and riparian management zones.

Class III	Discretionary*	Discretionary*	Discretionary*
Class IV	N/A	N/A	N/A

*Established at the discretion of the Registered Professional Forestry or the California Department of Forestry and Fire Protection

Table 3: California Watercourse and Lake Protection Zone Widths

Class I & II streams have zones ranging from 50-150 feet. Class III & IV zones may not have any buffers at all to protect these tributaries from harms caused by harvesting.

Like in Washington, within each WLPZ there are three zones, the core zone, inner zone and outer zone. The size of those zones differs based on geographic location.

Geographic Location	WLPZ	Core	Inner	Outer
Non- anadromy zone	100’	30’	40’	30’
Anadromy zone	150’	30’	70’	50’
Flood prone area	150-200+’	30’	A: 70-120’ B: End of FA	End of FA+50’

Table 4: California Watercourse and Lake Protection Core, Inner and Outer zone widths

The California forest practice rules define different goals for protections within each of the WLPZ zones. The objective for the core zone is to promote bank stability, wood recruitment by bank erosion and canopy retention, for these reasons, timber operations are excluded from this zone. The goal of the inner zone is to develop large trees for large wood recruitment, to provide additional shading and provide diversity for nutrient input and species habitat. Harvesting objectives aim to promote the growth of large wood. The objectives for the outer zone is to provide a series of protections for the other two zones such as wind protection or microclimate control.

The California Forest Practices Act does not contain vast differences in regulations of harvest based on geographic location. The major geographic distinctions in the rules occur between the coastal anadromy zone, the non-anadromy zone and areas identified as flood-prone. The location, beneficial use, and slope of the planned harvest area all determine the limitations for harvest in each of the zones. Although different

districts within California may have standards for commercial harvesting in their region, there are no requirements for districts to create site-specific considerations.

Fish Stream Harvest Prescriptions

In Oregon, fish bearing streams have a range of RMAs from 50 to100 feet in width with basal area targets depending on geographic region and harvest type. Basal area (BA) targets range from 20 to 50 BA on small streams, 70 to 160 BA on medium streams, and 130 to 310 BA on large streams. All regions must retain understory vegetation within 10 feet of high water level, trees within 20 feet of high water level, and all trees that lean over the channel and all snags and downed wood.

Geographic Region	**Standard Targets for Streamside Retention**		
Coast Range & S. Coast	300	160	50
Interor & W. Cascade	350	180	50
Siskiyou	290	140	50
E. Cascade & Blue Mountains	220	120	50

Table 5: Standard Basal Area Targets for Streamside Retention in Oregon on Fish-Use Streams for Type 1 or Unclassified Harvest Prescriptions

Type 1 or unclassified harvest prescriptions are heavy thinning or light thinning. Harvesting can only occur in the RMA if basal area targets are met.

Geographic Region	**Standard Targets for Streamside Retention**		
Coast Range & S. Coast	230	120	40
Interor & W. Cascade	270	140	40
Siskiyou	220	110	40

E. Cascade & Blue Mountains	170	90	50

Table 6: Standard Basal Area Targets for Streamside Retention in Oregon on Fish-Use Streams for Type 2 or 3 Harvest Prescriptions

Type 2 or 3 harvest prescriptions are clearcutting either with enough LWD or without. Harvesting in the RMA only occurs if target basal area is met first.

In Washington, the non-harvest core zone is either 50 feet or 30 feet—depending on geographic location—in Western and Eastern WA, respectively. The inner zone contains a buffer ranging from 10 to 100 feet from the core depending on stream site and site class (or site potential). Additionally, the basal area of the core and inner zone must meet desired future conditions target[9] at 140 years. The outer zone ranges from 22 to 67 feet from the inner zone. In the inner zone there must be 20 leave trees per acre and compliance with shade requirements, which depends on desired future conditions of the site class.

Site Class	**Target BA**	**RMZ Width**	**RMZ Width**	
			BFW <15'	**BFW>15'**
I	325 sq. feet per acre	200'	130'	130'
II	325 sq. feet per acre	170'	110'	110'
III	325 sq. feet per acre	140'	90'	100'
IV	325 sq. feet per acre	110'	75'	100'
V	325 sq. feet per acre	90'	75'	100'

[9] 1325 sq ft/acre in all regions

Table 7: Desired Future Conditions for Target Basal Area in Washington on Fish-Use Streams

Harvesting within the RMZ occurs only if target basal area is met. Studies found that target basal area does not differ significantly across site class. However, the width of the area that must contain the BA differs based on BFW and site class. If target basal area is met, there are two different harvesting prescriptions possible: thinning below the canopy and leaving trees closest to core zone.

In California, the zones for Class I (fish are always or seasonally present, and are domestic water sources) streams are 0 to 30 feet, 30 to 100 feet and 100 to 150 feet for the core, inner and outer zones, respectively. No harvesting is allowed in the core zone. The inner zone must maintain 80 percent of the overstory canopy cover in the Coast and Southern Districts and 70 percent in the Northern Forest District. Leave tree rules require the retention of the 13 largest trees per acre (TPA). Timber operations are allowed in the outer zone, so long as 50 percent of the overstory canopy cover is met. There are no leave tree requirements for the outer zones. Additionally, the preharvest canopy must be comprised of 25 percent conifers and hardwoods. Flood prone areas surrounding Class I streams require special considerations for harvesting. The core zone maintains a 30-foot buffer, inner zone A contains a 70 to 120-foot buffer, inner zone B ends at the end of the flood prone area, and the outer zone extends 50 feet past the flood prone area. Inner zone type A contains the same harvest requirements as non-flood prone Class I streams.

Class II streams in California are fish bearing streams that are not domestic water sources. The core zone is 30-feet and have a no-harvest prescription. The inner zone is 40-feet and require the retention of 70 percent of the overstory canopy and 7 of

the largest trees per/ac. The outer zone is 30-feet and require the retention of 50% of the overstory canopy cover.

Stream Class	Geographic Location	Core Zone	Inner Zone	Outer Zone

Table 8: Target Streamside Retention in California on Fish-Use Streams

There are no basal area targets required on fish-use streams. Listed above are the different harvesting prescriptions based on geographic location and stream class.

Non-Fish Stream Harvest Prescriptions

Harvesting regulations along non-fish streams are consistently less stringent than those for fish bearing streams across all three states. In Oregon, RMA size is about 30 feet less on either side of stream for type D and type N streams, and there are no buffer requirements for small non-fish and non-domestic water supply streams.

Geographic Region	Standard Targets for Streamside Retention		
Coast Range & S. Coast	140	60	0
Interor & W. Cascade	160	60	0

Siskiyou	120	60	0
E. Cascade & Blue Mountains	100	60	0

Table 9: Standard Basal Area Targets for Streamside Retention in Oregon on Fish-Use Streams for Type 1 or Unclassified Harvest Prescriptions

Type 1 or unclassified harvest prescriptions are heavy thinning or light thinning. Harvesting can only occur in the RMA if basal area targets are met.

Geographic Region	**Standard Targets for Streamside Retention**		
Coast Range & S. Coast	90	50	0
Interor & W. Cascade	110	50	0
Siskiyou	90	50	0
E. Cascade & Blue Mountains	70	50	0

Table 10: Standard Basal Area Targets for Streamside Retention in Oregon on Fish-Use Streams for Type 2 or 3 Harvest Prescriptions

Type 2 or 3 harvest prescriptions are clearcutting either with enough LWD or without. Harvesting in the RMA only occurs if target basal area is met first

In Washington, harvesting along non-fish use streams (Np class streams) often depends on the relationship to fish-use streams. In Western Washington greater the distance from the fish use stream that non-fish streams flow into, the smaller the no touch riparian management zone for the Np stream in Western Washington, with additional considerations given to sensitive site locations. In Eastern Washington, there is a 50-foot no harvest buffer along all Np streams, unless the stand meets target basal area[10]. Buffers are not required for streams that do not flow year round (Ns streams) but there is a 30-foot equipment limitation zone in both Western and Eastern Washington.

Streamside Retention in Western Washington

[10] Similar to target basal area on fish-use streams

Distance from fish use stream	Length of 50' No Touch RMZ
300>	The entire length of the stream
300'> 1000'	50% of the length, or 300'
>1,000'	500'

Table 11: Streamside Retention in Western Washington on Np Streams

Washington requires no-touch buffers along non-fish bearing streams and there are no target basal area requirements.

In California, Class III streams (streams with no aquatic life that flow into fish-use streams), and Class IV streams (human-made waterbodies) are both non-fish bearing streams. There is a 20- foot buffer along streams with slopes of greater than 30 percent and a 30-foot buffer along streams with less than a 30 percent slope. All trees must be retained in these buffers, but there are not distinctions of core, inner, or outer zones. Trees outside the 20 or 30-foot buffer are subject to “normal” harvesting practices outside the watercourse lake protection zones.

Class	Slope Class	
	<30 %	**> 30 %**
III	30'	20'
IV	N/A	N/A

Table 12: Streamside Retention in California on Non-Fish Bearing Streams

California requires no touch buffers on tributary streams and no protections on human-made bodies of water.

Evolution of Riparian Management

Following World War II timber harvest on federal, state, and private lands accelerated and the most economical harvesting was occurring at high-volumes in forests of large, old trees. The environmental impacts of such practices were not a consideration to foresters, policy makers, or the general public. Documented losses of

riparian vegetation and aquatic species caused concerns about environmental impacts to increase.

In the late 1960's, loss of forest habitat coupled with the ESA listing of several aquatic species in the Pacific Northwest gained public attention. Land management agencies responded to changes in forested habitats by creating state-level forest practices for both public and private forestlands. Agencies outlined six characteristics that influenced the development of forest rules on public and private lands (Everest & Reeves, 2007):

- Clear goals for management of resources
- Economic considerations of resources
- Non-market value of resources
- Social values regarding environmental and resource preservation
- Scientific information
- Federal and State laws

Although the initial forest practices contained few considerations for riparian habitats, the above six elements that shaped forest practices molded documents that would be dynamic in nature and scope (Everest & Reeves, 2007).

Since 1971, the goals and forest practice rules (generally known as 'best management practices' or BMPs) have changed numerous times, leading to the riparian management practices outlined in the previous section. Despite agencies and forest managers goal of basing these rules on scientific information, little research has been conducted analyzing what drives changes to forest practices. In Oregon alone, the rules for riparian protections have been majorly updated fifteen times in forty years (Everest & Reeves, 2007).

1970's to 1990's

Oregon

In 1971, the Oregon State Legislature drafted and approved the first comprehensive forest plan in the Pacific Northwest (ODF, 1995).

The goal of this policy was to:

> Encourage economically efficient forest practices that ensure the continuous growing and harvesting for 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 resources and scenic resources within visually sensitive corridors as provided in ORS 527. 755 and to ensure that continuous benefits of those resources for future generations of Oregonians (ODF, 1995).

The rules divided streams into two classes, fish-bearing (Class I) and non-fish-bearing (Class II). The goal for vegetation conservation all along both classes of streams was to comply with state water quality standards. Class I streams required preservation of 75 percent of the original shade cover. Shade cover requirements were achieved by leaving non-merchantable trees, or a fringe of merchantable trees in areas where there were not sufficient non-merchantable trees. If other means of maintaining stream temperatures were available, then the leave-tree requirements were waived. Vegetation requirements for Class II streams stated that retention or re-establishment of undergrowth must be sufficient to maintain water quality in the downstream Class I streams. There were no specific buffer requirements for either Class of stream.

The original rules evolved significantly over the next several decades. Many of the revisions incrementally increased protections of riparian areas, water quality, and other aquatic and wildlife habitats. In 1974 and 1976, the changes strengthened protections to reduce erosion, prevent runoff, and limit forest impacts from mechanical

equipment with the goal of protecting water resources, preserving biological diversity and meeting multiple conservation objectives.

Following the addition of Section 208[11] to the federal Clean Water Act (1977), best management practices required approval[12], for all actions that might directly affect water quality. In the same year, legislation added new rules addressing and limiting the "filling and removal" of material from stream channels and other stream channel alterations (ODF, 1995).

Several changes occurred in the 1980s in response to severe storms and mass erosion in the coastal range. In 1981 and 1982, rules were adopted requiring written plans for operations in areas with known high risk of erosion. In 1987, following several aquatic species listing under the ESA and updated ESA requirements, a new amendment required written plans for forestry operations within about 100-feet[13] of Class I streams and about 300 feet of sites of threatened or endangered species, wetlands, and other identified sensitive sites (ODF, 1995).

Washington

In 1974, Washington adopted their first comprehensive Forest Practices Act. The act was amended in 1976 to focus more on road construction, maintenance, timber harvesting, reforestation, and use of chemicals. In 1979, a committee identified fourteen issues related to forest practices and their impacts on the environment. The issues recognized were riparian considerations like erosion, watersheds, fish habitat, and slide areas. New rule changes following the 1982 Endangered Species Act, addressed issues

[11] Section 208 of the CWA requires agencies to control nonpoint source pollution by creating "best management practices" to reduce or remove waste to achieve water quality goals
[12] By the Oregon Department of Forestry
[13] Listed as 30 meters in the document, but current regulations measure in feet

of chemical applications, forest roads, timber harvest, debris disposal, and habitat considerations.

In 1984, several agencies in Washington conducted studies on cumulative effects of timber harvesting on riparian habitat and in the same year state legislature adopted the State Environmental Policy Act (SEPA), which required state agencies to adopt environmental assessment rules (WDNR, 2013).

In 1987, the Washington government established the Timber, Fish, and Wildlife (TFW) Policy Committee. The TFW is an interagency collaborative group including state agencies, industrial and small forest landowners, tribes, counties and environmental groups. The committee gathered together to develop and recommend the TFW rules package, a process for proposing rules to the Forest Practices Board. The TFW rules package for riparian areas[14] contained—riparian management zones (RMZs/RMAs) (1988), and watershed analysis requirements (1991) (WDNR, 2013).

California

Although California has regulated their forest practices since 1945, this legislation consisted of only voluntary regulations to encourage long-term production of timber. Several reports published from 1957 to 1962 connected California's forest practices to increased stream erosion, adverse watershed ecology, smaller salmon populations, and a failure of requiring timber harvesters to uphold public values[15].

[14] The TFW package was a complete overhaul of all components to forest management, those listed focus on changes to riparian management

[15] Final Report to the Legislature 1957; Findings and Recommendations Related to the Forest Practices Act 1961-1962

In light of these reports, and others[16], Legislatures in San Mateo County challenged the constitutionality of the State Forest Practices Act in an appeals case against Bayside Timber, and the laws were found to be unconstitutional (Bayside Timber Co. v. Board of Supervisors, 1971). Then in 1972, a study conducted by the University of California at Davis[17] lead to the creation of the current forest practice rules in California, the Z'Berg-Nejedly Forest Practices Act (Duggan & Mueller, 2005).

In 1973, the Z'Berg-Nejedly Forest Practices Act created an entirely new regulatory framework based on submission and review of Timber Harvest Plans (THP) and other types of plans or proposed projects to retain permits that govern timber operations on private forest lands. THP's are environmental review documents designed to protect timber harvest sites by requiring landowners to submit a plan for the types of harvesting, location and procedure of a project, and the process for mitigating environmental impact (Duggan & Mueller, 2005).

In 1982, California enacted a state level California Environmental Quality Act (CEQA) that required all state agencies to submit environmental assessments. As a result, the California FPA was updated, requiring that all companies must complete THPs before cutting timber on their land. However, in 1988, the Environmental Protection Agency refused to certify California Forest Practice Rules (FPRs) as "best management practices" under section 208 of the Clean Water Act. Because those practices lacked insufficient analysis and monitoring of environmental impacts, the EPA has continued to deny California's best management practices as compliant with the CWA Section 208 water quality requirements since 2002 (Kertsen, 2002).

[16] Man's Effect Upon the California Watershed 1965-1967; An Environmental Tragedy, 1971)
[17] Public Policy for California Forest Lands

Comparison

All three of these states passed their forest practices act in the 1970's. After their initial enactment, Oregon policymakers made several small changes to expand or clarify their rules the major updates to riparian policies occurred 1-3 years after a federal law protecting water quality or animal habitat. Examples of this include the change following the CWA addition of Section 208, and the updates following the Endangered Species Act.

Like in Oregon, Washington's FPA had small updates to their riparian protections in the first two decades. In the 1980's, Washington made several changes to their riparian protections following state policy changes like SEPA (1984) and the coalition of the TFW Policy Committee (1987) brought changes beginning in the late 1980's and continuing into the early 1990's.

California's early stage developmental history differed significantly from Oregon. Despite having an FPA in 1945, during this era, they failed to make adequate changes comply with federal level policies like the CWA Section 208 BMP requirement. The biggest change to riparian policies in California during these two decades occurred in response to the CEQA (1982).

All three states followed a pattern of development that begins with state or federal policy change. This requires the department of forestry to review their forest practices to determine any area where the policies do not comply with the new federal/state regulation. Then the department of forestry must propose changes to the rules so that the practices comply with federal or state legislation.

Figure 3: Development process of forest practices in Oregon, Washington, and California from the 1970's to the 1990's.

This developmental process appears to be the most basic cycle that public policy development for forest practices undergoes. There is little to no policy change independent of a federal or state level required update. All three state follow the same process from the enactment of their forest practices act in the early 1970's until the 1990's or later.

1990's to Early 2000's

Oregon

In December of 1990, the Oregon Board of Forestry met to review the 1987 water protection rules in response to concerns drafted by the Department of Fish and Wildlife. In 1991, Senate Bill 1125 passed and instructed the Board to review water classifications so that they reflect perennial streams, domestic water streams, and address a new target water quality standard (Lorensen, Andrus, & Runyon, 1994).

Subsequently, in 1992, adoption of interim stream protection rules required the Oregon Department of Forestry and the Forestry Board to publish a series of documents examining the effectiveness of stream protections and detailing new policy considerations[18].

In 1993, rules were adopted for listing habitat sites that are scientifically and ecologically significant, and in 1994 the rules were adopted for classification and protection of waters with the objective of reaching the desired future condition for mature riparian areas (ODF, 1995).

The 1994 water classification structure provides different levels of protection based on stream size and beneficial uses[19], and expanded protections for wetlands, lakes and other water bodies. Additionally, adoption of Type D (non-fish, domestic water sources) streams buffer protection occurred. These rules included considerations of large woody debris by providing incentives for conservation of hardwood riparian areas to conifers and stream enhancements.

In 1994, Proposals for a Forest Practices Monitoring Program (FPMP) were submitted and adopted in 1996 (Brown & Hallock, 2002).

In 1999, as part of the riparian monitoring program, the Governor of Oregon commissioned an Independent Multidisciplinary Science Team to assess the effectiveness of these practices for protecting salmonid habitats. This study found that the 1999 rules are unlikely to contribute to the recovery of habitat for depleted populations of anadromous salmonids (IMST, 1999).

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[18] In 1993, the ODF published the "Riparian Rule Effectiveness Study Report" (David, 1993) and the "Report on the Analysis of Proposed Water Classification and Protection Rules" (Lorensen T. , Andrus, Mills, & Runyon, 1993). In 1994, the Oregon Board of Forestry published "The Oregon Forest Practices Act Water Protection Rules: Scientific and Policy Considerations" (Lorensen, Andrus, & Runyon, 1994).
[19] The 1994 classification system is the current system.

Required by the monitoring program, the ODF has partnered with several agencies to conduct paired watershed studies beginning in 1998. In 2002, the ODF published a report evaluating the effectiveness of riparian protections comparing conditions of upstream harvest units to downstream harvest units. The 2002 report determined that more research was needed using a different method to adequately determine compliance with the Oregon Department of Environmental Quality (ODEQ) water quality standards (Brown & Hallock, 2002).

Washington

In 1997 four salmonid species native to Washington and the Pacific Northwest were listed on the endangered or threatened species list:

- Upper Columbia River Steelhead (endangered, 1997),
- Snake River Steelhead (threatened, 1997),
- Lower Columbia River Steelhead (threatened 1998),
- Bull Trout (threatened 1998)

As a result, several Washington state and federal agencies conducted a collaborative report, known as the Forests and Fish Report, "to develop biologically sound and economically practical solutions that will improve and protect riparian habitat on non-federal forest lands in the State of Washington" (USFWS, et al., 1999). The Forest and Fish Report (also called Forestry Module) combined with the Salmon Recovery Act (1999) prompted an update of riparian rules in 2001 (WDNR, 2013).

These changes included (WDNR, 2013):

- a riparian easement program,
- rules for harvesting on unstable slopes,
- a new RMZ structure,
- a new watershed analysis process,
- a new water classification system,
- an adaptive management program,
- a monitoring program

California

From the early 1990s to the early 2000s, several scientific studies have been published detailing the inadequacies of the California FPA at analyzing cumulative impacts, complying with the CEQA, and protecting endangered salmonoid species (Duggan & Mueller, 2005). One of the first changes to the original FPA was the implementation of a Monitoring Study Group in 1990. From 1991 to 1996, the Board of Forestry adopted regulations governing the analysis of cumulative effects, regulations to require monitoring of the effectiveness of mitigation measures as part of the THP review process, and procedures aimed at mitigation of impacts of harvesting on salmonid species (Duggan & Mueller, 2005).

In 1999, the California Resource Agency and the National Marine Fisheries Service submitted a report to the California National Marine Fisheries Service. The report concluded the THP process does not ensure adequate protection of anadromous salmonid populations, and the cumulative effects rule did not provide the necessary cumulative impacts assessment (Ligon, Rich, Rynearson, Thornburgh, & Trush, 1999).

Comparison

For Washington and Oregon, the era from 1990-2000 brought significant changes to protections in riparian areas. Unlike the previous period, these changes tended to incorporate scientific findings of riparian ecosystems.

In Oregon, following concerns by state agencies for timber harvesting impacts on aquatic ecosystems, Senate Bill 1125 was passed (1991) that required the review of all rules to ensure that they included scientific considerations for aquatic and riparian habitat health. Still, the policy process in Oregon was, policy sparked research that in turn changed the riparian rules.

After the creation of the Forest Practices Monitoring Program (1994-96), Oregon's rules for harvesting near riparian habitats were reviewed and regularly updated, per policy requirements, to ensure compliance with water quality requirements, salmonid habitat needs, and desired future conditions. These examples show that while the ODF incorporates scientific research when reviewing forest policies, it is not the driving force for policy updates. Instead, policy updates in Oregon follow state-level or federal-level legislation, or public demand.

Similar to Oregon, Washington's rules developed following federal or state policy changes. In Washington, the largest changes to riparian protections came after the listing of several salmonid species on the endangered or threatened species list in 1997 and 1998. In 1999, the Washington Department of Natural Resources developed the Forests and Fish Report to re-examine the aquatic protections within riparian areas on forestlands. 1999 was the first time Washington policymakers incorporated scientific findings into the creation of policies for harvesting near riparian and aquatic habitats.

Due to the lack of history of developments in their riparian area forest practices, the evolution of California's rules were challenging to outline. From the information available, it seemed that unlike in Oregon and Washington, California had very few changes to their policies during this era. In fact, many studies highlighting the inadequacies of California's policies at protecting riparian and aquatic ecosystems. Despite attempts from the California Board of Forestry to address the concerns laid out by other state agencies, in 1999 these were proved to be inadequate by the California Resource Agency and the National Marine Fisheries Service.

While forest practices in California and Washington follow the same developmental process as they did in the 1970's to 1980's (see figure 3), scientific information begins to play a more integral part of the policy making process after 1991. Figure 4 shows the change to the forest policies development process in Oregon. California and Washington continued to follow the development process shown by figure 3, where changes to the forest practices followed a state or federal policy change. Towards the end of the 1990's and the development of Washington's forest practices began to move out of figure 3 developmental phase and into figure 4's developmental process following the Washington Forest and Fish Report of 1999.

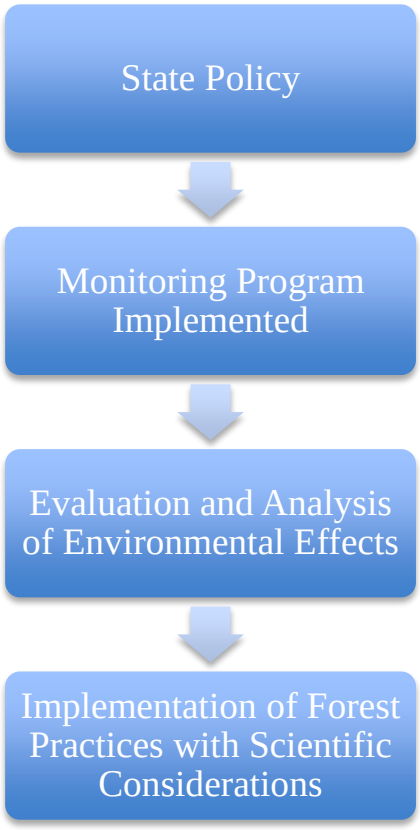

Figure 4: Developmental process of forest policies in Oregon in the 1990's to the 2000's.

Following the Senate bill requiring the implementation of a monitoring program, the developmental process of Oregon forest practices was altered so that review of forest practices occurred on a set schedule. Often, changes to the forest practices reflected new information discovered during the review and analysis process.

Early 2000's to Present

Oregon

Proposed in 2003, the Riparian Function and Stream Temperature (RIPStream) study combines research conducted by the FPMP, Oregon Department of Forestry's State Forest Monitoring Program (SFMP), the Department of Fisheries and Wildlife at Oregon State University and the United States Geological Survey (USGS), to determine

the adequacy of current forest practices at achieving the Department of Water Quality's stream temperature requirements.

As a result of the Forest Monitoring Program, the ODF began funding three paired watershed studies and a study on the impacts of harvesting on stream temperatures (Everest & Reeves, 2007). The paired watershed studies in Hinkle (2001), Trask (2006) and Alsea (revised 2006), are being reviewed and published, and will likely influence changes to the forest practices in the near future.

Findings from the RIPStream have already influenced rule changes for 2017. These changes include additional resources protections on small and medium sized fish-use streams. If enacted, these rules will increase forested buffers by 10 feet and double the tree retention requirements on those streams; this could happen as early as July 2017 (ODF, 2016).

Washington

Recent riparian management changes have included changes to the riparian easement program (2000), changes to the Type Np (non-perennial streams) buffer treatment (2008), and implementation of desired future conditions considerations (2009). In 2003 and 2012, Washington Riparian Pilot Studies were initiated and concluded in 2007 and 2016, respectively (WDNR, 2013). The most recent updates to riparian considerations are likely a result of these pilot studies.

California

In 2000, the Northern California steelhead trout was listed as threatened under the Endangered Species Act. From 2001-2003, several reviews of the forest practices impacts on water quality were published. These studies concluded that the THP method

was not sufficient at addressing effects on watersheds (Dunne, et al., 2001), protecting water quality and endangered species (Kertsen, 2002), or allowing growth of forest practices to ensure compliance of water quality standards (Humbolt Watersheds Scientific Review Panel, 2003).

Published in 2004, the Recovery Strategy for California Coho Salmon required a forest practices monitoring group. Since 2004, the Board of Forestry has worked to update and expand the protection of riparian areas through Watercourse and Lake Protection Zones. In 2005, the Monitoring Study Group became the primary advisory committee to the Board of Forestry (Zimmy, 2008).

Comparison

Over the past ten years, Washington has attempted to integrate similar considerations as Oregon to their forest practices. But Washington has yet to develop a comprehensive plan for forest practices monitoring and evaluation like the 1993 Policy Considerations document from the Oregon Department of Forestry. Regular monitoring of Oregon's forest practices since the mid 1990's, promoted studies evaluating the effectiveness of the BMPs. Those studies continue to influence updates to the riparian habitat protections today.

Implemented about a decade later than in Oregon, Washington's monitoring program has just begun to review the effectiveness of BMPs at reaching habitat and water quality desired conditions. Implementation of a monitoring program in California occurred about six years after Washington. Unfortunately, there was little information on the effectiveness of their monitoring program and few studies at the same magnitude as the Oregon RIP Stream study or Washington Pilot studies.

Since the early 2000's Oregon has been in a stage of policy where rule changes are monitored to ensure mitigation of potential negative impacts (see figure 5). Washington is still in the process of developing their monitoring and evaluation program, where their developmental process looks like figure 4. Despite enacting a monitoring program only four years after Washington, California's policy development process has not changed much in response.

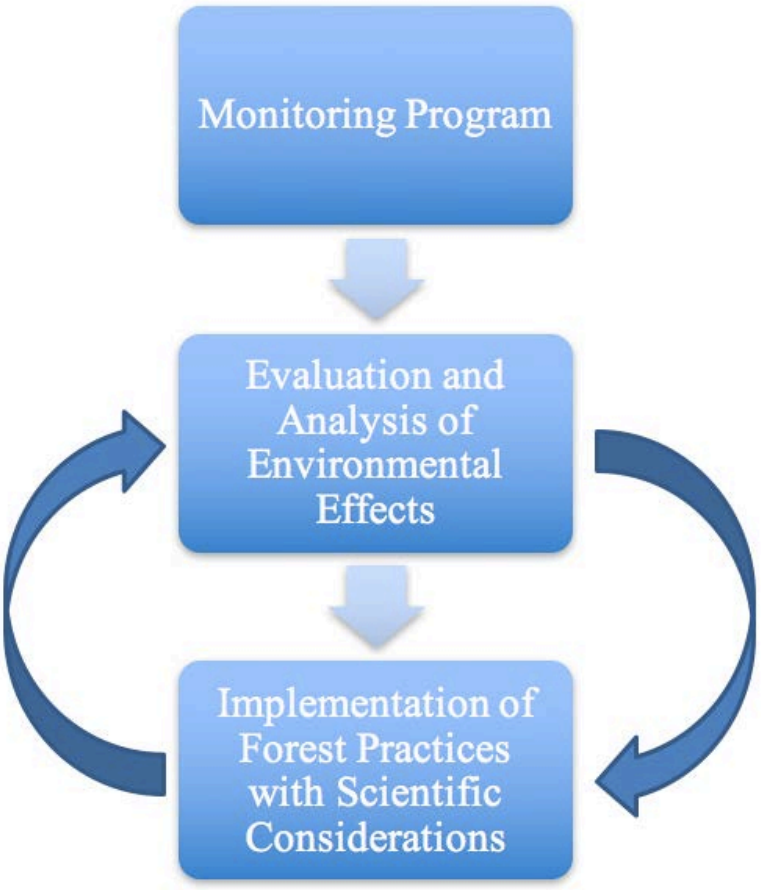

Figure 5: Developmental process of forest policies in Oregon in the 2000's to present.

Since the 2000's Oregon's forest practices policy development have continued to be monitored and updated following paired watershed studies and other collaborative studies all of which evaluate the effectiveness of forest practices at reaching Oregon's desired future conditions. The monitoring program shifted the policymaking process from being a linear process to a cyclic cycle of continuing monitoring and updating of forest practices.

Despite the similarities between Oregon, Washington, and California's forest practices in the first ten years of development, incorporation of scientific information occurred at different times. The integration of science into policies changed the course of each states harvesting rules in riparian areas. The developmental history of Oregon, Washington, and California shows that the process of incorporating scientific information into policy considerations vary on the basis of normative decisions made by

policymakers within each region. Different opinions among decision makers on how much protection riparian areas need to achieve their desired future conditions are the basis of variances in environmental public policy on riparian areas.

Discussion and Conclusion

This thesis concludes with an evaluation of the motivations that have shaped riparian protections in the Oregon Forest Practices Act. In light of current debates taking place amongst stakeholders involved in this topic, it is of the utmost importance to understand the part that science plays in the public policy process.

Since the time of their enactment, state-level forest policies in Oregon, Washington, and California have been developed to protect the streams and riparian habitats better. Current rules preserve the ecological processes that form and maintain riparian and aquatic ecosystems more than their predecessors. However, decades of environmental degradation to these areas have had lasting impacts.

In all three states, part of what slowed the development process of riparian policies was the burden falling on scientist to prove that habitat disturbances on riparian areas were a direct result of forest practices. In the first 10 years following implementation, forest practices were limited only following state or federal regulations. Without scientific proof of environmental damage, the timber industry and management were reluctant to respond to concerns for timber harvesting effects on salmon. And even when scientific proof existed in the early 1990's in California, Legislatures were slow to limit harvesting.

In Oregon, although harvesting had been occurring since World War II, evidence showing the negative impacts of timber harvesting near streams was not available until the Alsea Watershed Study in Western Oregon in 1973 (Morning & Lantz, 1975). Similarly, in Washington and California, rules were adopted in 1972 with

little to no research on the impacts of harvesting near streams (Everest & Reeves, 2007; Duggan & Muller, 2005).

My research suggests the variations in degree of scientific consideration between forest practices in these states lay in the different politics within state legislatures. Through the forest practices monitoring programs, Oregon Department of Forestry has done an adequate job at incorporating scientific considerations into their forest practices compared to Washington and California. However, it has never been the driving force behind policy changes.

Before monitoring requirements, incorporation of scientific information in the forest practices rules was largely up to the state legislatures. Prior to monitoring programs, evaluation and alterations in Oregon and Washington's forest practices only followed changes in state or federal legislature (see figure 3). That type of developmental process occurred from 1972 to 1992 in Oregon and from 1974 to 1999 in Washington.

Oregon's first forest practices had no rules requiring the Oregon Board of Forestry to monitor stream conditions or evaluate the impacts of forest practices on the environment. During this period, changes to harvesting rules in riparian areas only followed state or federal legislation for habitat or species protection. Federal statutes, like the Clean Water Act, required state agencies to conduct analysis on the impacts of policies on riparian and aquatic habitats. Typically, findings concluded that more protection was needed to achieve the desired conditions of riparian ecosystems.

This normative process of rulemaking and response was likely a result of a legislatures placing greater value on the economic importance of timber harvesting over

environmental protection. In the late 1960's federal agencies began limiting their harvesting actions on public lands in response to scientific research linking timber harvesting to habitat degradation in riparian ecosystems (National Resource Council, 2002). Between 1970 and 1990, while the forest practice rules were in effect, the quality of riparian and aquatic habitats on private forestlands in the Northwest declined (USDA & USDI, 1994). Therefore, it was not a lack of credible scientific information that limited the degree to which legislatures used scientific considerations in the decision-making process before monitoring programs; it was likely due to other politics.

Without monitoring requirements, the role of science in influencing forest practice rules is largely up to the state legislatures. Monitoring programs in Washington (1999) and Oregon (1992) required the state legislatures to pay closer attention to evaluations of the forest rules on protecting and maintaining aquatic and riparian ecosystems.

California is an example of what happens without an adequate monitoring program. Despite decades of research highlighting the inadequacies of harvesting practices at protecting salmonid habitat, the legislature failed to adequately address these issues[20]. The failure happened not because of a lack of scientific information detailing how to adjust their practices to better protect these areas, not only did state agencies publish documenting the needs of riparian ecosystems, but rather a reflection of the policymakers' view of necessary protection of riparian areas.

[20] See section on changes in California Forest Practices from early 2000's – Present under Evolution of Riparian Management

State agencies[21] regulating forestry practices are responsible for proposing monitoring programs to state legislatures. When programs are absent or ineffective; it is a result of forestry departments not placing enough value on environmental protection.

After monitoring program implementations, the phases of development of forest practice rules followed a pattern in Oregon and Washington (see figure 4). The monitoring program required frequent evaluation and analysis of the environmental impacts of forest practices on forest habitats. Following new scientific information gathered, the "best management practices" were negotiated between stakeholders with the goal of allowing for the greatest amount of harvest possible with the minimum level of protection needed to maintain productive riparian ecosystems.

The resulting BMPs often reflected decisions made by examining the available economic, social, political, and biological information and an attempt to balance the needs of all factors. Then after a few years of implementation, new research studies and ongoing evaluation of stream conditions deemed the BMPs insufficient to meet the management goals or required protections for riparian and aquatic habitats in regards to water quality, bank stability or aquatic habitat structure. Eventually, revisions of rules occur through a cyclic cycle of review, evaluation, and normative decision-making to determine updates to riparian rules. Changes reduced timber harvest and provided more protection for riparian habitats. This process continues today, with the 2017 proposed changes to buffers along fish-bearing streams in Oregon.

After the 1990's, numerous reports and research on the impacts of forest practices on riparian and aquatic habitats have shaped the current BMPs[22]. Suggesting

[21] The Oregon Board of Forestry, for example

that over time, Oregon Department of Forestry began to place greater emphasis on scientific considerations after the 1990's.

Nearly a decade later than Oregon, Washington Department of Natural Resources did the same. Despite this decade-long gap, Washington has more watershed-specific considerations in their BMPs. However, because of how recent those BMPs are, there has been little to no research evaluating their effectiveness.

Additionally, there is a variation of the degree of scientific consideration between the states with monitoring programs. The Oregon Department of Forestry is involved with four[23] major studies evaluating the effectiveness of forest rules at protecting riparian habitats. Washington Department of Natural Resources is only involved with two[24]. That difference suggests that the ODF places a higher degree of emphasis on scientific considerations in their development of current BMPs.

In the future, more research examining the fundamental differences between Oregon's BMPs and Washington's BMPs and evaluating the effectiveness of states BMPs at achieving desired future conditions will help to determine whether or not the decade gap between Oregon's incorporation of scientific considerations and Washington's had significant impact.

I would predict that because the ODF has had more time to conduct research evaluating their BMPs, these practices are more effective at achieving desired future conditions. Additionally, Oregon's paired watershed studies are often a collaboration between a variety of interest groups ranging from watershed community groups, to

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[22] See section on changes to Oregon forest practices from 1990's to early 2000's and early 2000's to present under Evolution of Riparian Management
[23] Hinkle (2001), Alsea (2006), and Trask (2006) Watershed Studies and the RIP Stream Study of 2002.
[24] Washington Riparian Pilot Study of 2003 and 2012

private timber company hydrologists, to scientists working with for the Oregon Department of Forestry. This type of collaboration brings all of the different stakeholders together and requires them to work to develop the new best management practices. The varying degrees of scientific incorporation between Oregon and Washington, measured by the number of riparian studies, could likely be a result of the collaboration seen amongst interest groups in Oregon when developing forest practices in riparian and aquatic habitats. Collaboration of interest groups is not seen in the same magnitude in Washington and likely has negative impacts on their policy development process.

Compared to our surrounding states, Oregon has done a better job at responding to concerns regarding the effectiveness of their practices at achieving the riparian and aquatic habitat management goals. However, decades of poor best management practices have resulted in degradation of riparian and aquatic habitat quality.

To what extent should current commercial forests be regulated to make up for degradation that occurred because of historical forest practices? This question is not answered in this thesis, and depends heavily on social, political and economic influences. Future management strategies must be based on ecological principles in order to preserve the riparian, aquatic and forest resources.

Future research should address the question; should scientific considerations play a more prevalent role in policy making on private timberlands? Streamside vegetation provides a host of ecological functions, several in which impact the health of salmon and other aquatic species. Frequently, streamside areas contain commercially

valuable trees. It is often up to the state departments of forestry and legislatures to decide on the appropriate balance between ecological benefits and economic factors.

Glossary

BA (Basal area): Area in square feet of the cross section of a tree bole measured at about 4.5 (or chest height) off the ground.

BFW (Bankfull Width): Stream measurement technique defined in the Washington Forest Practices as measuring across a stream where there is a break in the slope or the erosion line in a steep stream bank caused by the stream on either side.

BMP (Best Management Practices): Proactive forest stewardship practices that have been determined to be the most effect, practical means of preventing or reducing soil and other pollutants from entering any water.

CEQA (California Environmental Quality Act): California statute passed in 1970, to institute a statewide policy for environmental protection and assessment.

CWA (Clean Water Act): This federal statute established a structure for regulating pollutant discharges into waters of the United States (1972).

ODEQ (Oregon Department of Environmental Quality): Regulatory agency in Oregon, whose job is to protect the quality of Oregon's environment

DFC (Desired Future Conditions): Goal for vegetation retention in RMA, defined as the average live conifer basal area within unmanaged mature streamside stands in a geographic region.

FPA (Forest Practices Act): State regulation that sets standards for all commercial activities involving the establishment, management, or harvesting of trees on private lands.

FPMP (Forest Practices Monitoring Program): Oregon program that continually reviews the effectiveness of the FPA and its rules through monitoring research.

ODF (Oregon Department of Forestry): Government agency in charge of functions relating to the management, regulation, and protection of public and private forestlands in Oregon.

OFPA (Oregon Forest Practices Act): Body of legislation that sets standards for all commercial activities including the establishment, management, or harvesting of trees on Oregon's forestlands.

RMA (Riparian Management Area): In Oregon the RMA refers to the areas of forestland or vegetation adjacent to a waterbody, to be managed differently than other harvested forestland

RMZ (Riparian Management Zone): Washington's phrase for RMAs

SEPA (State Environmental Policy Act): Washington statute passed in ?, to institute a statewide policy for environmental protection and assessment.

SFMP (State Forest Monitoring Program): Forest monitoring program in Oregon, established in 2009.

TFW (Timber, Fish, and Wildlife): An interagency collaborative group in Washington, including state agencies, industrial and small forest landowners, tribes, counties and environmental groups, gathered together to develop a consensus process for rule proposals that could be recommended to the Forest Practices Board.

THP (Timber Harvest Plan): Environmental review document designed to protect timber harvest sites by requiring landowners to submit a plan for the types of harvesting, location and procedure of a project, and the process for mitigating environmental impact

TPA (Trees Per Acre): Total number of trees in an acre plot.

USGS (United States Geological Services): Federal agency focused on studying the landscape of the United States, its natural resources, and natural hazards.

WDNR (Washington Department of Natural Resources): State agency responsible for managing forest, range, agricultural, and commercial lands in Washington.

WFPA (Washington Forest Practices Act): Body of legislation that sets standards for all commercial activities including the establishment, management, or harvesting of trees on Washington's forestlands.

WLPZ (Watercourse Lake Protection Zones): California's phase for RMAs.

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