CLIMATE CHANGE ADAPTATION PLANNING FOR CULTURAL AND NATURAL RESOURCE RESILIENCE: A LOOK AT PLANNING FOR CLIMATE CHANGE IN TWO NATIVE NATIONS IN THE PACIFIC NORTHWEST U.S.

by

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The literature indicates that for indigenous peoples the environmental impacts of climate change and some proposed solutions threaten lifeways, subsistence, economic ventures, future growth, cultural survivability, rights, land ownership, and access to resources. However, limited understanding and awareness of the vulnerability and capacity of American Indian and Alaska Native tribes and of climate change impacts at the local level affect climate policymaking, planning, and equity. Case studies with the Coquille and Hoopa Valley Indian tribes in the Pacific Northwest U.S. explore the key considerations in planning for climate change adaptation, particularly for cultural and

natural resource resilience. Document analysis and semi-structured interviews offer insight on the risks the tribes face and the role of traditional and local knowledge and experience in planning for climate change adaptation. Conclusions offer information useful in planning for climate impacts, local-level climate adaptation research, and climate policy development at the local to global levels.

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CHAPTER I
INTRODUCTION

Climate change now impacts communities and ecosystems worldwide, and will continue to into the foreseeable future. In the Fourth Assessment Report, Working Group II of the Intergovernmental Panel on Climate Change (2007) asserts with very high confidence that regional climate changes, and temperature increases in particular, now impact natural systems across the globe. Working Group II also asserts with very high confidence that individuals, communities, and nations are, to a limited extent only, beginning to take action to adapt to climate change (IPCC 2007).

Research from the Climate Impacts Group at the University of Washington (2004) suggests that in the Pacific Northwest climate changes are creating warmer and drier conditions in summer, warmer and wetter conditions in winter, and more extremes and variability. These changes could, among many other things, increase potential for: pest and disease outbreaks; drought; wildfire; the loss of glaciers, water resources, and plant and animal species; disruptions in seasonal timing; sea level rise; and intense storms. These environmental changes pose significant risks to all communities, including American Indian and Alaska Native tribes and the landscapes they depend on for livelihood, subsistence, and physical and spiritual well-being (Hanna 2007).

The disruptions climate changes pose to essential ecosystem services and basic needs could significantly alter social, cultural, economic, and political characteristics of human communities (IPCC 2007). The literature indicates these disruptions could introduce new issues and opportunities (LaDuke et al. 2009), and exacerbate existing environmental stresses and social inequalities (Adger 2006). For American Indian and Alaska Native tribes climate impacts pose considerable risks to the landscapes they depend on – their current land bases and traditional territories. Risks to the land will in

turn affect culture, subsistence, economic ventures, future growth, rights, land ownership, and access to resources (Houser et al. 2000; Hanna 2007; Tsosie 2007; Nilsson 2008).

Research and planning at the international, national, or regional level can provide context about climate impacts, but are not a substitute for understanding and action necessary at the local level (Berkes and Jolly 2001; Duerden 2004). American Indian and Alaska Native tribes possess unique identities based on history, culture, social organization, and close connections to the land. Differences in landscapes and social connections to them, approaches, worldviews, cultural responses, and values among tribes make planning locally for climate change necessary in order for it to be appropriately enabled and implemented. Information regarding the climate risks specific to tribes needs to be collected at the local level, and incorporated into climate policy and planning at local, regional, state, national, and international levels so that tribes are able to act to address climate impacts already occurring and prepare for those to come.

Purpose of this Research

Currently, there exists a lack of understanding and awareness about the vulnerability of tribes to climate changes occurring and projected, and about the capacity tribes have to address climate change. There exists also a lack of understanding about how climate change will manifest at the local level – the level of human activity and experience (Duerden 2004). Considering these knowledge gaps, my research explores the key considerations in climate change adaptation planning by taking a look at climate vulnerability and adaptive capacity at the local level through cases studies with the Hoopa Valley and Coquille Indian tribes in the Pacific Northwest U.S. In particular it explores the climate risks the tribes face and their abilities to prepare for, respond to, and cope with climate impacts to natural resources and culture. I intend for the findings and conclusions to inform planning for climate change by the Hoopa and Coquille Indian tribes and climate policymaking and planning at multiple decisionmaking levels.

For the two tribes, this study offers initial assessments of adaptation in practice, current community priorities, observed climate changes and impacts of concern, and

barriers to planning for climate change adaptation. The information collected in the assessments is based on the following propositions:

- Past experience and current experience could inform planning for the future.
- Local experience and knowledge is important for engaging and informing climate policymaking and planning at local, regional, state, national, and international levels.
- Current issues are important to consider in preparing for climate change.
- Adaptive capacity is important to consider given the uncertainty of climate change impacts.
- An understanding of governance structure and existing social institutions, plans, and programs could help in considering how to incorporate planning for climate change.
- An understanding of relationships across tribal departments and across jurisdictions and political boundaries could help in considering the role of collaboration in addressing climate change at local, state, regional, national and international levels, given the global nature of climate change and the cross-jurisdictional nature of natural resources.

The assessment provides each tribe a starting point to further develop planning for climate change and strategies to prepare for, respond to, and cope with climate change. For climate policymaking and planning at multiple levels of decisionmaking, this study offers key considerations in planning for climate change adaptation and policy recommendations for strengthening the adaptive capacity of tribes, and in turn all people, to address climate change.

Research Questions

This study seeks to answer: what are the key considerations in planning for climate change adaptation, particularly for natural resource and cultural resilience?[1] Each case study seeks to answer the following questions:

1) In what ways can a tribe's responses to past and current impacts to well-being, natural resources, and livelihood provide insight on its adaptive capacity to prepare for, respond to, and cope with the impacts of climate change?

[1] The term resilience means through disturbance maintaining essential community functions and identity, and the essential functions and identity of the surrounding landscape a community relies on for subsistence, livelihood, and physical and spiritual well-being (Folke 2006).

2) How can understanding a tribe's capacity and experience inform planning for climate change adaptation?

To answer these questions, this study relies on semi-structured interviews with tribal members, staff, and leadership of the Hoopa Valley and Coquille Indian tribes.

Problem Statement (Consequences of Not Knowing)

Because of the risks to the landscape and in turn to culture and society, along with vulnerability to existing stresses, American Indian and Alaska Native tribes are expected to suffer the effects of climate change disproportionately (Houser et al. 2000). The literature suggests in addition to disparities in impacts and capacity to respond, the disparities between tribal contributions to climate change and the impacts to tribes makes this as an environmental justice issue (Krakoff 2008).

For this reason, it is vital to understand the vulnerability of tribes to climate change and their adaptive capacity to address climate impacts at the local level so that this information can inform planning and policy development from the local to global level. Policy can play a role in addressing disparities among communities that exist and are likely to increase if no action is taken. For instance, American Indian and Alaska Native tribes possess unique rights to land and resources for which the federal government has responsibility to protect. They also have unique cultures, long-term, land-based knowledge, and social practices which connect them to specific lands. In national and even regional climate assessments, these characteristics could be overlooked and lead to inequitable climate policies and adaptation strategies. Identifying and acknowledging differences in vulnerability and capacity and incorporating it in policymaking and planning will help to ensure equity so that all communities are able to address climate change (Nilsson 2008).

Background

Hoopa Valley Indian Tribe

For centuries, the Hoopa people have lived in the area now known in the U.S. as the Hoopa Valley along the Trinity River in Humboldt County, California. The Hoopa Valley Reservation today comprises around 90,000 acres of the valley and surrounding mountain slopes; it comprises about one-quarter of the Tribe's historic territory (about 400,000 acres). Of the 90,000 acres, around 2,250 acres are allotted lands, 1,300 are individually owned, and the rest are tribally owned (Tiller 2005). The Hoopa Valley Tribe has long had an established governance system. Fritz (1958) suggests that in 1916 the Tribe had in place a constitutional form of government and governing tribal council. Under the amended 1988 Indian Self-Determination Act the Hoopa Valley Tribe was one of the first tribes (one of 20 in the nation) to take on self-governance as a demonstration tribe. Self-governance became solidified in the early 1990s and has allowed the Tribe to define how it uses federal funds and develop its own programs to apply those funds.

The Tribe currently has about 2,000 members, but the reservation is home to over 2,600 people according to the 2000 U.S. Census. The Tribe relies on the Trinity River, tributary streams, prairie, and mixed hardwood and conifer forests for subsistence, well-being, and livelihood. Sacred to the Tribe, and conservatively protected, are its fishing rights.

The Hoopa Valley Tribe case study focuses on the Hoopa Valley Reservation, but considers its setting in the region, the Klamath Basin, and connection to adjacent lands. The land features the Tribe relies on do not end with the reservation boundary nor do the Tribe's rights or the complex of policy, regulation, and jurisdictions regarding natural resource management. For example, the Trinity River flows through the reservation, but originates in the Scott Mountains to the northeast and after traveling approximately 130 miles enters the Lower Klamath River just north of the reservation near Weitchpec, California. Before traveling through the reservation, the Trinity River is diverted by the Trinity and Lewiston dams, which send water to California's Central Valley. The dams influence the Tribe's drinking water supply and subsistence and cultural resources,

including salmon (which also cross the reservation boundaries traveling to the ocean via the Lower Klamath River) and other aquatic species. In addition, the Tribe's historic territory and continued interests and connection to the land today extend beyond the reservation boundaries across surrounding private and public lands. The surrounding landowners, including the Bureau of Land Management and USDA Forest Service, and their land management practices also influence the Tribe's lands and land management decisions.

Coquille Indian Tribe

For centuries, members of the Coquille Indian Tribe have lived along what is now known in the U.S. as the southern Oregon Coast. The Tribe's traditional territory spans over 700,000 acres along the Coquille River, inland, and north toward Coos Bay and North Bend, Oregon (Tiller 2005). The Tribe's land base today comprises around 6,500 acres which encompasses several parcels, including the Kilkich Reservation in the Charleston, Oregon, area, the Grandmother Rock site in Bandon, Oregon, the Mill Casino and Hotel property and the Tribe's administration building in North Bend, Oregon, and the Coquille Forest in the Coquille River Basin.

The Tribe signed a treaty with the federal government in 1855, yet it was never ratified. Members of the Tribe were forced off of their ancestral lands and moved to a reservation to the north near Florence, Oregon. As part of the Termination Act of 1954, the federal government terminated the Coquille Indian Tribe further dispersing tribal members and impacting social and cultural continuity. In 1989, the federal government restored the Tribe after great effort and commitment by tribal members. The Restoration Act provided for the creation of a five-county service area in southwestern Oregon – Jackson, Coos, Curry, Lane, and Douglas counties. It also provided authority for the Secretary of the Interior to take 1,000 acres of land into trust; however, it did not restore any land to the Tribe. Shortly following restoration, the Tribe made a private purchase of approximately 1,000 acres in the Charleston, Oregon, area which was taken into trust by the Secretary. Since restoration, members of the Tribe have worked hard to rebuild Tribal

government and community. In 1996, the Tribe regained 5,400 acres of forest lands formerly managed by the Bureau of Land Management and currently held in trust for the Tribe by the Bureau of Indian Affairs. Today, the Tribe manages the Coquille Forest for cultural, economic, and ecologic values, yet as stated in the language of the Coquille Forest Restoration Act, does so using the same standards and guidelines as apply to adjacent federal lands.

The Coquille Tribe currently has about 900 members, yet just around 200 live in the Tribe's traditional territory, on and off the reservation. Along with its current land base, important to the Tribe today are areas within its ancestral territory, including sites and a variety of ecosystems and species, including forest, prairie, the Coquille River and other streams, and the ocean. The Tribe relies on terrestrial and fresh- and saltwater aquatic plant and animal species for subsistence, livelihood, and well-being. The Tribe possesses unadjudicated hunting and fishing rights.

The Coquille Tribe case study focuses on the Tribe's current land bases, but considers their setting adjacent to urban communities in the area, including North Bend, Coos Bay, Charleston, and Bandon, Oregon. It considers also the Coquille Forest's setting among adjacent federal land managers and industrial landowners in the Coquille River Basin. The case considers climate impacts to the forest, streams, and the ocean, which could affect the Tribe's well-being.

Planning for Climate Change at the Local Level

The literature suggests several factors which make planning at the local level for climate change important.[2] First, is the current limit of planning for climatic changes, including extreme weather events at the local level; the costs and impacts to communities following events such as hurricanes, floods, droughts, and earthquakes in the recent past demonstrate this (Berkes and Jolly 2001). Second, is the need to develop plans suited to

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[2] In this paper, I use the term community to refer to places where people interact for mutual benefit (Flora et al. 2004); this includes American Indian and Alaska Native tribes. I assume the majority of interactions that influence the community occur at the local level, but interactions do extend far beyond the local level.

local conditions, based on community needs, and linked to existing community programs, policies, and decisionmaking processes (Smit and Wandel 2006). The impacts of climate change could include rapid, extreme weather events and slow-onset events such as changes in species diversity in forest ecosystems. These events will impact communities differently, depending on the community's geographic location, interactions with the environment and interactions among community members. Climate change is a global issue, however human activity occurs at a much finer scale and is shaped by the local climate, landscape, and community characteristics, including social, cultural, economic, and political (Adger 2006). Third, is the knowledge local communities can contribute about their location and past responses to change; they can offer insight based on multiple knowledge systems, including local and traditional knowledge, past and current experiences, and on how social, political, cultural, and economic factors affect their ability to adapt to changes (Duerden and Beasley 2006).

Vulnerability and Adaptive Capacity

The knowledge and experience community members hold at the local level can provide insight on a community's adaptive capacity. In ecosystems, adaptive capacity refers to the system's genetic and biologic diversity. In communities, it refers to "institutions and networks that learn and store knowledge and experience, create flexibility in problem solving and balance power amongst interest groups" (Resilience Alliance 2008). In defining vulnerability in the context of climate change, the IPCC (2007) suggests adaptive capacity is one component, along with climate risks, sensitivity to climate changes, and the magnitude and rate of climate change. Along with understanding the climate risks a community faces, the literature suggests that a community's adaptive capacity to respond to past and current impacts to well-being, natural resources, and livelihood may provide insight on a community's adaptive capacity to prepare for, respond to and cope with the impacts of climate change (Parkins and MacKendrick 2007). It may provide insight on how a community may adapt to short and

long-term impacts of climate change based on experience, knowledge, and local resources.

Assessing Vulnerability

This study relies on an initial assessment of past and current conditions and knowledge, along with occurring and anticipated climate impacts; it relies on an abbreviated vulnerability assessment, a prominent method in planning for climate change adaptation (IPCC 2007). Smit and Wandel (2006, 285) describe a community-based vulnerability assessment as

> ...research that investigates the adaptive capacity and adaptive needs in a particular region or community in order to identify means of implementing adaptation initiatives or enhancing adaptive capacity. This enables the identification and development of particular adaptive measures or practices tailored to the needs of that community... the focus is to document the ways in which the system or community experiences changing conditions and the processes of decision-making in the system that may accommodate adaptations ...

Vulnerability assessments rely on historical data and knowledge held by community members and scientific information on future climate trajectories; they integrate existing information about the past and the future with raw data collected at the community level over a period of one to several years (Berkes and Jolly 2001; Cruikshank 2002; Smit and Wandel 2006; Ermine et al. 2007; Parkins and MacKendrick 2007).

While the more information and knowledge compiled at the local level will offer greater insight in identifying adaptive strategies, climate change risks and sensitivities, and planning for climate change, it presents communities with a substantial task – not only to raise awareness about climate change and adaptation, but to gather information and apply it in the context of local conditions. In addition, in the face of climate changes already occurring and expected to accelerate (IPCC 2007), the sooner communities can begin to act, the sooner they can begin to prepare socially, culturally, economically, environmentally, and politically; and the greater the likelihood the information can inform policy development at local to global levels.

Scope and Delimitations

This study focuses on the experiences of two native nations in the Pacific Northwest U.S. and explores the climate risks they face and their adaptive capacities to address the risks through case studies. For this reason, the information collected and presented is not generalizeable to all American Indian and Alaska Native tribes. However, the findings regarding adaptive capacity are useful in additional research and in application, considering that understanding a community's adaptive capacity can help in understanding a community's ability to prepare for, respond to, and cope with climate change. Additionally, based on this understanding of adaptive capacity and acknowledging its prominence as a component of social vulnerability, the recommendations this study offers are useful in climate change adaptation planning and policymaking to strengthen adaptive capacity and reduce vulnerability.

Remainder of the Thesis

The following five chapters cover: 2) a review of related literature, 3) a description of the methodology, 4) the case studies, 5) a discussion of the findings from the case studies; and 6) the conclusion. The literature review chapter provides a description of social vulnerability and adaptive capacity; resilience; tribal sovereignty, culture, and knowledge; community-based natural resource management; and climate change adaptation research and action at the local level in order to frame the research questions explored in this study and the methods used. The methods chapter describes data collection, processing, and analysis, including the interview guide used during semi-structured interviews and the categories and theories developed to analyze the information collected. The case studies chapter provides insight and analysis on the information individuals shared for each tribe during the interviews. It includes insight on observed climate changes, impacts to the tribe(s), current issues, adaptive mechanisms that could facilitate adaptation to climate change, and barriers to adaptation. It considers each tribe's adaptive capacities based on past and current experience and response; and

how adaptive capacity can inform planning for climate change. The discussion of findings compares the experiences of the two tribes and their adaptive capacities to address climate change. Finally, the conclusion chapter reviews the study and offers recommendations for strengthening the adaptive capacity of the two tribes to address climate change through actions by the tribes and by policy- and decisionmakers at the local, regional, and national level.

CHAPTER II
LITERATURE REVIEW

The purpose of the literature review is to frame the research questions explored in this study. To do so, I review and connect research in the fields of vulnerability, resilience, community-based natural resource management, and climate change adaptation. In so doing, I define the key terms that provide roots for this study, vulnerability, adaptive capacity, and resilience. I differentiate the various levels at which climate change planning and policymaking occurs. I review the reasons why climate change adaptation research is considered necessary to prepare for climate change and inform climate policymaking and planning at multiple levels. I also review the role of traditional ecological and local knowledge in climate change adaptation planning and natural resource management, and the ethical considerations involved in integrating multiple knowledge systems.

To frame the two research questions I explore in the case studies, I describe adaptive capacity as it is considered in the context of community-based natural resource management and climate change adaptation. I also review the methods climate researchers use in assessing vulnerability to climate change, and describe the approaches of other tribes and communities in planning for climate change adaptation, including the tools, information utilized, and challenges. I conclude by linking the literature topics covered and describing how they support this study.

Vulnerability and Resilience

Vulnerability

The disruptions climate changes pose to essential ecosystem services and basic needs such as land, freshwater, food supplies, shelter from environmental hazards, and

protection from diseases could significantly alter social, cultural, economic, and political characteristics of human communities (IPCC 2007). These disruptions could introduce new issues and opportunities (LaDuke et al. 2009), and exacerbate existing environmental stresses and social inequalities.

> The existing evidence suggests that climate change impacts will substantially increase the burdens on those populations that are already vulnerable to climate extremes, and bear the brunt of projected (and increasingly observed) changes that are attributable to global climate change....Groups that are already marginalized bear a disproportionate burden of climate impacts, both in developing countries and in the developed world (Adger 2006, 273).

Regions, including islands, low-lying coasts, and the Arctic, and populations, including indigenous peoples, rural, resource-based communities, and socially vulnerable populations (the elderly, children, low-income populations, and communities of color) may experience the impacts of climate change disproportionately because of environmental, social, cultural, economic, and political factors (IPCC 2007). For indigenous peoples, the environmental impacts of climate change and some of the proposed solutions threaten lifeways, subsistence, economic ventures, future growth, cultural survivability, rights, land ownership, and access to resources – natural, cultural, technical, and financial (Nilsson 2008; Tsosie 2007).[3] Further research is needed to assess vulnerability and understand how environmental changes will impact specific regions, and communities, populations, economies, and cultures within those regions, differently; and what adaptive capacity exists to address the impacts (Wesche and Armitage 2006; Duerden 2004).

Defining Vulnerability – exposure-sensitivity and adaptive capacity

Assessing vulnerability requires first defining the concept and its components in the context of climate change. Adger (2006) describes how the concept of vulnerability has been applied in a wide variety of fields and disciplines, including food security,

[3] The term lifeways acknowledges indigenous peoples' cultural connection to specific lands in addition to other aspects of culture and religion (Tsosie 2007).

natural hazards, and human ecology; and how those applications now inform its use in the fields of climate change, sustainable development, and social-ecological systems. "The concept of vulnerability has been a powerful analytical tool for describing states of susceptibility to harm, powerlessness, and marginality of both physical and social systems, and for guiding normative analysis of actions to enhance well-being through reduction of risk" (Adger 2006, 268). In the context of climate change, a multi-scale, interdisciplinary issue, understanding vulnerability will require insight from many fields (Adger 2006).

The Intergovernmental Panel on Climate Change (2007, 883) defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including variability and extremes...Vulnerability is a function of the character, magnitude and rate of climate change and variation to which the system is exposed, its sensitivity, and its adaptive capacity." The IPCC (2007) further defines sensitivity as the degree to which any aspect of climate change – climate variability, intensity, and frequency of impacts – direct and indirect, affects a system adversely or beneficially; and adaptive capacity as a system's ability to adjust to, cope with, or benefit from any aspect of climate change.

Using the concept 'exposure-sensitivity', Ford et al. (2006) suggest also the importance of considering community characteristics in defining vulnerability. "Exposure-sensitivity reflects the susceptibility of people and communities to conditions that represent risks. It is a joint property of both the characteristics of climatic conditions, and the nature of the community in question" (Ford et al. 2006, 128). In defining adaptive capacity, Ford et al. (2006, 128) highlight that a community's ability to adapt, based on resource and risk management decisions, "is influenced by characteristics of the human system including economic wealth, social capital, infrastructure, social institutions, experience with previous risk, the range of technologies available for adaptation, and equality."

Scale of Vulnerability and Impacts

Burton et al. (2002) also describe vulnerability as a function of impacts and adaptation. Impacts result from a system's sensitivity and its exposure to climate-related stimuli; and adaptation results from a system's capacity to adapt and its willingness or ability to apply adaptive capacity to reduce vulnerability (Burton et al. 2002). In the context of climate change vulnerability and adaptive capacity, Smit and Wandel (2006) define adaptations as 'adjustments' in behavior in response to environmental or social changes in an attempt to reduce vulnerability or enhance coping; adaptations can occur at the individual or community level, can be anticipatory or reactive, and can be spontaneous or planned. Thus, the literature suggests vulnerability, its components, exposure-sensitivity and adaptive capacity, and its responses, adaptations, are dynamic and evolve over time in response to environmental and social changes. Past and current conditions and experience, and projected future conditions can inform understanding of these concepts at the local level.

Importance of Assessing Vulnerability

Assessing vulnerability to climate change at the local level offers opportunity to understand how changes in ecosystems will affect human communities culturally, socially, economically, and politically (Duerden 2004), how these characteristics influence a community's vulnerability (Ford et al. 2006) or vulnerabilities (Duerden and Beasley 2006), and how vulnerability is socially differentiated (Adger 2006; Ford et al. 2006). Smit and Wandel (2006) describe the local level or 'community scale' as the scale at which actions and strategies to reduce vulnerability are evident; and Duerden (2004) describes the local level as the level of human activity and experience, and suggests it is the level at which climate change impacts are and will be felt. "While many prognoses about change are made on a large scale, human activity is highly localized, and impacts and responses will be conditioned by local geography and a range of endogenous factors, including demographic trends, economic complexity, and experience with 'change' in a broad sense" (Duerden 2004, 204).

Assessing vulnerability is important in planning for climate change adaptation at the local level. Communities understand risk or vulnerability in terms of their specific cultural, economic, social, environmental, and political characteristics (Adger 2006). Their well-being is connected to local climate and landscape conditions and therefore makes identifying relationships and impacts important in preparing for changes.

> Much of the effort that social scientists direct towards assessing implications for human settlements can be broadly characterized as natural hazards research and is essentially community centric, predicated on the notion that detailed understanding of patterns of human activity and the relationship between a place and its local geography is a pre-cursor to identifying the manner in which people are affected by change (Duerden and Beasley 2006, 81).

Assessing vulnerability is important in understanding and increasing the capacity of communities to respond to, cope with, and recover from the impacts of climate change. Communities offer insight based on multiple knowledge systems, including local and traditional knowledge, and on how social, political, environmental, cultural, and economic factors affect their ability to adapt to changes (Wesche and Armitage 2006). Ford and Smit (2004) describe how indigenous communities of the Arctic that follow traditional lifestyles have been shown to be disproportionately vulnerable to climate change; however, they have also been shown to possess considerable capacity, or adaptability, to address climate change. Duerden and Beasley (2006) acknowledge that local climate vulnerability assessments can enhance a community's capacity to address change. "Studies that are highly localized can identify community specific concerns that may be overlooked in regional scale analyses and serve as a valuable tool for local empowerment and information exchange" (Duerden and Beasley 2006, 82).

Because vulnerability exists at multiple scales (Adger 2006) and because community residents and individuals are the ones able to describe how impacts affect their well-being, assessing vulnerability at the local level is important also in informing planning and policymaking at other levels. "Involving local residents, however, is crucial if research is to capture locally relevant conditions and characterize the complex social relations that influence exposure to hazards and coping mechanisms" (Ford and the

Community of Igloolik 2006, 148). However, vulnerability assessments at the local level, and other levels, must consider the potential for impacts to be socially differentiated (Ford et al. 2006). "At the local level, adaptation to environmental risks often reduces the vulnerability of those best able to mobilize resources, rather than the most vulnerable.... Integrating principles of equity with the identification of vulnerability is therefore an important element of adaptation decision-making" (Adger 2006, 276-277). Identifying and acknowledging differences in vulnerability and capacity, in addition to differences in access to decisionmaking processes, resources, and technology, and in coping and response strategies, and incorporating the information in policymaking and planning, will help to ensure equity so that all regions and populations are able to respond to and prepare for climate change (Nilsson 2008).

Resilience

Resilience and social-ecological systems research, the literature suggests, provides insight in considering how climate change will impact communities and in planning for those impacts. Resilience is an emerging concept in sustainable development and natural resource management. "Resilience is currently defined in the literature as the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Folke 2006, 259). The concept of resilience has contributed to shifting paradigms in managing ecosystems – from management focused on single species, control and resisting disturbance to management focused on function (rather than species and structure) and understanding system dynamics including biological diversity, disturbance, and change; it has contributed similarly to shifting paradigms in managing institutions and understanding the dynamics and mechanisms of social systems (Folke 2006). Most recently, the concept of resilience has contributed to research regarding social-ecological systems, a growing field focused on integrating an understanding of social mechanisms within ecosystem management and vice versa, integrating an understanding of ecosystem dynamics within the institutions of human communities (Folke 2006). In other words,

social-ecological systems research considers how a human community and the surrounding landscape interact and shape each other.

Adger (2006, 269) suggests vulnerability and resilience research "have common elements of interest – the shocks and stresses experienced by the social-ecological system, the response of the system, and the capacity for adaptive action." He identifies three elements of social-ecological systems: biological and biophysical processes of natural systems; rules and institutions of social systems; and knowledge, experience, and ethics that connect the social to the natural system (Adger 2006). In addition, he suggests elements of social-ecological resilience, "the ability to absorb the shocks, the autonomy of self-organisation and the ability to adapt both in advance and in reaction to shocks," influence vulnerability (Adger 2006, 269). Similarly, Folke (2006) suggests 'social-ecological resilience' considers adaptation, learning, and self-organization. Folke (2006) suggests resilience provides adaptive capacity; and beyond adaptation, which implies reacting to a current situation, resilience considers transformation or transformability, which implies improving social-ecological systems through adaptive governance.

Thus, the literature suggests research to assess the vulnerability and resilience of a social-ecological system can provide insight useful in planning for climate change adaptation. It can provide insight on how climate change will affect natural resource management and culture for American Indian and Alaska Native tribes, and how natural and cultural resource management may be adapted (or transformed) to prepare for, respond to, and cope with climate change in a way that maintains essential community functions and identity, and the essential functions and identity of the surrounding landscape that a tribe relies on for subsistence, livelihood, and physical and spiritual well-being.

Tribal Sovereignty and Self Determination

Climate change is a global issue and climate adaptation policy and planning are therefore necessary at international, national, state, regional, and local levels. Wood (2009) acknowledges this in recognizing that our atmosphere is a global public good.

International, national, and state-level climate policies and plans will affect the ability of communities and Indian tribes to address the impacts of climate change, which will be felt at the local level. In relation to the Inuit in Igloolik, Nunavut, Canada, Ford et al. (2006) describe the important of considering the potential effects of climate policies at all scales on communities and different populations within communities because of the potential for impacts to be socially differentiated and to disrupt interactions between humans and the land.

> The dynamic nature of these Inuit environment interactions in the twentieth century highlights that the implications of future climate change are not calculable from the physical dimensions of the shift alone, but will be conditioned by the interaction between biophysical and societal processes operating within and across local, regional, and global scales (Ford et al. 2006, 136).

This suggests effective action and planning to address climate change requires integrating information and acting cooperatively across levels. At all levels, the literature indicates that it requires addressing equity in the procedures of drafting, implementing, and monitoring climate policies and plans; and in the distribution of climate change impacts, responsibility, costs, and benefits (Ikeme 2003). It requires ensuring all communities are able to appropriately respond to and prepare for climate change (United Nations Framework Convention on Climate Change, Article 3 1994).[4]

Along with indigenous peoples worldwide, American Indian and Alaska Native tribes have the right to participate in international decision- and policymaking processes (UN Declaration on the Rights of Indigenous Peoples and Agenda 21). In the U.S., tribes have the right to autonomy and self governance (Indian Self-Determination and Education Assistance Act of 1975). In considering the vulnerability of American Indian and Alaska Native tribes, Houser et al. (2000) note the rights of tribes and their treatment in federal policy will impact their ability to respond to climate change.

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[4] Article 3 of the UNFCCC directs all of the parties to the Convention to protect the climate system for present and future generations on the basis of equity (United Nations Framework Convention on Climate Change 1994).

> The relationships between tribes and the federal government are determined by treaties, executive orders, tribal legislation, acts of Congress, and decisions of the federal courts. These actions cover a range of issues that will be important in adapting to climate change, from responsibilities and governance to use and maintenance of land and water resources (Houser et al. 2000, 352).

Trust Responsibility

As sovereign, domestic-dependent nations, the federal government has a self-imposed trust responsibility to American Indian tribes to manage land and resources for their benefit (Getches et al. 2005). It has the responsibility to uphold Indian treaties, which are legally binding and acknowledge the sovereignty of tribes, and their rights to landownership and access to natural resources and off-reservation lands. And even though Congress retains plenary power over American Indian tribes and the ability to abrogate treaties, the federal government also has a duty to act within the interests of tribes and to protect the natural and cultural resources on which they rely (Getches et al. 2005). In addition, under the public trust doctrine the federal government has a responsibility to protect the environment, including the atmosphere, for all people (Wood 2009). Under most federal environmental statues, including the Clean Air Act and Clean Water Act, American Indian tribes are treated as states. Thus, tribes like states are recognized as co-regulators of their environment and have the authority and funding available through Congressional acts to administer their own environmental programs (Getches et al. 2005). Numerous other federal legislative acts recognize the rights of tribes to access, manage, and protect natural and cultural resources, including the National Indian Forest Resources Management Act of 1990.

Equity in Climate Policy

Currently, in international and national climate policy contexts, the rights of American Indian and Alaska Native tribes and their vulnerability to the impacts of climate change are being overlooked (Nilsson 2008). Cordalis and Suagee (2008) point out the role of tribal governments in the U.S. in addressing climate change is being

overlooked. In part, the literature suggests, this is due to existing stresses and issues resulting from past and ongoing marginalization, discrimination, and exploitation (Tsosie 2007). In the U.S., past actions and exploitative policies of the federal government have contributed to American Indian tribes' vulnerability to climate change; policies beginning during the late 1700s with treaty-making and reservations, continuing during the 1800s with removal, allotment and assimilation, and persisting during the 1900s and today with termination and ecological degradation (Wood 2009). Throughout this time, American Indian and Alaska Native tribes have been disconnected and restricted from the lands and practices that support their lifeways (Tsosie 2007). They have been marginalized, isolated, and excluded from the political processes which affect their well-being (Getches et al. 2005).

In part, the literature suggests, the rights of indigenous peoples are being overlooked also due to a lack of equity in climate policy- and decisionmaking, and acknowledgement of the social vulnerability of indigenous peoples to climate change (Nilsson 2008). Brown and Corbera (2003) clarify the dimensions of equity as access, procedure, and outcomes. Equity in access considers an actor's ability to engage and participate; and the factors involved, including information, knowledge, communication, property rights, access rules, and the way different institutions operate at different scales. Access impacts procedures and outcomes, including the benefits available to actors. Equity in procedure considers institutions and decision-making. It considers, all phases of a project and decisionmaking process, including the way rules operate and whether the voices of all stakeholders are involved. Finally, equity in outcomes considers how projects impact actors, and how costs and benefits are distributed among actors as a result of access and decisionmaking. (Brown and Corbera 2003)

In the context of international climate adaptation policy, Paavola and Adger (2006) identify equity in four areas: 1) the procedural dimensions of climate change adaptation planning and decisionmaking; 2) the responsibility of developed countries for climate change impacts; 3) the amount of assistance developed countries should provide

developing countries for adaptation, and how that amount should be divided among developing countries; and 4) the distribution of assistance among countries.

The impacts of climate change challenge the language in treaties and policies and therefore the rights of tribes; the chemistry, composition, and elevation of tribal land bases and traditional territories and therefore sovereignty, and the existence of culturally important species and lands and therefore cultures. Without attention, the impacts of climate change on indigenous rights will grow. Williams and Hardison (2008) describe how the impacts of climate change threaten the legal obligation of the U.S. to protect tribes and the natural and cultural resources, sacred sites, and native homelands on which they depend for physical and spiritual well-being, livelihood, subsistence, autonomy, and sovereignty. They describe how the rights of tribes are connected to specific lands with fixed boundaries, including reservations and federally managed lands covering traditional territories and traditional use areas.

> Because of their unique political history, their recognized prior rights and treaty rights only apply to their reservations and usual and accustomed lands. Moving from these lands to adapt to large-scale environmental decline would cut them off from their origins, from the places of their collective memory, and the rights to self-determination the Tribes possess as peoples (Williams and Hardison 2005, 10).

Williams and Hardison (2005) point out that the language captured in the documents that for many tribes serve as a basis of their rights, treaties, reflects the belief that the environment exists in a fixed state and will forever provide ample resources for all people. Williams and Hardison (2008, 2) raise questions regarding the rights of tribes to culturally important species and sites, the cultural sustainability of tribes based on species and lands, and the capacity of tribes as resource-dependent peoples to adapt to climate change given they "are the first to be exposed, most sensitive to impacts, and least able to pay for defense or recovery." They suggest the need to consider what will happen to the rights of tribes when species ranges shift and species go extinct, and when the chemistry, composition, and/or elevation of lands and waters changes.

Nilsson (2008) suggests to avoid further injustices, and exploitative policies and practices, including removing indigenous peoples from their land and denying access to cultural and subsistence resources as species ranges shift, international, national, and sub-national climate policies must address equity, acknowledge American Indian and Alaska Native tribes' rights, and respect and incorporate their voices. In order for climate policies to do so, research that integrates a consideration of equity is needed to further understand the vulnerability and resilience of indigenous peoples to climate change.

Cultural Considerations

Traditional and Local Knowledge

Traditional Knowledge

Responding to the impacts of climate change already occurring, as well as preparing for and mitigating those projected for the future, requires integrating different knowledge systems and decisionmaking processes in order to improve understanding of the issue and manage risk (Gilligan et al. 2006). Environmental planners and managers rely heavily on scientific knowledge (SK) to inform decisions. Scientific knowledge derives from a Western or European approach to empirical study, research, and observation of various phenomena (Gilligan et al. 2006). Scientific knowledge is also described as 'expert-based knowledge', '"the domain of university trained 'experts'" and incorrectly referred to as 'Western Science' (Brook et al. 2006, 14). Scientific knowledge provides important insights and shapes the world we live in today.

> Undoubtedly SK has numerous benefits ranging from medical microbiology and climatology; furthermore, science has played a pivotal part in the development and evolution of the contemporary world that we live in today. In spite of this however, science is not free from flaws and is subject to certain limitations … (Gilligan et al. 2006, 6).

Gilligan et al. (2006) describe that the limitations of science include its empirical nature, basis in facts, and its difficulty in answering why as opposed to how a process works.

Traditional ecological and local knowledge contribute insight important in understanding environmental and social change (Riewe and Oakes 2006). Berkes et al.

(2000, 1252) define traditional ecological knowledge as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment." Traditional ecological knowledge emphasizes knowledge accumulated over a long time about an area or species (Gilchrist et al. 2005). It is based on tradition and passed from generation to generation (Gilligan et al. 2006). It is based on a long-standing, intimate relationship with the land (Hotain 2006). Blakney (2006) provides a specific example of traditional ecological knowledge in describing Inuit Qaujimajatuqangit.

> Inuit Qaujimajatuqangit, literally meaning 'knowledge of the old', is a dynamic process and emerges through the accumulation of complex and varied experiences and observations that have been lived, passed down, adapted, added to and applied to new situations (Blakney 2006, 77).

Where scientific information and data are lacking or unavailable other knowledge systems offer insight for decisionmaking (Gilchrist et al. 2005). Aside from scientific knowledge, traditional knowledge is important in providing a human perspective in environmental management and change; and in sustainable development, basing development on local priorities (Gilligan et al. 2006). It is important in providing insight on how to respond in new situations (Blakney 2006).

> Adaptation to rapid anthropogenic climate change may be a new challenge, but individuals, societies, and economies have adapted—in various ways and with various degrees of success—to changed and variable environmental conditions throughout history. These experiences in adaptive behavior provide information on the processes, constraints, and consequences of adaptations (Smit and Pilifosova 2001, 887).

Indigenous peoples have adapted to changes in climate for millennia. Their experience and perspective gained through an intimate connection with the land, and passed down through traditional ecological knowledge offers important insight valuable in developing strategies to respond to current and projected climate changes, particularly in geographical areas home to indigenous populations. "It is the First Nations people who can best advise strategies and plans to adapt to environmental change in their traditional

territories" (Hotain 2006, 29). Traditional ecological knowledge offers perspective on monitoring, interpreting, and responding to ecosystem changes and corresponding changes in natural and cultural resources that people depend on for livelihood, physical and spiritual well-being, and subsistence (Berkes et al. 2000).

However, the impacts of climate change pose threats to biodiversity, land features, and culturally important species, the indicators on which indigenous peoples' traditional ecological knowledge is based (Nilsson 2008). Thus, for many indigenous peoples, climate change threatens their survival (Tsosie 2007).

> Climate change has a harmful effect on biological diversity and the related knowledge, innovations and practices of indigenous peoples. Traditional knowledge is an inseparable part of indigenous culture, social structures, economy, livelihoods, beliefs, traditions, customs, customary law, health and their relationship to the local environment (Nilsson 2008, 13).

In addition, climate changes are projected to occur at a rate more rapid and intensity more severe than previously experienced in recorded human history (IPCC 2007). "It is when changes become increasingly dramatic and dangerous that Indigenous Elders say we must pay special attention and proceed with caution in making decisions that could affect livelihoods, and ultimately lives" (Hotain 2006, 29). Adaptations and coping mechanisms developed over time in indigenous communities may not apply to the climate changes occurring and projected, which raises questions about how social-ecological systems will cope(Wesche and Armitage 2006).

Although threatened by occurring and projected climate changes, traditional knowledge remains an important part of indigenous cultures. It remains important in social and cultural institutions, including the networking, sharing, and community cohesion associated with hunting, fishing, and harvesting traditional foods; sharing those foods among families; and in the process of teaching younger generations about land use and cultural identity (Wesche and Armitage 2006). Menzies and Butler (2006) describe that traditional ecological knowledge has survived past and recurring oppressive and inequitable policies by adapting to changing economic and environmental conditions; even though in some cases it has been and is being lost as a result of population declines

and disruptions in transmission across generations. Because it is based on years of accumulated experience between humans and the land, it still offers insight useful in new situations (Riewe and Oakes 2006).

Local Knowledge

Local knowledge, in addition to traditional ecological and scientific knowledge, offers insight important in addressing climate change (Riewe and Oakes 2006). Local knowledge is differentiated from traditional ecological knowledge by timescale. Local knowledge is "acquired more recently over the lifetime of individuals" instead of through oral history; it offers a blend of contemporary experience with the land and traditions passed down through generations (Gilchrist et al. 2005). Technology and other current influencing factors add variety to local knowledge not contained in traditional ecological knowledge (Mallory et al. 2006). Local knowledge can be held by any group of people with environmental and social experiences in common (Gilligan et al. 2006).

Local knowledge (LK) provides information that can be useful in environmental decisionmaking, as a compliment to scientific knowledge, particularly in areas where extensive scientific knowledge may not exist (Gilchrist et al. 2005). It is receiving increasing recognition as an essential part of environmental planning and natural resource management; a source of knowledge that provides context, long-term observations, and human experience (Gilligan et al. 2006). Integrating local knowledge into scientific research offers opportunity to benefit the groups of people who hold it by engaging them in projects and assisting them in developing the end-products (Riewe and Oakes 2006).

Acknowledging and Integrating Multiple Knowledge Systems

Although evidence exists to support the value of traditional ecological and local knowledge throughout history, as environmental management has become more and more influenced by science and technology, these knowledge systems have been marginalized and suppressed; as a result, the needs and concerns of the people who hold

(and held) traditional ecological and local knowledge are (and were) overlooked (Gilligan et al. 2006).

Climate change research has, until recently, focused on scientific knowledge to determine atmospheric greenhouse gas concentrations and the impacts of climate change on the physical environment. Global climate models, including Atmosphere/Ocean General Circulation Models, provide simulations based on the properties and feedbacks within the climate system, which help determine possible future conditions (IPCC 2007). They can provide an informed interpretation and range for potential future conditions on which decisions can be based (U.S. Climate Change Science Program 2008). Recent efforts attempt to downscale global climate models to a finer geographic scale, including regions, watersheds, and individual communities. Although limited in its distribution, downscaling or scenario-building, where applied, offers regions and communities some insight into possible future conditions at the level of decisionmaking.

Yet, downscaling from global climate models holds potential to miss local climate variations such as the Pacific Decadal Oscillation and El Niño/Southern Oscillation in the Pacific Northwest (Solomon et al. 2007).[5] The current limitations of downscaling, including cost, limited availability, and the potential to leave out local variations, require that other tools and information sources also be considered in providing insight on the range of future possibilities, and particularly the extent of local capacities, that decision makers require to begin planning how to address changes already occurring and those expected in the future.

As the inevitability of climate change and the need for adaptation becomes ever clearer, research, policymaking, and planning now look to other knowledge systems for insight (ACIA 2005; IPCC 2007; Crump 2008). In the face of global climate change, all communities must consider how they make decisions and the different knowledge systems they use and could use in the future as bases for decisions and actions (Adger

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[5] "ENSO and PDO have a major influence on PNW climate and natural resources on seasonal to decadal scales" (Climate Impacts Group 2004).

2006). Climate change poses heightened challenges in coping, responding, and preparing, and for this reason requires insight from all knowledge systems to fully understand the impacts and the potential strategies to address it. Although threatened by climate change, traditional ecological and local knowledge provide a human perspective and offer insight on environmental change and strategies to address climate change at the local level, and national and international levels (Nilsson 2008). "The message is simple, we as First Nations, have the traditional knowledge provided by our ancestors through oral history to offer a holistic way of thinking to assist in protecting our environment and Mother Earth" (Hotain 2006, 33).

However, in considering integrating knowledge systems, it is important to understand how to do so appropriately and with respect for the knowledge and the people who hold the knowledge (Riewe and Oakes 2006). Ethical considerations are important in incorporating traditional ecological and local knowledge into climate policies and plans. Menzies and Butler (2006) suggest the importance of considering traditional ecological knowledge in context in order to learn from it.

> As with all systems of knowledge, TEK grows in spits and spurts. It degrades, changes, and transforms, and ultimately its integrity is dynamically linked to wider social and economic processes. The ability to learn from TEK and to apply its lessons in the contemporary world necessitates that we honestly consider the context within which TEK is produced and maintained. To ignore this context benefits neither local resource users nor contemporary resource managers (Menzies and Butler 2006, 6).

Without ethical considerations, integrating traditional knowledge with scientific knowledge can fragment traditional knowledge and take it to some degree out of its cultural and social context. "Once collected, the control over the knowledge becomes that of the researcher, which, in some cases, because of their cultural limitations in understanding a foreign knowledge system, results in the dissection and misinterpretation of the TK and/or LK" (Gilligan et al. 2006, 8). It can also further marginalize traditional and local knowledge. "It is often then assumed that there are 'errors' in the local knowledge. But differences are actually inevitable due to differences in spatial and

temporal scales, methods used for data collection, and diverging world views rather than inaccuracies in knowledge" (Brook et al. 2006, 18).

Hotain (2006) suggests for science to integrate traditional ecological knowledge respectfully requires the development of 'ethical space', respectful learning about and understanding of each other's culture and knowledge. Brook et al. (2006) suggests it requires acknowledging conflict, and addressing and balancing power.

> [Assessing local knowledge for quality and validity] represents a value-judgment by researchers and similarly places the balance of power with scientists and managers. This loss of control is particularly evident in many studies where communities have little or no input into study design, study participants are interviewed on a one-time basis and the community receives no further information regarding the study results or opportunity to comment on them (Brook et al. 2006, 15).

Gilligan et al. (2006) suggest it is important to allow those with traditional knowledge to determine when, where, and how traditional knowledge is used in research; and recommend Intellectual Property Rights as a concept for developing guidelines around the use of traditional ecological and local knowledge to protect the collection, research, use, distribution, and storage of the knowledge. And, Brook et al. (2006) suggest communities should be involved in all aspects of research studies involving their knowledge, particularly in deciding how to link their local or traditional ecological knowledge to expert-based science, if at all. "Collection of knowledge held by local people should not be a one-time process where information from the informant is treated like any other dataset that is collected" (Brook et al. 2006, 15).

In order for indigenous peoples to develop strategies in their communities and to contribute to developing strategies in national and international contexts to address climate change, current inequities in process and distribution require attention. Nilsson (2008) recommends acknowledging the vulnerability of indigenous peoples to climate change; addressing the lack of resources and access to technology and decisionmaking processes that indigenous peoples currently face; and ensuring meaningful participation in planning and policymaking processes; and binding commitments and assurances for protecting and upholding indigenous peoples' rights and capacities.

Natural Resource Management in Indigenous Communities

For American Indian and Alaska Native tribes, and indigenous peoples worldwide, an important part of climate change adaptation will be planning for natural and cultural resource resilience within the boundaries of reservations and beyond – across the landscapes that make up native homelands and in some cases new landscapes as well.[6] Through time, over thousands of years, indigenous peoples have developed land ethics based on experience and interrelationships with the Earth (Lewis 1995). Indigenous peoples have been active land managers, learning, adjusting, and passing on practices that would ensure their survival, essentially engaging in 'adaptive management' (Rasmussen et al. 2007). Indigenous peoples recognize that environmental conditions are changing and uncertain and require human responses and adaptations (Berkes et al. 2000).

The exploitative, oppressive, and resource-intensive policies of the U.S. government have, however, affected the ability of tribes in the U.S. to practice traditional land management and even to access lands.

> Although native peoples have a long history of managing the natural environment, they have been marginalized by a natural resource policy process guided by utilitarian values and controlled by governments and extractive industries. They have, therefore, often been spectators in the development of the natural resources central to their subsistence and cultural heritage (Wilson 2002, 397).

Yet, since the U.S. acknowledged the rights of tribes to autonomy and self-governance (Indian Self-Determination and Education Assistance Act of 1975), tribes have had success in regaining access to lands and protection of natural resources, and a voice in natural resource management within their native homelands primarily through court decisions (Wilson 2002), but also through advocacy, political engagement, and land

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[6] The importance of planning for natural resource resilience should extend also to the landscapes that affect native homelands; it should also consider species migration and land inundation, erosion, and inhabitability over time.

purchases. For tribes control over land and natural resource management is an integral part of their sovereignty (Rasmussen et al. 2007).

Current tribal land bases and traditional territories continue to offer tribes culturally and economically important species and sites, and represent and sustain tribal sovereignty. Williams and Hardison (2005) express the importance of land to culture and autonomy in the context of the tribes of Washington State. "Unlike other citizens, the Tribes are tied to their homelands in a unique relationship to their lands and to the United States. Their identity is deeply rooted to their lands – the places from which they emerged, where their ancestors dwell, about which their stories and language refer, and to which they have continuing spiritual and collective obligations" (Williams and Hardison 2005, 10). Wilson (2002) points out the connection between land and sovereignty and cultural and economic prosperity for indigenous peoples in the Pacific Northwest U.S.

> [N]ative peoples in the Northwest are attempting to balance a deep cultural respect for the natural environment and a practical realization that development of natural resources can generate important economic benefits to historically impoverished peoples. The origins of this balanced value set can be found in part in the struggle of native peoples to meet their needs in a society shaped by non-native values and priorities (Wilson 2002, 408).

Additional policies acknowledging the rights of tribes to participate in natural resource planning and management (Executive Order 13175, TAS under environmental statutes, etc.), the recent paradigm shift in natural resource management, and the recognition of the importance of traditional and local knowledge in natural resource management has led to greater collaborative management of landscapes and ecosystems at the local level. In recent decades the dominant paradigm in natural resource management has shifted to incorporate the concept of resilience; to focus on the ecosystem as a whole, its function, diversity of species and interactions, and ability to reorganize following disturbance (Folke 2006). Along with this shift, Menzies and Butler (2006) note natural resource managers have taken greater interest in traditional ecological knowledge.

> This emphasis on TEK is based on the understanding that … the way that Indigenous people live off the land often means that they need to understand the way that the different plants and animals interrelate, how the ecosystem works as a whole, and how they can use that system to sustain themselves. This type of small-scale yet system-wide understanding is the approach that resource managers are turning to in order to better manage natural resources and the environment as a whole (Menzies and Butler 2006, 5).

In 'co-management', tribes are able to contribute human resources – knowledge, understanding, capacity and expertise – and financial resources (Wilson 2002).

Community-based Natural Resource Management

A widely recognized approach to collaborative management is community-based natural resource management (CBNRM). Hibbard et al. (2008) describe CBNRM as a collaborative, place-based approach, which seeks to balance community, economy, and ecology; it recognizes the complexity of natural resource management today and the importance of involving a range of individuals, entities, and interests. "Essentially, CBNRM uses collaboration to blend 'expert' and 'folk' knowledge in local-level decisionmaking. As such it has many similarities to the approaches to natural resource planning and management preferred by indigenous communities" (Hibbard et al. 2008, 8). In addition, CBNRM offers an adaptive approach to natural resource management through its self-organizing properties, emphasis on learning by doing, recognition of uncertainty, and through its social organization and structures for decision-making (Armitage 2005).

Armitage (2005) suggests social processes and structures are often overlooked aspects of CBNRM, particularly under uncertain and changing conditions, and recommends to enhance CBNRM in times of change or adaptation requires understanding how different actors are able to collaboratively define problems, learn and build capacity, and respond to changes in environmental conditions and associated resource use. He suggests, adaptive capacity offers a framework for understanding and assessing CBNRM performance in the context of changing conditions. Armitage (2005,

707) describes adaptive capacity in a socio-institutional context as "the ability of social actors to flexibly respond to change and disturbance, despite the value placed on social and institutional stability;" and recommends efforts to enhance adaptive capacity should focus on innovative strategies, ideas, and practices. Similar to a vulnerability assessment, he suggests identifying the variables that place stress on the social-ecological system and support collective action to address the stress. In so doing, Armitage (2005) outlines factors that influence adaptive capacity, including factors that influence opportunities for adaptive capacity – technical, financial, social, institutional, and political; and factors that have an inherent influence on adaptive capacity – power, scale, knowledge, community, and culture.

Berkes et al. (2000) emphasize also the links between traditional ecological knowledge practices and social mechanisms and suggest the importance of identifying the links in order to understand the coevolution of practices and mechanisms; they differentiate four categories of social mechanisms: local ecological knowledge; social institutions (rules-in-use to produce livelihood from the environment); cultural internalization; and world views. And Corsiglia (2006) suggests in integrating TEK into natural resource management it is important to understand how it is taught and transmitted among generations.

As a basis for assessing community capacity in the context of climate change, Tompkins and Adger (2004) suggest CBNRM can enhance adaptive capacity by building social networks and maintaining and increasing resilience in social-ecological systems. They describe that the mechanisms needed to enhance resilience often exist within community institutions that address environmental change; however, climate change will present new challenges and require new institutions or rules-in-use. "Adaptation to both gradual and significant changes should involve encouraging the evolution of new institutions that are sensitive to the resilience of the ecosystems they are managing and knowledgeable about the specific nature of the risks of climate change" (Tompkins and Adger 2004). Tompkins and Adger (2004) suggest that communities should build up their

social networks at the local level and regional, national, and international levels to increase their ability to respond to changes and their potential for support.

> Social resilience in this context appears to be promoted through at least two distinct forms of cross-scale interaction:
> - networks and community relations of individuals and groups operating to cope with variability and change in everyday decision making and,
> - wider networks of individuals or groups who may be able to influence the decisions that are being made at the local scale (Tompkins and Adger 2004).

In considering the social-ecological resilience of the Inuvialuit people in Sachs Harbour, Canada, Berkes and Jolly (2001) suggest also that new collaborative management institutions offer links across scales. "Newly developing co-management institutions create additional linkages for feedback across different levels, enhancing the capacity for learning and self-organization of the local inhabitants and making it possible for them to transmit community concerns to regional, national, and international levels" (Berkes and Jolly 2001).

Challenges to Community-based Natural Resource Management

CBNRM, the literature suggests, offers an area of research to inform climate change adaptation planning at the local level for American Indian and Alaska Native tribes. Adaptive natural resource planning for climate variability can also offer lessons in planning for climate change (Thomas and Twyman 2005). However, challenges to co-management are important to consider in this context as they apply also to collaborative, adaptive, community-based planning for climate change; which will not be a separate undertaking (Tompkins and Adger 2004), but one integrated into existing plans, policies, and programs (Smit and Wandel 2006). Of particular importance are challenges of equity, justice, and power sharing; overcoming differences in worldviews and knowledge systems; addressing past and current conflicts and building and rebuilding relationships; considering current stresses on ecosystems and human communities; considering

temporal aspects of resource access; and acknowledging property ownership nuances (Armitage 2005; Thomas and Twyman 2005).

Wilson (2002) describes the complexity now surrounding natural resource management in the context of the Pacific Northwest U.S., and therefore the continued importance of tribal participation.

> [T]he Northwest's shared resources (for example, fisheries and water), because of the 'common pool' dynamic that often leads to overexploitation, are managed by complex, sometimes collaborative, institutional structures. As a consequence native peoples view participation in these institutional arrangements as an important step towards protecting and promoting their interests in regional economic development and environmental protection actions (Wilson 2002, 399).

Hibbard et al. (2008) suggest CBNRM offers an approach to natural resource management that incorporates equity and values indigenous rights and interests. Governments, including Australia, New Zealand, and Canada have attempted to institutionalize 'co-management' through agreements with indigenous peoples (Hibbard et al. 2008). However, Spak (2005) points out in the case of some Canadian co-management organizations, the basis for incorporating indigenous knowledge is a scientific approach and therefore takes indigenous knowledge out of context and maintains a power imbalance.

> Even co-management boards which make a serious effort to include Indigenous Knowledge in their operations (such as the GRRB), do so without stepping outside of the state's Euro-Canadian scientific/bureaucratic framework of resource management. Scientifically trained resource biologists do in the end decide which aspects of Indigenous Knowledge are to be included in the management process and which are to be ignored (Spak 2005, 243).

Additionally, when natural resource management planning overlooks collaboration, questions arise regarding its sustainability (Tompkins and Adger 2004). Thus, the literature suggests, co-management requires building common ground and addressing existing conflicts among governments (Wilson 2002). And, within assessments of community-based natural resource management it is important to consider equity and balance power along with interests in access, procedure, and outcomes.

Current Efforts in Planning for Climate Change Adaptation in Indigenous Communities

Indigenous peoples in vulnerable landscapes worldwide are already experiencing the impacts of climate change on their lands, livelihoods, and health – physical, mental, emotional, and spiritual (Ermine et al 2007; Tsosie 2007; IPCC 2007; Macchi et al. 2008; Crump 2008), and are taking action to address the impacts. Crump (2008) describes how the actions and efforts occurring in communities in the Arctic and Small Island Developing States (SIDS) are important for the rest of the world to learn from as it prepares for climate change and as communities worldwide consider their adaptive capacity to address climate change. "Lessons learned through the Many Strong Voices Programme will support policy processes at the local, regional and international levels, and will provide decision-makers both in the Arctic and SIDS with the knowledge to safeguard and strengthen vulnerable regional social, economic and natural systems" (Crump 2008, 25) The Many Strong Voices Programme is a collaborative of indigenous peoples' organizations, community organizations, researchers, and policymakers focusing on vulnerability and adaptation research that integrates traditional and scientific knowledge, knowledge-sharing to help develop appropriate adaptation strategies, outreach to expose the impacts and capacity of communities in the Arctic and SIDS, and advocacy to ensure global climate policy discussions include consideration for the vulnerability of SIDS and the Arctic (Crump 2008). "There are voices always heard, and voices seldom heard, in the discussions about climate change. People in vulnerable regions are usually among the latter. However … there are ways for these voices to be heard – in the scientific research and in political lobbying" (Crump 2008, 30).

The work of Many Strong Voices and many others, including EALÁT a project focused on assessing reindeer herders' climate vulnerability (EALÁT 2009), the Arctic Climate Impact Assessment (ACIA 2005), and the Inuit Observations of Climate Change project (Berkes and Jolly 2001), provide important insight on the functionality of vulnerability assessments and their ability to inform effective planning for climate change

adaptation. All of these efforts intend to incorporate equity and build the capacity of indigenous peoples to prepare for, respond to, and cope with the impacts of climate change. They are cross-jurisdictional, cross-cultural, and interdisciplinary, and aim to inform policy, decisionmaking, planning, and action. Each incorporates assessing vulnerability as a starting point and to varying degrees combines scientific knowledge on past changes and projected future changes along with traditional and local knowledge on past and current changes and human responses to those changes.

Climate impacts and adaptation research generally recognizes two approaches to vulnerability assessments: the standard or hazards-based approach and the vulnerability approach (Burton et al. 2002; Ford and Smit 2004; Füssel 2007). Initially research efforts focused on the standard or hazards-based approach in considering the degree of projected impacts and the degree of mitigation required to avoid catastrophic impacts (Burton et al. 2002).[7] However, interest in and focus on the vulnerability approach has grown as recognition of the need for adaptation has increased. The hazards-based approach focuses on the physical impacts of climate change as projected by global climate models (Burton et al. 2002; Füssel 2007). While this approach provides great insight on climate risks, it has proven less useful in planning and developing climate policy (Füssel 2007). Füssel (2007) suggests the limitations of the hazards-based approach include its reliance on model-based projections of climate impacts which may be imprecise at the local level and based on a timescale (e.g. 40-80 years) incongruent with decision-making.

> Furthermore, [hazards-based] assessments usually give insufficient consideration to current risks associated with natural climate variability and non-climatic stressors, to key uncertainties and their implications for the design of robust adaptation policies, to non-technical aspects of adaptation (e.g. adaptive capacity and the social determinants of vulnerability), and to the wider policy context of adaptation (e.g.

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[7] Planning for climate change is important in preparing for occurring and projected impacts. It is also important in the context of reducing greenhouse gas emissions resulting from human actions. While adaptation refers to human action to manage and reduce vulnerability to current and potential unavoidable effects of climate change, mitigation refers to human action to reduce greenhouse gas emissions and address the causes of climate change (IPCC 2007).

> sustainable economic development and natural resource management) (Füssel 2007, 271).

The vulnerability approach focuses on a community's climate vulnerability – who, what, what stresses, and in what way – and adaptive capacity – current ability to adapt (Ford and Smit 2004). It assesses future risk based on current and projected future climate impacts and past experience; involves community members from the beginning; incorporates consideration of social aspects of vulnerability; and bases adaptation in community conditions and characteristics. Although the highly localized nature of the vulnerability approach makes it less useful in providing broad-scale recommendations, it has proven effective in engaging community members (Berkes and Jolly 2001) and identifying adaptation priorities and potential strategies for action (Füssel 2007). Füssel (2007) suggests the two approaches are complementary and current research, including that of the IPCC on climate impact, vulnerability, and adaptation assessments (IPCC 2007), seeks to integrate elements of both in assessing vulnerability to climate change.

Ford and Smit (2004) describe the steps involved in applying the vulnerability approach at the local level. "The first stage is to assess current vulnerability by documenting exposures and current adaptive strategies. The second stage is to estimate directional changes in those current risk factors and characterize the community's future adaptive capacity" (Ford and Smit 2004, 396-97). Based on their work with Inuit communities in the Arctic, Ford and Smit (2004) suggest two methods for compiling information on a community's current vulnerability: one is gathering community insight, observations, and traditional and local knowledge on past and current impacts and responses through interviews, focus groups, and participant observation; the second is gathering information on past impacts and responses by analyzing the content of government reports and newspaper articles, and considering the experience of land managers. In so doing, Ford and Smit (2004) point out the importance of determining a timeframe for current vulnerability. Ford et al. (2006) emphasize also the importance of considering past and current vulnerability as a baseline for future change and how it may affect a community.

In planning and preparing for a range of future impacts, Tompkins and Adger (2004) suggest the importance of first considering a community's current adaptive capacity. "Thus, although there are limits to spatial or temporal analogs of climate change adaptation, the present-day capacity to adapt and to be resilient is a crucial starting point for that adaptation" (Tompkins and Adger 2004). And, Wesche and Armitage (2006) describe that the difficulty in developing adaptation strategies for projected, uncertain environmental and in turn social, economic, cultural, and political impacts has led researchers to shift their focus from identifying specific adaptation strategies to identifying ways to increase adaptive capacity for a range of future impacts. In describing research regarding the practical application of climate adaptation strategies, Smit and Wandel (2006) suggest incorporating climate change into existing planning and programs, 'mainstreaming'.

> One of the fundamental findings from [local level climate vulnerability research] is that it is extremely unlikely for any type of adaptive action to be taken in light of climate change alone … Practical climate change adaptation initiatives are invariably integrated with other programs, and often aim to enhance adaptive capacity (Smit and Wandel 2006, 285-286).

To assess future vulnerability (stage two), Ford and Smit (2004) suggest evaluating climate projections, the potential impacts of those projections on the community, and the effectiveness of current community responses in addressing future impacts. For this second stage, Ford and Smit (2004) recommend considering socio-economic projections and working with climate scientists to identify potential future changes based on community observations and concerns.

Challenges Specific to Climate Change Adaptation Planning in Indigenous Communities

Planning how to address future environmental change and associated social, cultural, economic, and political changes at the local level presents considerable challenges. In addition to those listed above in relation to community-based natural resource management, climate change adaptation planning requires considering existing

stresses on human communities and ecosystems, the ability of current laws and policies to uphold rights in light of landscape and ecosystem changes, and planning across sectors and jurisdictional boundaries.

Existing Stresses

Climate change impacts coupled with current stresses on the environment from human land use, development, and pollution could threaten the survivability and recovery of some ecosystems (Tompkins and Adger 2004). Climate change impacts coupled with current stresses on human communities could also compromise the ability of communities to prepare for, respond to, and cope with climate change. Duerden and Beasley (2006) describe how the existing vulnerabilities of human communities will contribute to climate change vulnerabilities.

> While a changing climate may become an increasing source of stress, the factors that make communities vulnerable to climate change are also factors that make them vulnerable to a host of other problems. Narrow economic bases, diminution of human resources and lack of capacity have been long term features of Arctic communities despite a host of intentions and initiatives. Addressing these issues should be a key component of strategies to maintain viable communities (Duerden and Beasley 2006, 89).

Wesche and Armitage (2006) describe the impacts of oppressive government policies, including relocation and isolation and the market-based economy, on the application of traditional knowledge in responding to change for the mixed Dene and Metis population in the Slave River Delta region of Canada. They describe how these changes have led to decreases in the use of traditional knowledge, knowledge transfer between generations, and even land use. They also describe resulting impacts to livelihood and well-being, all of which could compromise the ability of the Dene and Metis to address climate change.

Past and current government policies and aspects of contemporary life, the literature suggests, affect the vulnerability of indigenous peoples to climate change as their ability to move across the land has been reduced and in turn so has their ability to

subsist off of the land and to transfer knowledge across generations. However, the literature suggests also that their ability to endure environmental and social impacts contributes to their resilience. In sum, the literature suggests in planning for climate change in indigenous communities, it is important to consider aspects of contemporary life along with traditional knowledge, local knowledge, cultural practices, and wisdom.

Upholding Rights – water, land use, land access

Climate change impacts pose threats to indigenous rights to land, water, and resources. Tribal water rights – access to sufficient quantity and quality for agriculture, domestic, recreational, cultural, and other uses (in some cases in-stream flows) – are guaranteed through treaties, statutes, and decisional law; and any changes in the amount of precipitation, the seasonal timing and flow, and the quality will affect tribal water rights (Houser et al. 2000). Similarly any changes in species migration, population, and seasonal timing, and land composition, elevation, and ability to support life will affect the rights of tribes to natural and cultural resources on and off reservations.

Landscapes have become complex patchworks of ownership and attached laws, which under changing conditions could make accessing lands and resources much more difficult. As a result of the allotment era polices and others in the U.S., a considerable number of non-Indians live, work, and lease lands on reservations, and many reservations now resemble checkerboards of landownership and "many tribes face severe legal difficulties in creating or enforcing comprehensive plans for land use or natural resource management, a situation that will complicate planning for climate change" (Houser et al. 2000, 356). Changing conditions could bring into question the ability of existing laws and ownership to uphold rights. "Tribes are tied to their lands through their ancestors and by legal definition that sets up reservations, outside of which they have limited rights so that they may no longer move and track environmental changes" (Williams and Hardison 2007, 5).

Planning Across Sectors and Jurisdictional Boundaries

Changes in landscape conditions and the need to address associated impacts to land ownership, access, and rights suggests that climate adaptation strategies should be aligned across sectors (social, economic, cultural, political, environmental), plans, and jurisdictional boundaries. Climate adaptation and mitigation strategies will need to be aligned across jurisdictions to avoid any unintended consequences and deleterious effects (Moser et al. 2008). It will require an approach that is integrated across sectors and scales, and is collaborative, adaptive, restorative, participatory, sustainable, and started now (Williams and Hardison 2005).

Climate change planning and policymaking will require collaborative planning across jurisdictional boundaries. Reservations are intricately linked to the forests, grasslands, watersheds, and ecosystems that surround them and as a result any changes in tribal environmental and land use regulations may require consent from non-Indian landowners, and any changes in federal environmental and land-use regulations will require consultation with tribes (Houser et al. 2000). In planning collectively for climate change, Williams and Hardison (2005, 10) suggest taking responsibility for our actions at the individual level and sub-national, national, and international levels, and "to understand the impacts, our history, our values, and come to a collective decision about our future."

Summary of Literature Review

Current lack of awareness and understanding regarding American Indian and Alaska Native tribes' vulnerability to and capacity to address climate impacts; and climate change manifesting at the local level suggests the need to consider how climate change is already affecting and projected to affect individual tribes environmentally, socially, culturally, economically, and politically. The fields of vulnerability, resilience, community-based natural resource management, and local-level climate adaptation research, and lessons from its application in indigenous communities, provide definitions and context useful in framing this study.

The definitions related to vulnerability and resilience provide a basis for understanding vulnerability and adaptive capacity at the local level. The unique knowledge and attributes of tribes individually and generally – rights, cultures, and natural resource management experiences, frame the importance of considering tribes in climate adaptation planning and policymaking. The ethical and procedural considerations in integrating multiple knowledge systems and in collaborative planning offer guiding principles for this study and similar studies, and climate policymaking and planning at multiple levels. The vulnerability approach assessment method offers an appropriate starting point and means to identify key considerations in planning by linking observed changes, current issues, and knowledge and experience to projected climate impacts. It offers means to engage tribes in considering impacts and sharing their knowledge and experience to inform planning adaptation priorities and potential strategies for action based on community experience, insight, and goals. Yet, influencing factors such as social processes, rights, land ownership and access, external and internal links, equity and power sharing, and worldviews and knowledge systems will also require consideration in planning for climate adaptation in indigenous communities and the regions in which they reside.

At the local level, incorporating elements of the hazards-based and vulnerability approaches in planning for climate change will vary depending on the social, environmental, political, and cultural characteristics of the community. For many communities, the hazards-based approach may be infeasible for numerous reasons such as financial and cultural; however, the vulnerability approach may offer an appropriate starting point from which a community can consider its key climate sensitivities and concerns, and plan how to address them in the context of local conditions and processes. Therefore, in this study, I approach the exploration of climate change adaptation planning at the local level by drawing from the literature on assessing adaptive capacity within CBNRM; and the literature on climate change adaptation, particularly assessing vulnerability using the vulnerability approach. In the next chapter, I describe in more detail my approach.

CHAPTER III
METHODS

This study relies on case studies conducted with the Hoopa Valley Indian Tribe and the Coquille Indian Tribe to explore adaptive capacity and the key considerations in planning for climate change adaptation, particularly natural resource and cultural resilience. In this chapter, I discuss the methodology used in developing and conducting the case studies and in analyzing information collected. I describe the semi-structured interview process, including participant selection and the interview guide. I describe my approach in processing and analyzing the information collected through interviews and comparing across cases. In addition, I address the limitations of the methods I used and offer considerations for strengthening the cases.

Overview of the Approach

Using the methods suggested by Ford and Smit (2004) in conducting part one of a vulnerability assessment, I consider vulnerability by gathering community insight, observations, and knowledge, traditional and local, on past and current impacts and responses through semi-structured interviews. Within the case studies, I focus on learning about natural resource management, climate risks, and barriers to addressing climate change so that I can consider the adaptive capacities of the two tribes. I also focus on learning about current social and environmental stresses in order to consider how they contribute to the tribes' vulnerabilities to climate change. To consider the adaptive capacities of the tribes, I rely on the factors Armitage (2005) outlines as influencing adaptive capacity in the context of community-based natural resource management.

Sampling

Case Selection

I selected the cases for this study based on responses to a letter describing my proposed study, which a list of tribal contacts in the Pacific Northwest U.S. received by email in summer 2008 (thanks to a member of my thesis committee). I received interested responses from two tribes, the Hoopa Valley Indian Tribe and the Coquille Indian Tribe, and proceeded in developing this study with those two tribes. Representatives from each Tribe were integral in helping develop and conduct this study, including providing assistance in developing research agreements and a scope of work, coordinating interviews, and reviewing and providing input on chapter and analysis drafts. Case selection was purposive, based on the tribes' interest in exploring planning for climate change.

Case Boundaries

I designed the case studies to focus on natural resource and cultural resilience in planning for climate change adaptation. In so doing, I developed a list of the types of people who could provide important insight on natural resource management, cultural resources, tribal governance, and connections among landowners and natural resource managers in the region. The list also included people knowledgeable about other community sectors, including health, housing, social services, and emergency management, to consider the connection between these sectors and responses to potential climate change impacts. Figure 1. offers a list of the types of people considered in selecting case participants. After developing this list, I worked with individuals for the Hoopa and Coquille tribes to identify around 20 people within tribal government, staff, and membership to contact about participating in this study. I relied on a purposive, snowball sampling strategy driven by my primary and case framing research questions.

Figure 1. Types of people considered in selecting case participants.

Tribal leadership, members, staff	Additional Stakeholders
Members of the Tribe	**Local**
Fishers, hunters	Community members
Elders	Local government
	Community organizations
Tribal officials	
Council members	**Regional**
Other policy and decisionmakers	Intertribal organizations
	University Scientists
Tribal staff	Regional organizations
Natural resources	Natural resource agencies
Fish and wildlife	
Forestry	**State**
Fire	Policy and decision-makers
Hydrology	Planners
Cultural resources	
Health	**Federal**
Education	USDA Forest Service
Commerce	USDI Bureau of Reclamation
Emergency services, disaster response	USDI Bureau of Land Management
Social services	Environmental Protection Agency
	USGS
Others	NOAA Fisheries
Recommended	

Hoopa Valley Indian Tribe

I conducted 15 semi-structured, in-person interviews in Hoopa during April 2009 with staff from the Tribe's Forestry and Fisheries departments, and Hoopa Tribal Environmental Protection Agency; past and current Tribal Council members; and community elders. The individual I worked with to identify potential participants, first contacted people by phone or face-to-face to introduce me and this study. I explained the study's purpose and my interest in scheduling a time for an interview, which would last approximately one hour. People had the opportunity to agree to or decline participation. I scheduled times with those people who agreed to participate and conducted interviews over the course of five days. As part of each interview, I asked for recommendations of additional people to talk with and compiled of list of those people.

Coquille Indian Tribe

I conducted 15 semi-structured interviews, a combination of in-person and over-the-phone interviews, with members of the Coquille Indian Tribe; staff from the Tribe's Housing Authority, Community Health Center, Land, Resources and Environmental Services Department, and Economic Development Corporation; and Tribal administrative staff and committee chairs. After receiving approval from the Coquille Tribal Council to conduct interviews, I worked with several individuals to identify potential participants and information on how to contact them. I first notified participants by email to introduce myself and the study's purpose. I then attended the Tribe's Restoration Celebration in June 2009 to meet tribal members, leadership, and staff in person and further explain the study and my interest in conducting interviews. I scheduled interviews in-person, by phone and by email with contacts provided by the Tribe and contacts I made while attending the Restoration Celebration. People in this case also had the opportunity to agree to or decline participation. I scheduled times with those people who agreed to participate and conducted interviews through June and July 2009. As part of each interview in this case also, I asked for recommendations of additional people to talk with and compiled of list of those people. In this case, some of the individuals I interviewed did come as recommendations from others interviewed as opposed to Hoopa in which all interviews resulted from an initial list.

Case Frame

The study's objective is to explore adaptive capacity and the key considerations in planning for climate change adaptation at the local level, particularly for natural resource and cultural resilience. The generalizations and conclusions I draw from the information collected through semi-structured interviews is analytic and may be used to inform: planning for climate change by the Hoopa and Coquille tribes; climate adaptation research at the local level; and climate policymaking and planning at the local, regional, state, and national levels.

Data Collection, Processing, and Analysis

I approached data collection, processing, and analysis in this study using insight from grounded theory (Glaser and Strauss 1967). After drafting my research questions, I developed an interview guide based on my research propositions, conducted interviews, and in processing and analyzing the information collected through the interviews, I attempted to develop a theory that reflected the relationships among the information. Below, I describe these steps in more detail.

Collection

Interview Guide

I adapted the interview guide used in this study from interview questions used in similar studies on vulnerability and climate change adaptation at the local level (Ford et al. 2006; Brklacich et al. 2007; Burton et al. 2002). It covers six topic areas intended to provide insight on: past or current experience that could provide lessons in planning for the future; observed climate changes; climate impacts of concern, occurring and anticipated; current issues affecting well-being; existing capacity: programs, relationships, practices, etc. that could facilitate adaptation; and strategies and barriers to addressing current issues and adaptation. Figure 2. provides an overview of the interview guide's topic areas. Appendix A. provides the full interview guide.

Figure 2. Interview guide topics.

- The Past as a Means to Understand Current Conditions and Capacity for Future Change
  - Community experience, observations and stories gained through past impacts and events could provide insight and lessons important in planning for future climate changes
- Current conditions as a Basis for Future Planning/Current Community Well-being
  - Impacts occurring and the affects of those impacts on community well-being: social, cultural, environmental, political and economic
  - Current community concerns about the environment, the economy, health or education important to address in planning for climate change
- Cultural and Natural Resources and Climate Sensitivities
  - What current or projected environmental changes are posing or could pose risks to natural and cultural resources
- Governance, decision-making structure and process
  - The process for planning and decision-making locally and regionally could influence preparing for climate change
- Looking to the Future
  - What are the Tribe's goals and plans for the next 25-50 years
- Climate Change Impacts, Community Development and/or Resource Management
  - How might projected environmental changes impact the Tribe's current activities and future plans, and how could planning now increase resilience
  - What strategies are in place to address impacts; what strategies could be used to address impacts
  - What barriers exist in addressing impacts

Interviews

In each interview, whether conducted in person or over-the-phone, I recorded individual responses by hand and attached no identifying information to responses. All interviews lasted from 40 minutes to over an hour and relied on the interview guide to focus the conversations. In each interview, I began by providing an overview of the project and of climate change as it relates to the project. To avoid politics and opinions regarding the causes and causers of climate change, I defined climate change for participants as: any changes in climate that you have observed that are positively or negatively impacting the tribe; and any changes that have been projected for the future as a result of increases in carbon dioxide and other greenhouse gases in the atmosphere. I also described my interest in learning more about the participant's concerns for how climate changes could impact different aspects of well-being: cultural, social, environmental, economic, and political; and provided the following definitions for

cultural, social, environmental, economic, and political adapted from the Centre for Indigenous Environmental Resources (2008):

> *Aspects of community well-being:*
> *environmental*: Could changes in climate affect the physical environment – air, land, water – positively or negatively; could changes affect plants, animals, fungi, and insects negatively or positively?
> *cultural*: Could changes in climate affect language, ceremonies, or traditional practices?
> *economic*: Could changes in climate affect: economic opportunity positively or negatively; costs to tribal administration; costs to the traditional or subsistence economy; or the cost of living?
> *social:* Could changes in climate affect health, safety, recreation, housing, social organization, or self-governance?
> *political*: Could changes in climate affect rights?

Depending on the individual, their experiences and knowledge, I focused the interview on certain topic areas outlined in the interview guide as opposed to all of the topic areas.

Processing

In processing, I sorted the information collected through interviews in categories to help in considering the tribes' adaptive capacities. I describe below how the interview questions informed these categories. To help in sorting the information into categories, I developed a list of codes. See Appendix B. for the list of codes and code definitions. I used the scientific software ATLAS.ti to code and sort the information recorded in interviews. I then transferred information to Microsoft Excel to work with it further.

Categories and Relevant Interview Topics and Questions:

Past Experience

To get a better sense of current conditions, focus the interview on impacts to well-being, and consider lessons provided through past experience, I asked interview participants what major changes have occurred within the community in the recent past.[8]

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[8] The timeframe for 'recent past' depended on the number of years the individual was familiar with the area; for the most part responses addressed events in the last 25-70 years, but ranged from four to 150 years.

Follow-up questions asked participants to consider how the changes affected the community, how the community coped with the changes, and if the experience could provide lessons in addressing future changes. In addition, answers to questions throughout the interview provided responses relevant to past experience or referencing past experience.

Observed Climate Changes

To capture whether individuals were noticing environmental changes locally, I asked participants if they felt the climate or environment had changed in the region in the recent past. Responses included observations potentially attributable to 'climate change' otherwise attributable to human land uses and potentially exacerbated by climate change.

Impacts to the Tribe

If individuals were noticing environmental changes, follow-up questions asked participants how changes were impacting well-being: social, environmental, economic, cultural, or political aspects of well-being. If so or if not, I asked participants what projected impacts they were concerned about and how the projected impacts to the environment could affect well-being. Additional follow-up questions asked participants what aspects of well-being were particularly sensitive to impacts, including particular populations or locations.

Current Experience and Current Issues

To get a better sense of current issues in the community and barriers to addressing climate changes, I asked participants to describe current issues of concern or current priorities the Tribe was focused on addressing. Responses to questions regarding impacts to the Tribe provided insight also on current issues and community experience.

Responses to Current Conditions

To understand the extent of adaptation in practice to current environmental changes, I asked participants what programs, practices, or partnerships exist to address current changes. Because current conditions could be the result of climate changes already occurring or because climate change could exacerbate current conditions, there is some overlap between responses to current conditions and responses to climate changes.

Responses to Climate Changes

To understand capacity to adapt to future changes, I asked participants what knowledge exists to prepare for, respond to, or cope with changes; and what programs, practices, or partnerships could be built upon to address changes.

Strategies Proposed

I asked participants also for recommendations for addressing changes occurring and projected, and enhancing the Tribe's ability to address changes. Responses to questions regarding past experience and future goals and objectives provided insight also on capacity and strategies proposed. I asked participants what they would like their community to look like in 20 years; responses to that question are incorporated also in this section.

Barriers to Adaptation

To get a sense of existing barriers to adaptation, I asked participants what are the challenges or barriers to addressing existing issues, improving well-being, and addressing future changes. Follow-up questions asked participants what additional information or action would help increase the Tribe's ability to adapt. Insight on strategies and future goals and objectives provided information important also in understanding existing barriers.

Analysis

Once sorted in categories, I grouped information as social, cultural, economic, political, and cultural. And, to answer my case-framing research questions, I considered the relationships between climate impacts, strategies, adaptive mechanisms, and barriers, in considering the adaptive capacities of the two tribes. In so doing, I relied on the factors Armitage (2005) outlines as influencing adaptive capacity in community-based natural resource management. Figure 3. presents the factors Armitage (2005) outlines as influencing adaptive capacity.

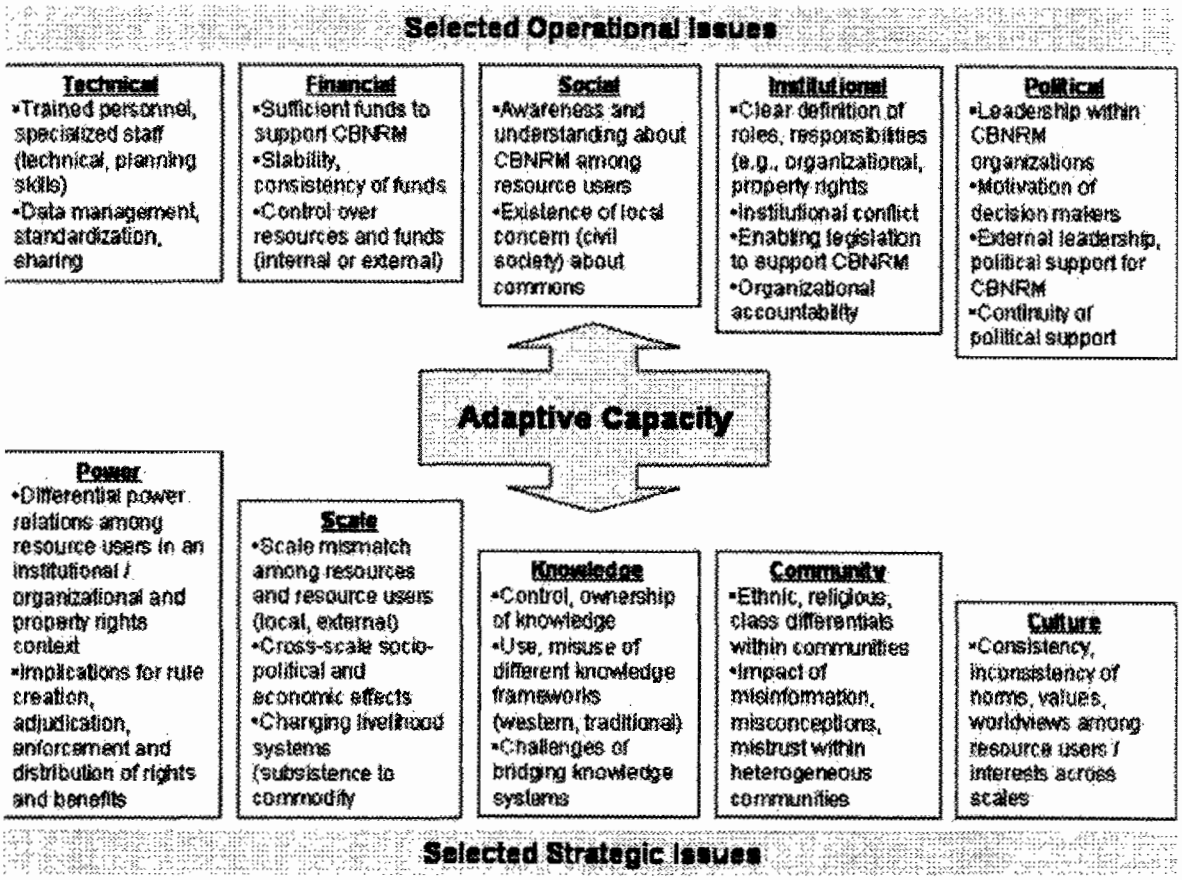

Figure 3. Factors influencing adaptive capacity for CBNRM (from Armitage 2005).

Comparing Across Cases

Based on the findings from each case study, I compare the factors affecting the tribes' abilities to address climate change, including the cultural, social, political, and

economic impacts climate changes occurring and projected present; the adaptive mechanisms – existing programs, practices, knowledge, and relationships the tribes have in place to facilitate adaptation; current issues regarding well-being; and the barriers, including external influences to addressing climate change and building resilience. I then draw conclusions on the key considerations in planning for climate change adaptation, particularly natural resource and cultural resilience.

Study Limitations

Case Study Research

Because I rely on case studies for my research, it is important to point out the strengths and weaknesses of case study research. In weakness, the findings cannot be generalized to a population such as all American Indian and Alaska Native tribes. In strength, the findings can be used to build theories, in this study, how past and current experience can provide insight on a tribe's adaptive capacity to prepare for climate change; and how adaptive capacity can inform planning for climate change adaptation. And these theories can be applied to substantive areas, in this study, tribal planning for climate change adaptation.

Cross-cultural Social Research

In addition, it is important to point out the challenges of cross-cultural social research. Because of my position as a researcher approaching the tribes as an outsider, individuals could have been hesitant to reveal their thoughts during interviews. Even though the two tribes invited this study and supported me in setting up interviews, the individuals who participated in the interviews could have held back sensitive information – with good reason. As described in the review of literature, outside researchers can extract knowledge and experience from communities unethically and inequitably, without fully respecting and understanding the context of that knowledge and experience. Although this study intends to use an ethical and equitable approach, it is likely that information collected and analyzed has been taken out of context. Therefore, to address

the limitations of this study in considering the importance of equity in access, procedures, and outcomes, future studies of this nature should consider a balanced approach in outlining study objectives, procedures, and outcomes.

Climate Change at the Local Level

Finally, limited understanding of how climate change manifests at the local level presents challenges in interpreting individuals' observations regarding changes. It is not the intent of this study to validate observations, only to record the observations and learn how changes are affecting well-being. Yet, it is important to consider the challenges in interpreting the observations because actions to address their impacts require some understanding of the causes.

CHAPTER IV
CASES

The case studies conducted for this study provide opportunity to understand the climate change risks that two American Indian tribes face and the tribes' adaptive capacities to address the risks. They provide opportunity also to better understand how climate change will manifest at the local level, considering past and current experience and current issues within the community; and how traditional and local knowledge and experience may inform planning for climate change at the local level. I present the information individuals shared in interviews for the Hoopa Valley and Coquille Indian tribes below and discuss the insight it provides on adaptive capacity.

Individuals interviewed in each case study contributed knowledge and insight on environmental changes, natural and cultural resources, natural resource management, forest-based economies, tribal governance, and connections between climate impacts and natural resources and community well-being: human and environmental health, economic and cultural sustainability; and strengthening, protecting and upholding rights, sovereignty and culture. They described past and current experiences, including the effects of federal policies and land management practices, which provide context for current conditions and considerations for future planning. They described the relationships that exist between tribal departments and between the tribe(s) and surrounding landowners and land managers. They also described strategies for addressing climate impacts and community issues, and existing barriers to doing so.

Hoopa Valley Indian Tribe

Past experience

Hoopa Tribal members, staff, and leadership interviewed described several major events or changes that occurred in the recent past and how those events affected the Tribe's well-being. These descriptions provided insight on past responses the Tribe used to address changes, the outside influences that affected the Tribe's ability to respond, and past practices in managing the environment that Hoopa people used to sustain themselves.

Changes in Forest Management and the Timber Industry – effects on jobs, forest composition, and small farms

Individuals interviewed described the incredible expansion (1940s-1980s) and then collapse of the timber industry and how it at first provided many jobs through logging and mills for men and women from the Tribe. One individual described,

> Because the forestry industry was the livelihood of the reservation, there used to be all kinds of companies coming in and logging, which provided jobs for people on the reservation. People made good money back in the 1950s. Logging was great because we had timber to log. Timber used to be so plentiful - big monstrosity trees. It used to be that logging trucks would just have one big log.

One individual also described a bug infestation that occurred in the forest in the late 1940s up through the 1970s, which led to overharvesting five to six times the sustained yield called for in the forest management plan.

At that time, individuals explained that the Bureau of Indian Affairs was in charge of forest management planning for the Tribe. One individual suggested the BIA was planning with the economic interests of the Tribe in mind, but the Tribe never approved any of the BIA's forest management plans. Others suggested the BIA and Forest Service managed the forest the direct opposite of the way Hoopa people used to manage the forest, noting the forest management policies put in place in the 1920s-30s banning the use of fire.

> In the 1920s-30s, because of the Forest Service and Smokey Bear, fire use was stopped and species composition changed. The policy considered all fires arson. Over the last 80 years, the landscape has evolved, along with the climate getting drier, along with subtle changes and the lack of the use of fire. The landscape has evolved to the point where plants are unhealthy, shaded by Doug firs that have encroached.

Individuals interviewed described how the Hoopa people have used fire as a management tool for centuries. One individual described,

> The Hoopa people burned area by area to remove brush, rejuvenate food species. The Hoopa people burned certain areas for basket material species too – hazelnut and another alpine species. Cultivating these species required lower temperature burns so as not to kill them through too hot of a burn. Forest management used to focus on managing forest resources such as tanoak which bears acorns and was used for food.

In addition to changes in the forest, one individual interviewed described how the timber industry's expanse also affected the small farms, which were once numerous in the valley in the first half of the 1900s following white settlement. The individual described how 1944 aerial photos show small farms and orchards in the valley and in the 1950s with the increase in logging activity, the number of farms decreased.

In 1988, the Tribe took over forest management planning and implementing, yet the BIA retains signatory authority on the forest management plan. Individuals described how the Tribe switched from an economic-driven management to a mix of forest values – economic, ecologic, and cultural.

Weather Events – storms, wildfires, and drought

When asked about past events, individuals interviewed described a number of weather events that impacted the Tribe, including a major flood in 1964, which flooded out homes in the floodplain, and a 2006 intense winter storm, which blew out many roads in the mountains, over 40 culverts that were designed for 100-year flood events, and with 110-mph winds, blew down a lot of trees in 30-50 year-old forest stands. Individuals described wildfires, one in 2005 on adjacent Forest Service land, which did not burn onto the reservation; and fires in 2008 on surrounding lands, which filled the valley with

smoke and significantly degraded air quality, particularly affecting elders in the community. Individuals also described droughts. One individual noted,

> 1975 was the first time I heard of the word drought. It was the first time the area had a drought, experienced what drought conditions really were. It was a shock to see the water levels so low from normal. It was the first time some springs dried up. It affected wildlife and vegetation drastically. At one time, the area had some of the finest surface water in the world. It also had four distinct seasons.

Changes in the Trinity River

Individuals interviewed described the installation of the Trinity and Lewiston dams on the Trinity River in 1963 as a major past event, and the impact of the dams on fish populations and housing development. Individuals recalled the abundance of fish in the past and past practices Hoopa people used in fishing. One individual described,

> The Hoopa people used to build fish dams, which had gates in the middle that fishers would remove every night for fish passage. The Tribe was criticized for this practice because outsiders assumed they were blocking the river. The fish trapped behind the dam were distributed to people without fishing sites. Other families also set nets to catch fish.

Social Institutions, Policy and Legal Action

When asked about past events, individuals described past social institutions within the Tribe, including passing fishing sites down through families, giving away fish to those who needed them, and how people nourished the plants and in turn the plants nourished the people. One individual described,

> The Tribe had rules and laws that weren't written, but understood, that reflected ways and practices perfected over time. There was no need for jails, judges and other things that exist today. There was no need for the word hell. Members of the Tribe used to have respect in all interactions with the Earth, even reciprocity/responsibility for detrimental actions. The Hoopa people used to have respect for all that leaves foot prints on Mother Earth, for all that is given.

Individuals also described the policy and legal action the Tribe has taken, including taking legal action to: protect its fishing rights through the 1970s fish wars and the 2002 fish kill on the Klamath River; maintain adequate water allocations for the

Trinity River; and to change federal agency practices, including stopping the BIA from taking six percent of tribal timber sales revenue. One individual described the 2002 fish kill and accompanying litigation and legislation,

> In 2002, more than 70,000 adult salmon died on the Klamath River. The immediate response of parties involved was to call for additional water. The Bureau of Reclamation denied the requests. Supplemental water was released from the Klamath, but it was not adequate to mitigate the damage. This led to litigation. The Hoopa and Yurok tribes brought suit against the federal government on the basis of the federal government's trust responsibility. Both tribes reached out of court settlements because the federal government couldn't be found liable for the action. In 2005, federal legislation rededicated water back to the Trinity River. The Tribe worked to develop the legislation, basing its recommendation on 20 years of studies. The Tribe was in litigation from 2001-2005 and did win the case.

Observed climate changes

Individuals interviewed described changes they had noticed in the environment that could be attributable to climate change. Responses reflected the fact that people are not certain about precisely what is causing local changes in the environment, whether it is climate change, development, hunting pressure, technology, increased roads, forestry activities, dam installation, or some combination; people aren't certain what is attributable to climate changes alone. Nonetheless, individuals described that the changes they are observing are impacting well-being. The responses of individuals interviewed focused on changes in weather, water, and the forest.

More Extremes and Variability

Individuals described observing more intense precipitation and seasonal variability in winter. One individual noted,

> This past year, the area had snow in December (quite unusual). It had a big snowpack in January. In January there were cold days, but there were also days where the temperature approached 80 degrees. This led to the snow melting earlier in the year.

Warmer Winters

Individuals described noticing warmer conditions a lot earlier in the year. One interviewee described,

> This time of year (mid-April) it would be snowing and raining. Icicles would be hanging off the rafters and eaves of the houses. Now, everything's drying up, even the river. This year, we're not going to have much of a river. The newspaper recently described that one-third of the dam is dry already - this year the water is down 600,000 cf in the dam. I think we're headed for a big drought, it's hot this time of year compared to the past. March, April, May used to be cold.

One individual also described how people are acclimating to changes in the seasons and surprised by weather now which used to be commonplace such as winter rains and power outages.

Warmer Summers and Drought, Forest Fires

Individuals described how the summers seem warmer and much dryer. One individual described,

> Now, I cut the grass and the tips turn brown right away. I used to be able to have a green lawn all summer with just a little watering. The drought and the chemicals in the water are killing the grass - chlorine, which is supposedly used to disinfect the water.

Individuals described how forest fires seem to be increasing in prevalence. One person noted,

> Last summer, fires on the reservation went out fairly quickly, but all around the reservation, fires burned all summer. Since 1999, the Hoopa Valley has had more smoke-filled summers. The size of the fires on the reservation has been getting larger.

Forest Health and Water

Individuals described how forest species composition is changing, noting the seeming disappearance of elk and small mammals, and the encroachment of Doug fir and spread of invasive species such as Scotch broom. Individuals also described significant changes in water availability, water quality, and the presence of aquatic species,

including salmon. Individuals suggested that current changes could be exacerbated by future changes to the local environment, including warmer temperatures and further decreases in available water. Table 1. summarizes some of the changes Hoopa tribal and community members have observed based on descriptions provided in interviews.

Table 1. Hoopa tribal and community member observations of environmental changes.

	Hoopa Tribal and Community Member Climate Change Observations
Impacts to Water	
drinking water	It seems as though the area has gone through more droughts in the last 20 years. It used to be that fall rains would start and not stop until spring. In the 1980s, the Bald Hill area had a spring. Two years ago the spring almost went dry. People living in the area had to have water delivered that year and this past year in September.
river use/access	The river is so low compared to what it used to be; the water used to be bank to bank and you had to swim across to get to the other side. Now you just wade across; in some places the water is only ankle deep. Today, the water is warm, not cool. I haven't been swimming in 15 years, since a company got caught pumping sewage into the river, and I try to tell my kids not to swim in it either.
salmon and fishing	I notice the decrease in salmon more than anything.
	The creeks used to support abundant salmon, trout. In the 1970s a fisher could catch 100 fish in one day and all those fish would be gone in one day because more people were eating fish then. It used to be that the people fishing would give fish to the people who needed them.
seasonal precipitation/ availability	During the winter, there is enough water; during the summer, we have to ration water. The river is getting low; the aquifer underground, the water table, they're all low. The creeks are getting lower as a result.
	Creeks used to come out of their banks, they used to flow over their banks. Trees and vegetation used to wash out of creeks and the river.
	Droughts are more common. People are getting used to dry winters and are surprised by heavy rain and power outages (what used to be commonplace). But we need rain and snows. People's acknowledgement of this is changing.
	For the last several years, Pine Creek has started drying up in the summer and going underground.
Impacts to the Forest	
timber harvesting	The amount of blow down after 2005 has increased. Hundreds of acres just get wiped out. It's unclear why the blow down is occurring and whether it is a trend or a result of forest management or climate change.
Wildlife	Cougars and bears are coming into populated areas. Bears are getting pretty aggressive, eating garbage. Cougars are coming close to homes. Some wildlife have more or less disappeared. Very seldom do I see chipmunks around anymore - could be because of pesticides, other human actions. There are less of other smaller species also.
Wildfires	Because fires have been increasing in occurrence and because of changes in climate, the potential for stand-replacing fire is increasing. The areas that burned in the last three years are the same areas that burned in the 1980s in stand-replacing fires. How many times can a forest burn and still remain a forest?

	Hoopa Tribal and Community Member Climate Change Observations
	Negative impacts are increasing. Droughts are increasing. Drought and fire conditions have been bad for about four years now. Fire season is longer than it used to be.

Impacts to the Tribe

Based on the environmental changes observed, individuals interviewed described how those changes are impacting well-being, including the Tribe's economy, culture, governance, and social aspects such as health and education. Table 2. presents the impacts to well-being that individuals described in interviews, categorized by changes observed: weather, forest, and water.

Table 2. Climate change impacts to well-being for the Hoopa Valley Indian Tribe

Climate Change Impacts to Well-being – Hoopa Valley Indian Tribe	
Weather	
More extremes and variability	
damages to infrastructure: culverts, roads	damages to timber: blowdown
firewood poaching	less snowpack
increased energy costs for residents (already eat up a lot of money people use to live on)	
Winters: warmer and variable	
tanoaks shift in range (and elevation)	less available water in summer
less firewood poaching	spread of Sudden Oak Death
Summers: warmer and drought	
detrimental to tanoak	affect air quality
reduce available drinking water	increase fire season length
increase fire susceptibility	dry up local springs
Forest	
Fires	
threaten culturally important plants and animals	decimate timber economy
change forest species composition	smoke affects health, elders and older residents
Forest health	
impact culture and valuable species	affect acorns
disrupt entire ecosystem, including tanoak (keystone species)	affect summer tree growth
Water	
affect agricultural crop choice, growing season	affect fishing

Climate Change Impacts to Well-being – Hoopa Valley Indian Tribe	
affect water available for new, existing homes	affect ceremonies, cultural traditions
reduce water quantity and quality	affect health
increase water temperature	impact streams, buffer areas, amphibians
affect salmon	less fish makes it tougher for elders without means to harvest own fish

Current experience and current issues

Descriptions of past events and experience provided a basis for current experience and current issues that linger as a result of past events. When asked about current conditions, and impacts to well-being the Tribe is addressing, responses focused on forest management, the Tribe's economy which relies primarily on timber revenue, the Trinity River, salmon, and drinking water, and changing social institutions regarding fishing. These areas, if not already being affected, could be sensitive to future climate impacts.

Changes in Forest Management

Individuals interviewed described the impacts from past management practices on the Tribe's current forest management activities and objectives. Individuals described that the Tribe now manages the forest to maintain culturally important species, in addition to managing for economic species. One individual described the role and importance of tanoak in the forest.

> Tanoak is the ecological key in the forest in Hoopa - it provides cavity nesting for squirrels and fishers and food for squirrels, fishers, bears and humans. Because of their cultural significance, the Tribe manages for tanoak. Tanoaks are associated with areas receiving 60 inches of annual rainfall, which is the case in Hoopa. There are places in tanoak's range where it grows as a shrub, but in Hoopa, tanoaks grow to be 50 feet in diameter. Fishers and bears eat acorns (hard mast) and nest in tanoaks, bears eat fishers. There are a lot of Bard owls in the reservation. The Tribe still has a stable population of Northern Spotted Owls and a healthy population of Pacific fishers.

The same individual described that in areas the Tribe logs, it leaves refugia for species, including lichens, bryophytes, large-diameter standing trees, and downed trees, to

disperse from, and the Tribe leaves buffers along streams and has 17 percent of its forestlands in reserves.

Yet, individuals also described conflicts between managing for culturally important species and economic values, including conflicts around bears and managing the landscape for prairie and oak woodland vs. forest. One individual described how bears are a culturally important species, but bad for timber production, destroying young plantation trees. The behavior is thought to be connected to forest patchiness – a result of past forest management practices. The problem, individuals described, started in the 1990s and since then, the Tribe has taken steps to address the problem. One individual described,

> The behavior is learned. Before the behavior was common in prairie areas, then just on the west side, but is now common throughout the forest on the reservation because of the forest management practices. Bear removal is only a band-aid. Bears are such a nuisance to the point they are shot. The bear problem exists to the west of the reservation on private lands and now is spreading to the east in the national forest.

Past forest management practices also affect the Tribe's ability to manage the forest for economic values. One individual described how the bug infestation in the 1940s-70s has affected the long-term sustained yield on the reservation; and others described how past management could be one of the reasons the forest is experiencing more blowdown – hundreds of acres getting wiped out on and adjacent to the reservation. One individual described that this is not affecting the Tribe yet because there are other areas to harvest, but it is a concern, particularly because the Tribe is unsure what is causing the blowdown.

In addition, individuals described how surrounding land management practices increase the potential for catastrophic fire to spread onto the reservation. Catastrophic fire could decimate the Tribe's timber economy; it could also harm culturally important species and sites, and human health.

Effects on Jobs

Individuals described how the Tribe has responded to the timber industry collapse by chartering a number of its own corporations, including a medical center, timber company, gravel extraction business, and a modular home operation. However, the Tribe's efforts have not made up for the number of jobs the timber industry supported. One individual described how the lack of jobs is leading to higher drug and alcohol use, hurting families, and forcing people to leave the area to find work,

> There are no more jobs in logging because there are no more trees. A lot of young men don't want to work. So, they are into alcohol and drugs. They live off of government checks - every Tribal member receives a per capita payment from the Tribe's timber revenue; people also turn to the TANF office for money assistance. It all boils down to people can't pass a drug test. But people don't want to give up drugs. It's hurting families and the community. People aren't taking care of their families and other families like they used to. The unemployment rate is so high. People are struggling here so bad, it's not funny. The people here who are working are fortunate to be. Jobs are hard to find here. Once people are hooked on drugs, it's difficult to get off.

Currently the Tribe relies on timber revenue from the old growth that it logs to fund Tribal government and provide funds to Tribal members. The Tribe's timber is Smart Wood Certified by the Forest Stewardship Council (FSC) for which there is a greater market value compared to second growth. However, individuals interviewed described that current projections suggest the Tribe only has about 5-10 years left of old growth available to harvest. Individuals described that a switch to second growth could mean a significant drop in revenue for the Tribe.

Changes in the Trinity River

Individuals described how dam installations and water allocations have changed the river's flow patterns and water quality and quantity for the reservation. One individual described that the high water mark has changed and now people are putting in homes and septic systems in areas that used to be flooded because now these areas are easy to access and housing is needed on the reservation. Others described the impact of

low river levels on people's drinking water supply, noting that some people who used to rely on the river for water now rely on outside services for water; and in the summer time water has to be rationed between users: hydropower, agriculture, humans, and other species, to the point that choices need to be made between endangered species. In addition, individuals described current concerns regarding water quality. One individual suggested,

> A lot of people don't drink their tap water because of concerns about poor water quality. There are people who say that some water lines are lined with asbestos. People have concerns about this. People have concerns about the water sources too - the pollution in the Trinity River and tributaries. There is a problem with people on the reservation throwing their garbage in the creeks.

Social Institutions

Individuals interviewed described changes in knowledge transfer among generations and the effects of a lack of jobs on traditional practices, including fishers no longer sharing fish among community members in need and people trespassing on family fishing sites, which can lead to conflict. One individual described,

> Now, instead of giving fish to community members in need, more people are selling fish, for a number of reasons. One reason is because they'd rather sell fish than go to school. Young people aren't catching fish to eat they're catching to try to sell it. However, young fishers are not being as respectful with the resource, sometimes wasting what they catch. The elders in the community are no longer teaching the young people about fishing and respect. The same thing is occurring in the school system - young people are getting disciplined and dropping out. A lot more elders are raising their grandkids now because the parents have died or aren't able to raise the kids.

Responses to Current Conditions

When asked how the Tribe is responding to current conditions, particularly environmental changes, individuals described a number of programs, plans, practices, and partnerships in place, including emergency management planning for intense winter storms and wildfires, activities to reduce wildfire risk, and education to restore a sense of

community and respect and reciprocity for the land. Because there is some overlap between current conditions and climate changes, these responses provided some insight on adaptation in practice and are combined with responses described in the next section, responses to climate changes. Below are a few descriptions of responses the Tribe has taken to address current conditions.

Policy and Legal Action

One individual interviewed described how the Tribe is involved in settlement discussions regarding dam removal on the Klamath River, along with 26 other parties, including dam operators, farmers, and other tribes.

> One of the reasons the Hoopa Tribe has opposed the Klamath Basin Restoration Agreement is the allocation to the Bureau of Reclamation. The Agreement guarantees water for agriculture, but leaves fish at risk. The Tribe believes it is not the right volume of water and too large a risk to fish as a result. The Agreement does not thoroughly answer questions about what happens in a drought. The Agreement references drought in the plan and maybe mentions climate change, but not much more than an acknowledgement that another plan needs to be developed to address drought conditions and climate change. The Agreement requires that tribes waive the claims brought through litigation. The Tribe has realized that it needs all of its tools in its arsenal to protect its interests. The Tribe's water rights are largely premised on fishery recovery and maintenance.

Education, Cultural Resilience

One individual also described how the Tribe is using education to restore a sense of community and connection to natural resources and culture. One example is a locally produced video on deer hunting and interviews with tribal members shown in the school as a teaching tool.

Social Institutions – emergency planning

One individual described how the Tribe is responding to the 2006 intense winter storm by developing an Emergency Operations Plan, and how the Tribe used the plan last summer to address the smoke from wildfires.

> The 2006 New Year's storm was a wake up for the Tribe as far as emergency services. Since that event, the Tribe has come a long way. We've gotten involved in OES trainings and have developed an Emergency Operations Plan as a result of the trainings. Before this plan, there was no department-to-department plan in place, no plan for communication between Roads, Tribal police, Tribal Council, etc. The Tribe used the EOP last year when they made an emergency declaration regarding smoke from the forest fires. The Tribe followed the incident command system structure.

Natural Resource Resilience

Individuals interviewed described how the Tribe's Forestry Department is in the process of updating its Forest Management Plan, the guiding document for managing the forest. The Tribe is currently working to determine strategies to incorporate into the plan to address bear damage occurring in young timber stands, annual allowable cut for old-growth, and transitioning to second growth. Individuals also described a number of ways the Tribe is responding to existing wildfire risk in preparation for future events. The Tribe is developing and implementing plans to thin forest stands and remove ground fuels, and do prescribed burns and cultural burns, which individuals described could be cost-effective, proactive, protect cultural values, and help manage pests.

To respond to current conditions in the Trinity River and tributary streams, individuals described actions to restore habitat for salmon and other aquatic species, in addition to actions to protect water rights.

Responses to Climate Changes

When asked about existing capacity to address current environmental changes and those projected for the future, including warmer temperatures, decreases in water resources, and more intense storms and extreme wildfires, which could exacerbate current changes, individuals described numerous practices, programs, plans, and partnerships, which could facilitate adaptation. These responses, adaptive mechanisms, could be built upon to address future climate change. The responses spanned: policy and legal actions to address climate change; education, cultural resilience; social institutions;

economy; and natural resource resilience, including planning, monitoring, fires, forest health, and water. The information below incorporates answers to questions regarding responses to current conditions also.

Policy and Legal Actions to Address Climate Change

Individuals interviewed described various policy and legal actions the Tribe is taking to address environmental changes at national, state, regional and local levels, including nationally, lobbying for equitable funding resources to research and adapt to climate change, litigating to protect rights and motivate federal agencies to make changes, and working through federal programs and federal agencies to access resources to address climate change. One individual described,

> What is highly important regarding preparing tribes for climate change is that tribes and Alaska Native villages are sovereign governments, and as such, under statutory requirements are co-regulators of their environment. Tribes and Alaska Native villages have the authority and funding through Congressional acts to administer their own environmental programs.

Another individual described how the Tribe is monitoring proposed legislation to ensure that it does not affect the Tribe's rights or sovereignty.

> There is also currently legislation floating around regarding the Klamath Basin. The Tribe has to ensure this legislation doesn't circumvent rights and water allocations for fisheries also. The Tribe is monitoring legislation so that the legislation doesn't sever the trust responsibility of the federal government to the Tribe.

Table 3. summarizes the policy and legal responses of the Hoopa Valley Tribe to environmental changes occurring and preparation for future changes.

Table 3. Policy and legal responses of the Hoopa Valley Tribe to existing environmental stresses and preparation for future change.

Policy and Legal Responses and Climate Preparation – Hoopa Valley Indian Tribe
National
tribes are co-regulators of the environment tribes are lobbying for set-asides, equitable resources to address climate change, and language allowing appropriate application tribes are requesting funds for adaptation research forcing federal agencies to change through litigation

Policy and Legal Responses and Climate Preparation – Hoopa Valley Indian Tribe
working with EPA monitoring proposed legislation to protect rights, water allocations; maintain trust responsibility ***Regional***
protect water rights through Klamath Basin Restoration Agreement working with EPA ***State***
tribes are partnering with states to address climate change ***Local***
individuals in the community are organizing others to advocate for water rights ordinances, plans, and policies governing aspects of the Tribe

Education and Cultural Resilience

Regarding education and sustaining traditional practices, one individual interviewed described how the Tribe received relief funds to buy fishing and preserving supplies, teach young fishers how to save and preserve fish, and create more access to fishing sites.

Social Institutions – emergency planning

One individual described how the Tribe is working to further develop its emergency services, currently focusing on a back-up system for communication and a reservation-wide alert system that will put all Tribal departments and community members on the same frequency.

Economy

Regarding the economy, individuals described a number of initiatives the Tribe is pursuing to diversify its economy and create more jobs for tribal members, and do so in a way that is sustainable. Individuals described how people in the community knowledgeable about small-scale, organic agriculture could mentor others; how the community is going to start a sawmill to process smaller logs; and how the Tribe is looking into carbon sequestration as one way to reduce timber harvest but retain revenue.

Natural Resource Resilience

Regarding natural resource management, individuals described actions the Tribe is taking to plan how to prepare for and respond to climate changes, to monitor environmental changes, and to address wildfire risk, forest health, and water resources. Individuals described the importance of the Forest Management Plan in addressing climate change. One individual described,

> The Forest Management Plan may need a section on how to deal with the potential effects of climate change or each section may need to address the potential effects of climate change, just as they address stream protection buffers, fuels, etc. Not sure if the science of climate change exists to develop specific standards and guidelines. Community concerns could justify the actions - actions could address people's current concerns regarding tanoak production, water, deer, etc.

Another individual described,

> The Tribe needs to focus on the Forest Management Plan for climate change preparation. Everything in the plan tells the Tribe how to manage the environment. Preparation has to start there.

Individuals also described the range of research and monitoring activities the Tribe is currently engaged in, including collecting weather data and monitoring air quality, streams, wildlife species such as Pacific fishers, bears, and Northern Spotted Owls, and aquatic species such as salmon, green sturgeon, and eels.

Individuals described planning and management activities the Tribe is engaged in to address wildfire risk. Individuals mentioned the Tribe's Fuels Management Plan, Smoke Management Plan; invasive species and prairie encroachment mapping; thinning and underburning, and working with the USDA Forest Service through a stewardship contract to create a fuel break along a road adjacent to the reservation. Individuals stressed the need to treat fuels around the borders of the reservation to reduce risk posed by surrounding lands.

Individuals interviewed described actions the Tribe is taking to protect forest health such as washing logging trucks that travel outside the area to avoid introducing Sudden Oak Death. Individuals described actions the Tribe is taking to reduce sediment loading in streams as a result of logging, including closing and water baring roads to limit

their use. Individuals also described actions the Tribe is taking to restore aquatic ecosystems and protect water quantity and quality such as inventorying all sediment sources flowing into streams. One individual described this,

> The Tribe does watershed restoration, including upgrading road crossings and culvert replacements to protect fish. It has an inventory of all sediment sources flowing into streams, including east side streams flowing from Forest Service managed land and west side streams, including Pine Creek, a major fish-supporting stream that flows into the Klamath.

Table 4. lists all of the natural resource management responses of the Hoopa Valley Tribe to existing environmental stresses and actions to enhance natural resource resilience.

Table 4. Natural resource management responses of the Hoopa Valley Tribe to existing environmental stresses and actions to increase natural resource resilience.

Natural Resource Management Responses and Climate Preparation - Hoopa Valley Indian Tribe
Planning
a tabled Integrated Resource Management Plan - fisheries, forestry, TEPA
considering standards and guidelines to address climate change in FMP (current expired 2008)
working on projecting annual allowable cuts, working in bear damage impact and different stand improvement techniques
Monitoring
could incorporate monitoring for streams, aquatic species into FMP
Tribe is coordinating weather and forestry data
Tribe has 2 weather stations with desire to keep in one place to notice changes part of collaborative group working on fisher conservation strategy; FMP incorporates a lot of wildlife data
Northern Spotted Owl and fisher monitoring systems, share data with federal agencies
collecting temperature data for streams
TEPA and Forestry monitoring air quality
Tribe works with USGS to monitor water levels (inform salmon management)
Tribe monitors fish populations on tributary streams
Tributary monitoring where timber management occurs
Fires
lessons learned from 2005 Megram fire
Tribe has Fuels Management Plan, one plan for reservation, includes cultural burn plans, burns from fuels reduction activities
fuels management plan is based on past and present climate
mapping invasive species and prairie encroachment, figuring out past extent of prairie
developing smoke management plan for Hoopa airshed

Natural Resource Management Responses and Climate Preparation - Hoopa Valley Indian Tribe
use fuel modeling software to project fire behavior inside and outside areas to burn
thin timber stands around reservation borders to create buffers and catch fires
Tribe has fire line
Tribe has stewardship project with Forest Service - developing a shaded fuel break along the road
access fuels treatment dollars through BIA
underburning in owl cores
thin plantations (have to retreat every 5 years)
Forest Health
wash logging trucks to not transport disease (Sudden Oak Death from S. Oregon)
limit sediment loading in creeks from logging; close and decommission roads
manage for culturally important species, leaving refugia in logged areas
Water
federal agencies measure snow pack to estimate summer availability and determine water allocations
inventory of sediment sources flowing into streams
watershed restoration
using funds to address drought conditions
creating more areas for fishing
PUD does outreach on water conservation

Strategies Proposed

When asked what the Tribe could do to increase its ability to address current and projected climate changes, individuals suggested actions which also spanned: policy and legal actions to address climate change; education, cultural resilience; social institutions; economy; and natural resource resilience, including planning, monitoring, fires, forest health, and water. The actions suggested demonstrate ways to build upon existing strategies and responses and increase capacity to address climate change. Yet, they also help to point out existing barriers to doing so and barriers that could come to be.

One individual for the Hoopa Tribe described that the Tribe recognizes climate change is occurring and requires attention and planning.

> Climate change has been occurring for 8-12 years. The Tribe needs to begin planning now to address climate change with the hope of offsetting impacts that could come to be in the next 20 years.

Policy and Legal Actions to Address Climate Change

In addition to the legal and policy actions the Tribe is already engaged in, individuals interviewed described local and national actions the Tribe could pursue to prepare for climate change. One individual described how the Tribal Council could engage tribal members more in planning at the local level.

> What it boils down to is the Tribal Council needs to get with the people - have a big general meeting to let the Tribal Council hear what the community has to say; we could also have a number of smaller meetings, and have heads of departments go to Council and go to the public. Tribal Council is supposed to find out from the people what needs to be done.

One individual described actions the Tribe could continue along with tribes nationwide, including advocating for a federal-tribal advisory committee to collaboratively develop climate policy; coordinating among tribes and tribal organizations to build capacity to motivate action on addressing climate change at the federal level; and lobbying representatives to have set asides – equitable resources for tribes to adapt to and mitigate climate change, and to do so appropriately, how tribes think it's appropriate to use the funds. At local and national levels, individuals described the need to advocate for water preservation and water rights.

Social Institutions - emergency planning

One individual suggested emergency operations training for improving preparation for extreme events, including role-playing through scenarios that reflect what could happen locally.

Education, Cultural Resilience

Individuals described strategies to prepare for climate change through education such as teaching youth about climate change, holding employment trainings on the reservation for people to develop job skills, and using storytelling to pass down lessons and traditional practices. Individuals stressed the importance of nurturing respect for the land, planning for future generations, and restoring a sense of community among tribal

members. Individuals described also how traditional knowledge and practices need to be incorporated into addressing climate change at all levels of decisionmaking, global to local. One individual noted,

> Tribes have traditional knowledge that is important in understanding the environment. This knowledge needs to be given proper weight in addressing climate change issues.

Economy

Individuals offered numerous strategies for diversifying the economy on the reservation as part of increasing adaptive capacity to address climate change. Individuals suggested bringing back small-scale agriculture, developing small-scale timber processing, and adding value to the Tribe's modular home operation by making green modular homes powered by wind and solar energy. The strategies proposed, individuals described, could help to reduce reliance on timber revenue, contribute to efforts to improve forest health, create more jobs locally, and enhance self-sufficiency and health for community members. For small-scale agriculture, individuals described that the land, water, and market exist for crops and livestock, and in considering the potential for conditions to change, crops could be adjusted as needed. One individual described,

> It would be nice to see the Tribe have other methods for sustaining itself besides forestry. The valley could be great for agriculture. A great program could be developed for job creation and self sufficiency through agriculture and growing your own food. Irrigation water is set up in a lot of places.

Regarding small-scale timber processing, one individual described,

> The modular home plant could add value to the second growth wood which will be harvested here in the near future. If the Tribe is entering the second-growth market, it will need to add value to the wood to make the same income. The market for second-growth wood is saturated. There are all kinds of other potential uses of wood, but there are questions about economic feasibility. There could be uses for smaller diameter poles, and biomass, and burn less slash as a result.

Individuals also shared strategies for renewable energy that could address existing issues also, including heating the school in Hoopa with geothermal energy, a strategy that could be cost-wise over the long term.

Natural Resource Resilience

For natural resource management, individuals described strategies to enhance planning and monitoring such as connecting the Tribe's various planning documents and more monitoring for changes, particularly tributary streams, culturally important species, and amphibians, which individuals described are sensitive to and could be indicators of environmental changes. One individual suggested,

> Some people have thought of eels (Pacific lamprey) as an indicator species for environmental health.

Another individual described,

> Main stem fisheries work is being done on the Trinity and Klamath Rivers and the ocean, but I'm not sure the extent of work being done on tributary streams. Tributaries could be indicators for climate change - could be the place to look for the effects of climate change. The case may be that what happens in the streams is an indicator for drought and other changes. Then again, it may not because of the dams in place, which distort temperature and stream flow throughout the year.

To address forest management, responses included diversifying the species mix planted and changing management practices. To address wildfire risk, individuals described planning for a fire resilient landscape so that if fires occurred they would burn slowly through the landscape, and more fuels treatments and prescribed burning. One individual described

> The Tribe needs to be planning on a larger scale, it needs to be planning for a 'fire resilient' landscape, which could also address the bear problem. The Tribe needs to be prepared for putting out fires year round. In the future, the Tribe could manage the larger blocks of forest 100-400 acres to mimic a natural fire regime. Fire would burn a larger area compared to the size of the patches logged now. As a result now there are patches of Doug fir; hardwood-conifer mix; and tanoak; and along the streams, complex stands. The patchiness that has resulted from logging doesn't reflect natural conditions.

Individuals described reincorporating traditional burning as a tool to use in creating a fire resilient landscape, noting that if fire hits an area already burned, it could have a dramatic effect on the way the fire spreads.

And, to address the Trinity River and habitat for aquatic species, one individual described how the Tribe is looking into a partnership to address the lack of cool-water refugia for fish. One individual described,

> We could partner with the Army Corps of Engineers, US Fish and Wildlife, and Hoopa Fisheries, Tribal Environmental Protection Agency and Forestry for a project deepening the river channel to solve the cool-water problem for fish. Similar work moving gravel has been done in the area, on the Mad River. We could also remove vegetation from the stream banks and river bars so that the river could meander again, and use the Tribe's gravel operation to do so.

Individuals also stressed the need to use adaptive management to manage the Trinity River, add complexity back to the river channel, and protect, restore, and enhance fish populations as strategies to prepare for climate change.

Barriers to Adaptation

When asked what barriers existed to responding to current conditions and preparing for future changes, responses addressed the areas covered above: policy and legal barriers to addressing climate change; social institutions; education, cultural resilience; economy; and natural resource resilience, including planning, monitoring, fires, forest health, and water.

Thinking broadly about planning for climate change individuals interviewed suggested the difficulty in addressing locally something that is occurring on a global level. In addition, others suggested that however much action the Tribe takes to prepare, it may not be enough. Individuals described how if drought conditions are too severe, the Tribe's best efforts may not save the trees. Yet, they also described that the Tribe is going to work to do what it can, realizing that it may not be enough, but something is better than nothing.

Key concerns raised in the interviews regarded: preparing for future generations and ensuring future generations will have the ability to practice the same things the Tribe now practices; protecting culturally important species; and incorporating actions into

forest management that will increase resilience through wildfires and drought. One individual shared,

> If we lose the things that make us a people - salmon, tanoak, the river - then we wouldn't be a people anymore. I have no idea how to prepare for that.

Another individual described,

> If we don't try to look out for culturally important species, we will be doing future generations a disservice.

Throughout the interviews individuals raised questions, revealing key uncertainties and knowledge gaps, regarding preparing for climate change and addressing current issues, including the following.

- How might the Tribe plan for subtle changes and intense storm events?
- How might we do day-to-day forest management actions differently?
- How will a decrease in precipitation (20 inches) affect trees and fire?
- What is a lack of moisture going to mean for summer forest growth?
- How might Forestry consider fire lines for the future?
- What can be done to maintain the habitat and culturally important species of today?
- How might climate change affect water allocations?
- How might we address population growth and needed housing?

For the Hoopa Valley Tribe, these knowledge gaps require consideration in planning for climate change adaptation.

Policy and Legal Barriers to Addressing Climate Change

Individuals interviewed raised several political and legal barriers to climate change adaptation, barriers that exist at national, regional, and local levels. One individual described that at the national level tribes are currently receiving inadequate funding to address climate change, are reactionary to proposed climate change policy instead of involved in crafting it from the beginning, and are stuck as a result of federal inaction.

> As co-regulators, tribes are not funded at an appropriate level to address climate change issues. Tribes have to rely on the General Assistance Program, which provides funding for states and tribes to address environmental issues. Out of the total allocations, around $59 million per

> year is available to tribes to address all environmental needs: water quality, air quality, solid waste, superfund sites, and climate change issues.

At the regional level, individuals described the barriers to adaptation posed by surrounding land owners, including federal agencies the Tribe works with that have yet to incorporate climate change into their management plans. One individual described,

> Federal agencies (Bureau of Reclamation, NOAA-Fisheries, US Fish and Wildlife) need to become proactive and begin to implement climate change preparation measures into their management responses.

Individuals described the uncertainty of federal agency decisions as barriers also, particularly water allocations on the Trinity River. In addition, at the regional level, settlements and legislation regarding the Tribe's rights could pose barriers to adaptation.

At the local level, individuals described the barriers posed by Tribal governance, including the Tribal Council's priorities and the Tribe's regulations. One individual noted,

> Until climate change affects the Tribe's ability to manage timber, harvest fish and harvest traditional foods, the priority from the Tribal Council here is economics, keeping people employed.

Another suggested,

> Most of our own regulations are what keep us from doing things, but as times get tougher, we may have to loose our regulations.

Education and Cultural Resilience

Individuals described that the lack of available jobs and training opportunities, which is forcing people to leave the area, and the lack of knowledge transferred between generations pose barriers to maintaining traditional practices.

Economy

Individuals interviewed described the lack of economic diversity and jobs as barriers to general well-being. In considering the potential for small-scale agriculture, individuals mentioned the questions surrounding water availability and water pollution, including that irrigation water comes from streams with questionable water quality and

that in the summer the water in irrigation sidebars and ditches gets pretty low. Individuals also pointed out the barriers federal regulations pose to the Tribe's economy.

Natural Resource Resilience

Individuals described the barriers to natural resource management that the reliance on timber revenue poses. In addition, regarding monitoring, individuals described how funding limits monitoring and management, particularly the Tribe's ability to manage for cultural values. One individual described,

> Tanoak, Northern Spotted Owl, Pacific fishers, Pileated Woodpeckers, deer, bear, angelica, hazel - are important to the Tribe, but don't necessarily receive consideration in broader science because they aren't considered endangered species.

Another individual noted,

> Active programs to restore fisheries don't look at culturally important species like Pacific lamprey and green sturgeon. It is hard to get funding to study culturally important species as a result and advocate for their importance.

Regarding forest fires, individuals suggested that conflict between the Tribe's Fire Department and Fuels Management program, which is a part of Forestry limits the Tribe's ability to do prescribed and cultural burns. One individual described the controversy as follows,

> There is a personnel conflict between forestry and fire. There is conflict over cultural burning and prescribed burning. As a result, prescribed burning and cultural burning are not occurring as much as Forestry would prefer to be able to manage for cultural values and forest health. The Fire Department is supposed to do a fire planning analysis and have a fire management plan that outlines tactics, strategies and fire management zones. The fire management plan could connect to the forest management plan and the fuels management plan. However, currently there is disconnect - the fuels management plan separates out activities by watershed and the fire plan separates out fire management zones, different land divisions.

Another individual noted,

> The Forestry Department and the Wildland Fire Department need to get on the same page. Wildland Fire needs to understand prescribed fire. Some

> way is needed to figure out how the jobs of the two departments can be worked out.

In addition, individuals suggested the cost of fuels reduction and the lack of human resources within the Tribe and the BIA, which approves the Tribe's Fuels Management Plan, affect the Tribe's ability to address fire risk. One individual described that finding the right time to do prescribed burns also poses barriers to treating the forest.

Finally, the threat of fire spreading from adjacent lands affects the Tribe. Individuals described how the wilderness area adjacent to the reservation is susceptible to fire and areas to the east and northwest where a lot of blowdown has occurred contain a lot of ground fuels and could be sensitive to fire. One individual described,

> Forest fuels are high on Forest Service and BLM lands surrounding the reservation. The Tribe is trying to treat the boundaries of the reservation to protect it from surrounding fuels.

Individuals described barriers to protecting the Trinity River and aquatic habitat, including the lack of funding allocated for restoration and uncertainty regarding water allocations. One individual noted,

> There has been upwards of $100 million in restoration on the Trinity River, but the missing link is adequate flows. The Record of Decision has funds estimated for restoration work. However, agencies have been trying to compromise the restoration intent and in turn decrease funds allocated for the work. Federal agencies capped funding and decreased funds allocated. The project lacked collaboration across funding, infrastructure and implementation.

Table 5. lists all of the barriers to addressing current issues and planning for climate change that individuals for the Hoopa Tribe described.

Table 5. Barriers to addressing existing issues and planning for climate change adaptation for the Hoopa Valley Tribe.

Existing Barriers to Climate Change Adaptation – Hoopa Valley Indian Tribe
Political and Legal
National
tribes are reactionary to legislation (opposed to upfront involvement)
no federal allocations for tribes yet
inadequate funding as co-regulators; reliance on GAP

Existing Barriers to Climate Change Adaptation – Hoopa Valley Indian Tribe
climate change research funding not readily available to tribes
current economic crisis puts tribal funding on back burner
federal agency inaction on integrating climate preparation in management
agencies are stovepiped
Regional
surrounding land managers and management practices
Local
how to address something occurring on global level
BIA required approval of Tribe's burn plan - affects ability to implement
Tribal Council priority = economics, keeping people employed
Tribe's own regulations limit actions
Tribal politics make it difficult to get anything done
Tribal Council not having opportunities to hear from the people
limited areas to develop housing, issues with property allotments
conflict between Tribe's Fire Dept. and Forestry Dept. fuels program
Social, Cultural
unsure how to plan for subtle changes AND intense storm events
lack of human resources to address firewood and non-timber forest products poaching
lack of street names and house addresses for emergency response
messages are not reaching young people
elders no longer teaching youth about fishing, respect
more youth are selling fish to make money
families aren't taking care of each other like they used to
Economic
lack of jobs = leaving the reservation, problems with drugs
Tribal Council not agreeing on profit-making venture
drug testing and driver's license requirements, policies impact people's ability to find work
having to go into the TERO office to see job announcements
small-scale agriculture
questions about how clean irrigation water sources are
sidebars and ditches for irrigation get pretty low in summer
local PUD considering rate increases for water services
small-scale timber processing
less timber revenue would affect Tribal government, which depends on revenue
infrastructure no longer exists
natural resource availability to support activity
carbon sequestration
carbon market requirements (?)

Existing Barriers to Climate Change Adaptation – Hoopa Valley Indian Tribe
another funding source to offset harvest
Environmental
unsure how to plan day-to-day actions around potential climate impacts
tribal government dependence on timber revenue
plant and animal species important to the Tribe don't receive consideration in broader science (not endangered)
need for housing on reservation - considering forest residential development
Planning
alterations in Forest Management Plan could decrease annual allowable cut - adds risk to Tribe's primary revenue source
uncertainty of climate science makes it difficult to develop specific standards and guidelines
unsure what can be done to protect culturally important species
figuring out funding and human resources to support new actions
required Tribal Council and public review process
Monitoring
funding not available for species important to the Tribe
data collected depends on funding
Forest Fires
high arson rate in the area
Fuels Management Plan dictates funding available to the Tribe for projects (from BIA)
losing prairie to encroaching Doug firs because of limits on fire use for management
conflict between Fire and Forestry departments
information to determine best time to burn (prescribed); finding the right time to burn
cost of fuels reduction
high fuels on surrounding land
smoke management issues
lack of human resources - BIA, Hoopa Fire and Forestry dept.s
"If drought is too severe, our best efforts may not save the trees."
Forest Health
use of fire for management could spread invasive species
wilderness area adjacent to Hoopa, areas NW and E high blowdown, fire susceptible
inaction to address fuel loading on adjacent federal lands
non-timber forest products poaching
Tribe has to cut timber every year to maintain revenue, sustain economy
Water
people don't drink tap water, swim in river because of pollution, contamination
Trinity Reservoir diverting streamflow
Hoopa environment so water rich people don't consider climate impacts
lack of complexity in river channel

Existing Barriers to Climate Change Adaptation – Hoopa Valley Indian Tribe
lack of adequate flows
lack of culturally important species incorporated into active fisheries restoration programs
unsure how climate change will affect percent water allocated for users
power balance - hydropower, agriculture are big players
primary funding source for restoration - BIA watershed restoration program
people building homes and septic systems in the floodplain because of reduced flows, areas susceptible to flooding, where channel once meandered
ongoing Klamath settlement discussions on dam removal

Findings for the Hoopa Valley Indian Tribe

Past and Current Experience and Adaptive Capacity

The interview questions which focused on past and current experience and response offered the opportunity to learn how responses to past and current impacts to well-being, livelihood, and natural resources provide insight on the Hoopa Valley Tribe's adaptive capacity to prepare for future changes.

The descriptions individuals provided offered insight on environmental, social, cultural, economic, and political characteristics of the Tribe's adaptive capacity to address impacts to well-being. The descriptions suggest the Tribe has significantly increased its adaptive capacity since regaining self-governance in 1988. They also suggest that in increasing its adaptive capacity, the Tribe has looked to the past to reincorporate aspects of culture, social organization, and knowledge. Considering past impacts to the Tribe, and its adaptive capacity to address impacts suggests resilience within the Tribe to maintain identity and function through impacts. Although the Tribe is still working to restore and maintain aspects of its identity, overall it has worked to do so to date and has plans and strategies in place to continue doing so.

The Tribe has built capacity in natural resource management since it took over forest management from the BIA. Considering past experience provides insight on how. It also provides insight on lingering and external factors influencing the Tribe's ability to apply adaptive capacity. For example, the past pest infestation (1940s-70s) in the forest, the short-term response (removal), and the long-term effect of reduced annual yield and

revenue provides context on response, coping, and external influences, as do other events. The Tribe's balanced approach to forest management today, incorporating cultural, economic, and ecologic values, shows that the Tribe is enhancing its ability to manage the forest based on its knowledge and experience, and for its goals and objectives. Yet, problems such as the impacts of bears on young timber stands present challenges in forest management. These challenges result from a combination of internal and external forces, including the Tribe's primary economic objectives in forest management, surrounding land management practices, and past forest management practices. The Tribe has a program and strategies in place to address the bear problem, using technical capacity to understand the causes and effects, and to make changes in forest management practices. Yet, politics, economics, and inter-departmental conflict do limit the Tribe's adaptive capacity in addressing the problem. These factors, economics and politics, affect the Tribe's ability to address additional existing environmental and social stresses.

The Hoopa Valley Tribe has built economic capacity: it has chartered its own corporations and business ventures, and become a leading employer in the county. However, a lack of job opportunities and poverty affect the Tribe's ability to grow and address other areas of capacity such as cultural, social, and environmental – all of which receive influence from economics. Individuals described that socially, the Tribe has capacity in partnerships, local organizers, local media and outreach, and educational programs which incorporate cultural values and land stewardship. However, economic challenges affect social cohesion and consistency in norms and worldviews. Culturally, the Tribe has also rebuilt its adaptive capacity, incorporating cultural values into all that it does. However, social and economic impacts constrain the Tribe's ability to enhance and protect culture, as does environmental degradation and demands on natural resources from other users.

The Tribe has developed considerable political capacity: developing policies, processes, and structure for governance at the local level. At national and regional levels, individuals described how the Tribe has grown in its capacity to assert itself, protect its rights, advocate for its needs, motivate federal agencies to action, and partner with other

tribes to further increase capacity. However, at the local level, individuals described limits posed by a lack of community involvement in setting Tribal Council priorities, and as a result limits to power sharing, participation, and action to address issues within the Tribe and community.

Considering past and current experience provides insight on how adaptive capacity in the past compares to adaptive capacity today, and how barriers to applying adaptive capacity in the past compare to barriers today. Compared to the recent past, the Hoopa Valley Indian Tribe has enhanced its adaptive capacity to address impacts. However, barriers lingering from those past impacts, along with new ones, prevent the Tribe from increasing its adaptive capacity in certain ways. Barriers today regarding federal oversight and influence on Tribal decisionmaking resemble past barriers, but affect the Tribe to a different extent. In the recent past, federal management of the Tribe's forest provided jobs, but disrupted culture and social networks and organization, and political capacity – control over decisions. Today, federal decisionmaking regarding funding allocations for social services and environmental regulation limits the Tribe's ability to address existing issues and prepare for future changes; and federal policies, including the Endangered Species Act affect the Tribe's ability to sustain itself economically and protect all that it values in the landscape. Federal influence still poses barriers to applying adaptive capacity today. This suggests that to strengthen adaptive capacity, effort should focus on self-sufficiency and political and economic challenges at the local to national level.

Observed Climate Changes and Impacts to Well-being

Individuals for the Hoopa Tribe described observing environmental changes in seasons, resource availability, extreme events, and species populations and interactions. These changes directly affect well-being and are at risk of being exacerbated by climate change. Individuals described risks to its timber economy; subsistence and cultural resources, including terrestrial and aquatic species, and water resources; health and housing; water rights and access to surrounding lands which climate change could alter

through fire, drought, and severe storm events. Climate impacts occurring and potential put additional strain on areas of adaptive capacity already weakened by existing challenges.

Barriers

Individuals described barriers to addressing existing economic, political, social, and environmental stresses, and planning for climate change. Understanding these barriers helps in understanding what limits applying and building adaptive capacity. Individuals described how federal inaction and inadequate funding allocations for tribes pose significant barriers to preparing for climate change and to addressing existing issues. Surrounding land management limits the Tribe's ability to reduce risk, as does uncertainty regarding federal resource management decisions in the region. Economic reliance on forest revenue limits natural resource resilience, along with past management practices and policies; and a lack of job opportunities and natural resource resilience limits cultural resilience. These limits in addition to those described above regarding past and current experience require attention in order to build resilience and capacity for climate changes to come. Yet, they require the Tribe's attention at the local level, and attention by additional regional, state, and national stakeholders, including policymakers and resource managers because of the influence these stakeholders and their decisions have on the Tribe.

Adaptive Capacity to Inform Planning for Climate Change Adaptation

Understanding the Tribe's adaptive capacity can inform planning for climate change adaptation. Although significant barriers and stresses exist, the Tribe has well-developed plans, programs, practices, and relationships in place that could serve as starting points to facilitate adaptation to future climate change. Identifying these existing strengths helps also to identify gaps in action and knowledge such as a lack of resources available for building resilience of culturally important species and knowledge about how to plan day-to-day forest management decisions in the face of uncertain future conditions.

It helps to identify what's preventing applying adaptive capacity, such as external influences, and how they could be addressed. For example, individuals for the Hoopa Tribe described how at the federal level, a federal-tribal advisory committee could help to address the reactionary approach tribes now take to climate and natural resource policymaking and planning. The Tribe has the capacity to inform federal policy so that it incorporates the Tribe's interests and ensures the Tribe's needs are met at the local level. However, it is prevented in doing so because of power imbalances between the Tribe and federal government.

With understanding of its adaptive capacity, particularly its existing practices, knowledge, and relationships, and the external influences preventing the Tribe from applying adaptive capacity, the Hoopa Valley Tribe can consider planning for climate change adaptation and building its capacity to address climate change. In so doing, the Tribe can consider connecting strategies with existing adaptive mechanisms and incorporating measures to address key uncertainties.

Coquille Indian Tribe

Past Experience

In response to questions about major events in the recent past, members, staff and, leadership of the Coquille Indian Tribe described social, political, and cultural impacts to the Tribe as a result of federal government policies during the late 1800s and throughout the 1900s. Individuals described more recent changes in the economy of the area and resulting changes in the environment.

Impacts to Political and Social Organization, Culture, and Sense of Community

Individuals described the events coastal tribes endured as a result of federal government policies, including treatymaking, reservations, and termination, on what is known in the U.S. as the southern Oregon Coast. Through the era of treatymaking and reservations, the federal government took tribal lands away from the Coquille Tribe, along with other coastal tribes. Individuals described that unless tribal members married white settlers they were forced to move from their traditional territory to the Siletz Reservation to the north; many who traveled north died and many resisted, remaining in the area risking capture and death. Individuals described how the treatymaking and reservations eras, and termination affected cultural and social continuity. One individual described,

> My family doesn't do much for cultural traditions because we were assimilated into the white society. In the past, a lot of people didn't say anything about being Native American, they just tried to blend in. We didn't really have cultural activities because we didn't practice our culture.

Another individual described,

> Growing up I was aware I had Indian blood in me, but not much more than that.

Individuals interviewed also described the great effort and work that went into restoration, gaining federal recognition for the Tribe twenty years ago. Individuals described that since restoration, the Tribe has worked to rebuild as a government and as a

community. When the Tribe was reconstituted, individuals described that the Tribal Council began planning, and reached out to tribal members asking about their priorities; number one was healthcare and number two was education. As a result, the Tribe has made priority to provide education and health services. In 1995, individuals described that the Tribe opened a health clinic, Coquille Indian Tribe Community Health Center, which provides primary care for tribal members, non-Indian spouses and kids, and other Native Americans in the Tribe's five-county service area.

Social Institutions

Individuals interviewed described the permeability of indigenous territories on the southern Oregon Coast in the past as people moved seasonally following food.

> There weren't formal agreements between coastal tribes in the past, but it was accepted that different tribes along the coast crossed each other's territories through the seasons following food. Coastal tribes in the area used to move a lot depending on the season for hunting, fishing and harvesting.

Individuals described that coastal tribes enjoyed a bounty of food sources, including berries, game, and lots of fish and seafood: eels, clams, oysters, salmon, flounder, and crab. One individual noted,

> Our tribe were fish eaters. When the tide was out the table was set. They ate clams, cockles, barnacles, mussels.

Another individual described,

> My tribal relatives used to do a lot of clamming and fishing. People would clam cohogs, empires, and butter clams in Charleston in the deep mud and razor clams in the sandy beaches in Bandon.

Individuals described the social practices surrounding food and relationships. One individual described,

> When harvesting or hunting natives never took more than they needed for 1 to 2 days. Indians still do that when fishing, hunting foods. They'll ask themselves, who am I catching for? It's fun to catch and give away. It's connected to the Tribe's tradition of potlatches – getting together with others and giving gifts; the more you gave at a potlatch, the greater your

> esteem. Potlatches helped to develop social bonds and friendships among people and different tribes.

Collapse of Timber and Fishing, Industry Impacts to the Land

Individuals interviewed described past changes to the economy of the area, which timber and fishing industries used to dominate. Individuals described that when the mills were around the economy was strong, but has been sluggish since. One individual described,

> The biggest change is the logging industry's decline and of course, fishing too. I think these things are connected. The changes we make to the environment are all connected and have an adverse effect. The economic loss of the timber industry has caused an economic downturn and the community has struggled for the past 25-30 years.

The timber industry, individuals described, affected the environment, including the Coquille River Basin which is a part of the Tribe's traditional territory and has been intensely logged for the past 50-60 years. One individual described the impacts to the forest as a result of logging.

> The forest land I grew up on has changed drastically as a result of clear-cut logging. Streams, reservoirs and watersheds are different. I wonder as a result of logging, if other changes in the land have occurred and the way it operates has changed.

Another individual described the impact mills had on the Coos Bay estuary.

> The main detriments to the estuary were saw mills dumping sawdust into the bay, which caused a horrible stench. The sawdust also starved out clams and bottom fish. Eventually, however, dumping was stopped in the 1950s or 60s, I believe. People used to go crabbing up near North Bend. However, that stopped because of the sawdust dumping. But, now people believe the crabs might be coming back.

Others described also the impacts of human actions on salmon populations.

Observed Climate Changes

Individuals interviewed shared observations regarding changes in weather, seasonal timing, species distributions, and ocean conditions. These changes, individuals suggested could be because of climate change, particularly changes in weather and

storms, and seasonal timing; however, changes regarding plant and animal species could also be because of human actions on the landscape. Individuals described feeling uncertain about what precisely changes could be attributed to, but noted they were observing changes, and that those changes were affecting well-being, particularly species declines. Table 6. presents some of the environmental changes members, staff, and leadership of the Coquille Indian Tribe described observing.

Table 6. Coquille tribal and community member observations of environmental changes.

Coquille Tribal and Community Member Climate Change Observations	
Impacts to Water	
seasonal precipitation	There is a noticeable warming trend and it's not as wet – that is really noticeable. As a kid I remember the winters were wet. It would rain until the latter part of February. Now, you'll get some rain, but not as much. The rain starts later and there are breaks, it's no longer constant.
	It used to be that every year rain fell October through May, rain fell intermittently, but sometimes fell for days. The rains no longer fall like they used to. Souwesters, storms with strong wind gusts used to be common in winter. Now, they've disappeared. I notice this because my family used to go to the beach and watch the storms, so did many other people.
	Growing up in Charleston, I remember the summers were cooler. Now, there seems to be warmer summers. I've noticed the summers are getting quite a bit warmer. We used to get by in the summers even though they were colder, we would swim in the cold ocean water.
	As a child, I think we had more rain then. My husband and I both felt it was pretty rainy. I remember beautiful sunny days and at 4:00 p.m. the fog would roll in and the fun was over. In summer, it happened quite frequently when it was warm in the valley it would draw the fog in.
beach erosion	I noticed as a kid there were sandy beaches everywhere, with hardly any rocks. Now, there's been a lot more erosion and there are a lot more rocks on the beaches.
	The sand is pushed back because of rougher waters, storms in winter. Over the last 10 years, for instance, the parking lot at Sunset Bay is now half gone because the sand that's been pushed back. Smelt Cove – an area where people would go down and dip for smelt – the beach is now gone and access is limited, and now there are no smelt.
	Water and storms come in higher and are raging more than they used to be in the winter.
species shifts	There are more crows today than there were when we were kids; you find them on mudflats where you rarely saw them before. White egrets are present here now, and pelicans – you never saw them as kids. This year, pelicans overwintered here, which they don't do.
	The area used to have Black Oyster Catchers present, but there aren't many left.
species population declines	Clams, cockles, barnacles, mussels, rock oysters, have all diminished. As a kid I remember there used to be mussels all over the rocks at low tide. Now you very seldom see rock oysters, which used to be down in Whiskey Run. You just don't see them now.

Coquille Tribal and Community Member Climate Change Observations	
	There has been a decline of eel runs on the Coquille River. Eel runs used to be very big; there used to be thousands, millions of them. Eel runs have declined all along the coast and you hardly see them now.
sea level rise	Village sites of coastal tribes off Heceta Head are now under 50 to 60 feet of water and this could be due to climate change. However, the makeup of the coast is different down in North Bend compared to Heceta Head – there is different shoaling.
Impacts to the Forest	
seasonal timing	I think the seasons have shifted about a month. July, August and part of September used to be nice. Now the wetter weather doesn't arrive until August. I think there's been a seasonal change across the calendar. Now, we're picking blackberries in July instead of August and September. It is weird to see the salmon berries not out until the end of July, it used to be June. The lilacs, my favorite flowers, are not blooming until June, it used to be the end of April/beginning of May. But, I think people adjust with the weather.
	The fall salmon runs are later because it starts raining later
species population declines	There used to be tons of small native blackberry, which grows along the ground and over rocks. In the last 30-40 years they are much less plentiful. The same with salmonberry, which grows along streams. Now you can hardly find salmon berries.
	You rarely see flying squirrels in the woods anymore; when the eldest of elders say you used to see them jumping off trees as abundant as flees off a dog.
Disease	We have seen an increase in Swiss Needle Cast on the coast. The Tribe has a bad infestation on the reservation, the Empire property. There is concern that climate changes on the coast may be exacerbating Swiss Needle Cast, or have the potential to in the near future, but this is just an idea and people only think it could be connected.
Habitat	The vegetation canopy over rivers is being lost

Impacts to the Tribe

Coquille Tribal members, staff, and leadership provided responses regarding climate impacts to community well-being in reference to environmental changes occurring such as species declines and warmer summers, and changes projected for the future such as rising sea level, tsunamis, red tides, forest fires, and drought. Individuals described how these changes could affect the Tribe's timber and service industries, housing, and sense of place, impacting natural and cultural resources on land and at sea. Individuals suggested that as a result of human actions and climate change, people can no longer subsist off of local wild food resources.

Individuals suggested also that climate changes could bring opportunities for increased tourism and attendance at Tribal events. In considering occurring and potential climate impacts to the Tribe, several individuals said they were happy to be living on the

Oregon coast as opposed to other places that are experiencing and could experience much more severe impacts.

Weather

Even though individuals described observing changes in winter weather, they did not describe many impacts to the community as a result. One individual noted that beach erosion is affecting locals who are used to spending time at those places.

Individuals described how warmer summer temperatures inland could bring additional people to the coast to escape the heat; it could bring more people to the Tribe's casino, hotel and RV park, and to the Tribe's annual events. Individuals suggested warmer weather could bring additional tourism dollars to the community; it could also lead to population increases if people settle in the area. One individual described,

> Population increases could occur as a result of rising temperatures. We could see an increase in the elderly population, and the area is already heavily skewed toward retirees.

The same individual described that temperature increases inland in the Willamette Valley are contributing to extremely high pollen counts, which could further influence population migration to the coast, suggesting that this would be reflected first in the elderly population, which doesn't have the same employment concerns as other segments of the population. Individuals noted that the Tribe and its economic development corporation would have to consider changes in temperature and resulting changes in population in development and housing planning.

Another individual described that managers of outside workers would need to consider the effects of temperature increases on employees.

> More extreme events, increasing warm temperatures will be a real challenge for working in the forest and in the cranberry bogs. Managers will have to be concerned with people's safety, and warn people that they need to drink water, take breaks, etc.

Individuals also raised concerns regarding climate impacts on species which draw people to the coast. One individual described,

> People are already seeing species from the south migrate north in the ocean, including shellfish and pelicans. It could affect oysters and clamming, which brings recreationalists to the area.

Sea Level Rise, Wind Storms, and Tsunamis

Individuals described concerns regarding the impacts of wind storms, tsunamis, and sea level rise on the Tribe, including impacts to development, housing, and people living on the coast. One individual described,

> If sea level is going to rise, Coos Bay and North Bend are vulnerable because a lot of the community is built at sea level. Also, the Mill Casino is on Coos Bay.

Individuals interviewed described that the Tribe would need to adapt the Mill Casino and Hotel building, and adjust its future development plans on Coos Bay, including building adjacent to the casino and putting in docks in front of the casino. Individuals described the area's vulnerability to storms and sea level rise, noting the many roads that sit at sea level and flooding projections that suggest the reservation is at risk. Individuals described that increased storms and sea level rise could cut the area off from the rest of the state. The results of which, one individual described,

> The area would no longer have food transported in by truck. The area would lose roads. Low roads in the area could be inundated by water or landslides. There are low spots on Highway 101; and on the roads to Roseburg and Eugene there is the potential for slides and flooding. 15-20 years down the line I foresee this could happen. This area, along with other coastal communities could be cut off.

The same individual shared concerns also about the potential for more frequent events to affect the response time of the state to assist smaller communities in emergencies. Others mentioned the vulnerability of Kilkich Reservation, which has limited road access, and the road to the reservation is right along Coos Bay. One individual also described the projections that suggest the reservation is at risk to tsunami waves.

> I've seen FEMA maps showing inundation for tsunami waves would cover Cape Arago Highway, which goes right in front of Kilkich Reservation. The RV Park at the entrance to tribal lands would be the extent of the water. But, FEMA is currently revising its inundation maps because of their being based on flawed data. The special flood zone maps show

> flooding up to the Housing Authority office, up to the bogs on the Reservation. Sea level rise would mean greater wave potential and the flood hazard zone creeping further uphill onto the Reservation. We need to look at developing housing at higher elevations.

Seasonal Timing

One individual described the impacts of seasonal variability and seasonal timing on the Tribe's cranberry business, Coquille Cranberries.

> Last year, 2008, we had an unusually high number of frost events extending late into spring; this year, not as many, but still had some frost events. We're experiencing flip-flopping warm and cold periods; and periods of cool during the growing season that are impacting production. We experienced an unusually wet spring during the bloom period which impacts pollination, which in turn impacts production.

Another individual described concern for pest and disease outbreaks also affecting cranberries, suggesting climate change could force the Tribe to change its organic management practices if climate change introduces new pests or diseases. One individual also described that fall salmon runs are later as a result of fall rains starting later; and this change affects people economically if they are living off fish.

Forest - impacts to forest species of importance

Individuals described concerns for climate change to impact the Coquille River Basin, which is a part of the Tribe's traditional territory and includes the Coquille Forest, which is important to the Tribe culturally and economically. Individuals stressed concern for how climate change might affect culturally important species, including cedar, bear grass, camas, hazel, and other ground cover species.

Individuals described also that climate projections suggest conditions could become wetter or dryer or that uncertainty raises concerns about how to prepare the forest for future changes. Individuals described concerns about climate change exacerbating pests and disease, including Swiss Needle Cast, which has already shown up in the Tribe's forest lands. One individual described,

> Swiss Needle Cast is a fungus that affects Douglas fir. It is something the Tribe is dealing with at the Empire property – the reservation. The forest had quite a pocket there. I'm not sure if dryer climate would increase it. But, if we get into a stress situation on the forest that could promote an epidemic of insects or disease it could affect the Tribe economically and culturally.

One individual described that a pest or disease epidemic in the Tribe's forest could mean a salvage situation and revenue gain in the short term, but reduced revenue flow in the long term.

Individuals described concerns that climate change could affect species distributions across the landscape, including Douglas fir. One individual described that species balances have bearing on the Tribe's economy and how the Tribe allocates funds for human resources. Another individual noted that climate change could spread noxious species such as gorse and Scotch broom which could also affect forestry and cranberries.

One individual also described impacts to habitat, particularly riverine habitat, and resulting impacts to wildlife.

> The warming trend, hotter days and warmer nights, is affecting the type of vegetation the area has, which is affecting fish and wildlife. We are seeing a migration of species with vegetation change. The vegetation canopy over rivers is being lost and along with it, salmon habitat. This is probably one of the biggest concerns.

Regarding food resources in the forest, individuals suggested climate change is affecting berry species such as the native Oregon blackberry and salmonberry, and other roots and berries important to the Tribe. Others expressed concern for rising river temperatures and insufficient water supply for fish runs. Still others expressed concern for insufficient water supply for humans.

Fire

Individuals interviewed described concern for drier conditions in the future and in turn increased fire risk. Individuals suggested fire could affect forest species, decimate the Tribe's timber economy, and its plans to use forest slash and byproducts from thinning projects for energy and hog fuel, which as one individual described, is one of the

few resources available on the coast to generate power because coastal winds, with high gusts and breaks, are not consistent and as a result the area is not suited for wind power generation currently. One individual stressed,

> Fire is a big issue if it comes through the Coquille Forest. 5,400 acres is not a lot to burn. The Tribe would lose all economic, cultural and wildlife resources.

Water - impacts to sea species of importance

Individuals described noticing declines in traditional and current food sources that come from the sea, including salmon, smelt, eels, flounders, clams, cockles, mussels, and barnacles, and suggested concern for climate change exacerbating declines. One individual noted,

> The lamprey have diminished dramatically. They are very difficult to find and you need a permit from ODFW to harvest and a very limited harvest is allowed. Lamprey are a very important food because of their protein and oil. Lamprey traditionally travel with salmon runs, some people consider them to be like the canary in a coal mine. If the lamprey are down, then salmon are down.

Individuals suggested species declines affect people who rely on them for subsistence and livelihood. One individual described how as a result of declines in salmon runs, people who used to supplement food at home with salmon now have to look for alternative food sources.

Specifically considering the potential for climate change to increase red tides on the coast, one individual described,

> Having clams and fish has always been a strong thing for coastal tribes, and having gatherings to share them. If the weather impacts clams, that would impact the tribes. More red tides would impact the clam beds, and in turn the tribes.

Table 7. summarizes the climate impacts to well-being occurring and potential for the Coquille Tribe.

Table 7. Climate change impacts to well-being for the Coquille Indian Tribe.

Climate Change Impacts to Well-being – Coquille Indian Tribe	
Weather	
Summers: warmer	
increase area visitors, benefit Casino, Hotel, RV	impact forest and cranberry workers' health
increase attendance to Tribe's annual events	affect Tribe's development plans
population influx, increase elderly population	increase housing demand
More extremes and variability	
affect development, people living on coast	affect state's emergency response
increase tsunami risk	
Sea level rise	
cut off reservation from rest of state	flood reservation
inundate roads, landslides block roads	flood Mill Casino, Hotel, RV
Seasonal timing	
affect cranberry production	
affect salmon, salmon subsistence fishers	
Forest	
affect all economic, cultural, wildlife resources	spread invasives - Scotch broom, gorse
affect forest species mix	affect ancestral territory
Pest and disease	
affect cranberries	spread Swiss Needle Cast fungus
short-term timber revenue increase, long-term decline	
Species distribution	
people no longer able to subsist off wild foods	decrease berry species and harvests
affect culturally important species - camas, cedar, bear grass, hazel, others	changes in vegetation types
disrupt species balance	impact economy
impact funding for human resources	affect traditional knowledge
Habitat	
decrease vegetation canopy over rivers	decrease salmon habitat
increase water temperatures	impact fish runs
Ocean	
Species distribution	
species south migrate north - shellfish, pelicans - affect oysters, clams	decrease available subsistence foods, affect people's seasonal food tendencies
affect fishing	affect cultural food traditions - eels, clams, oysters, crab, salmon, lamprey
Red tides	

Climate Change Impacts to Well-being – Coquille Indian Tribe
affects to clam beds affect coastal tribes and traditions

Current Experience and Current Issues

When asked about current conditions within the community and current issues of priority for the Tribe to address, individuals interviewed described the area economy; the Tribe's finances and concerns regarding health and education service provision; changes in the relationship between the Tribe's economic development corporation and the Tribal Council; the environment, particularly species and habitat; and the Tribe's political and social organization, and social institutions as a result of restoration.

Area Economy – growth of service and tourism industries

Individuals described that the area in which the Tribe operates, the economy is slowly shifting from fish and forest-based industries. Since fishing and forestry declined 20-30 years ago, the area has struggled to find economic replacements. Individuals described how many people are living in poverty and scrambling for work. One individual described,

> Growing unemployment in the area is now close to 15 percent. The good jobs are in natural resource management, base industries – fisheries and forestry. However, in forestry timber prices have been falling and Swiss Needle Cast could be driven by warmer temperatures; and in fishing the price for fish has fallen and ocean conditions are changing.

Another individual described,

> People are going out and doing things for survival, scrambling for work, doing whatever they can to have income, picking up construction jobs and other opportunities that come along. People are picking mushrooms, drying cedar boughs, picking salal, etc. for sale – there's a lot more of that going on because people need the money.

Individuals described that the service industry is becoming the dominant industry in the area. The Tribe opened the Mill Casino in 1995, the Mill Hotel in 2000, and last year added to the hotel. Yet, individuals noted that service industry jobs offer much lower

wages than jobs in forestry and fishing. Individuals described that a lot of young people have moved away to find work and as a result the area is becoming a retirement community. One individual noted,

> The demographic is much older now than in the 1970s. The 1969 class at Marshal High School had 2,000 kids; in 2010 there will be just 1,050 kids – nearly half the amount of students as 50 years ago.

The lack of job opportunities has affected the Tribe. One individual noted that of the 900 members of the Tribe, just 200 live in the Tribe's traditional territory, many have moved to find work. Other individuals interviewed described how the lack of family-wage jobs, high unemployment, and low socioeconomic status directly affects access to health care and the self-sufficiency of tribal members. One individual described that outside the Tribe's health clinic, there are very little resources in southwest Oregon for tribal members to access health services outside of primary care. And, individuals described how the current economic climate globally impacts the Tribe's development plans, essentially putting a stop to development.

Individuals described how the counties, cities, other organizations, and the Tribe are all working to increase job opportunities; however, controversy has met change. One individual described,

> About six different businesses have tried to come in the area, including a glass factory. But people rejected all of them – some portion of the area worked to block all of them. I guess people want it to stay like it is in the area.

Political Organization

Since restoration in 1989, individuals described how the Tribe has become a leading contributor to the area's economy and social services. One individual described that the Tribe now has three functions: it functions as a government, a social service provider, and builds and sustains community. Yet, individuals described that the Tribe is still learning and growing. One individual noted,

> The Tribe is in the process of asking itself, trying to re-imagine what things might have been like without 35 years of termination; what tribal government and community would be like. For the Tribe in the modern

> context, activities, processes and actions often times are a totally new experience. The big change is that we are a community now. The question is, 'what are we thinking about as a community, not as individuals?'

Other individuals described how the Tribe and its economic development corporation, CEDCO, have recently come to together to work toward a common vision; in the past the two entities worked separately, but after a rocky patch last year, the Tribal Council and CEDCO are now moving in the same direction, improving their abilities to communicate and complement each other.

Finances, Health, and Education

Following restoration, the Tribe made health and education its priorities. Instead of offering per capita payments to Tribal members, the Coquille Tribe decided to provide healthcare and education services. Individuals described that all tribal families living in the designated five-county service area pay no out-of-pocket costs for healthcare. They also described that the healthcare the Tribe provides is the highest level of care. In addition, for education, individuals described that the Tribe provides scholarships, adult vocational assistance, and funds for each tribal member for post-secondary education.

However, the current economic downturned has impacted revenue from the Tribe's top three economic ventures: gaming, timber, and investment, and combined with the area's already sluggish economy, environmental impacts, and energy supply and cost, brings concerns regarding the Tribe's ability to sustain itself financially and continue providing the highest quality healthcare to tribal members and families. Individuals described that last year the Tribe had significant investment losses; held off on timber sales due to low market prices, and, CEDCO added onto the Mill Hotel and racked up considerable debt, affecting its ability to provide revenue to the Tribe.

One individual described that health care is the biggest part of the Tribe's budget and the Tribe can't check the cost of it. Individuals interviewed explained how the Tribe has two sources of revenue, one federal – from Indian Health Services, and one Tribal – money from the Tribe's general fund. Currently, the Tribe receives insufficient funding from IHS to provide the highest level of care and therefore has to cover more of the

amount necessary from its general fund. Individuals described how the Tribe is concerned about its ability to continue providing the highest level of care and is in the process of trying to figure out what to do to address the problem.

Forest Management

The Tribe's Land, Resources, and Environmental Services department manages the Tribe's 5,400-acre Coquille Forest and forestlands on the reservation. Individuals described that the Tribe manages the Coquille Forest for its economic, cultural, environmental, and biological values. The Tribe uses an interdisciplinary team that represents the different forest values to develop, implement, monitor, and review forest management. One individual described that forest management activities are primarily commercial, including timber sales and thinning; and cultural, including meadow, bear grass, and hazel restoration and enhancement; and ecologic, including managing wetlands and riparian areas. Forest activities, the individual described, are done using an adaptive management approach so that the Tribe can look at the impact of its actions and make modifications if necessary. The same individual explained that language in the Coquille Restoration Act and the Coquille Forest Restoration Act talk about the economic self-sufficiency of the Tribe; the language in these two pieces of legislation is the reason economic value is the Tribe's primary forest management goal. Additionally, the language in the Coquille Forest Restoration Act mandates that the Tribe manage its forestlands with the same standards and guidelines as adjacent federal lands.

Individuals described also that a mix of landowners and activities surrounds the Coquille Forest, including primarily industrial lands that have been intensely managed for 50-60 years, and some lands managed by the Bureau of Land Management that have recently been transitions to more mature forest, as timber harvest has been scaled back under the Northwest Forest Plan over the last 15 years.

Social Institutions

Individuals described how impacts to habitat, including clear-cut logging, have led to species declines, which in turn affect the self-sufficiency of Tribal members. One individual described that Tribal members no longer can subsist off wild foods.

> Now, for tribal members to survive they have to go find jobs either in this area with limited fishing and logging opportunities left, or elsewhere. In the past, tribal members did not work much; there was not much need to work because people could subsist off of the available foods. Now, many people have moved out of the area because of the need to survive; they've needed to find work to have money to buy alternative foods and fill subsistence needs. In part, the ability to subsist off of wild foods has declined also due to state and federal restrictions on land access and harvesting, which has affected access to roots, deer, other wildlife, and fish.

One individual described also how the lack of job opportunities has put more pressure on species, suggesting people are harvesting, poaching more deer, waterfowl, and fish for food. Another individual suggested the rising cost of fuel impacts people's ability to fish.

Culture and Sense of Community

As a result of federal policies, individuals described that the Tribe has lost a lot of knowledge. One individual explained,

> The Tribe has been so fractured as a result of reservations and allotment that a lot of traditional knowledge on preparation of foods (finding, harvesting, and transferring knowledge) has been lost.

Responses to Current Conditions

Individuals interviewed described numerous responses to current conditions and issues of priority, including actions to address finances and the rising cost of health care, and to restore culture and a sense of community within the Tribe.

Finances and Health Services

Individuals described that a current priority for the Tribe is coming together to address finances, particularly the difficulty the Tribe now faces in covering the cost of health and education services. One individual described,

> The Tribe is currently trying to come together and address healthcare and education. Healthcare costs over the last five years have grown by 10-15 percent per year. It has come to the point where it's unsustainable. The Tribe is trying to address healthcare through a community forum to talk about where the Tribe has been and where it's going.

Individuals described that the Tribe is trying to address healthcare through a community forum; the Tribe is working to come up with ideas for diversifying the economy and has also established a committee to look into how to make the Tribe's budget more sustainable for the long term.

Housing

Considering how to address the potential for population increases in the area and sea level rise as a result of climate changes, one individual described,

> The Tribe owns a piece of property, which is at a higher elevation and on which the Tribe has plans for developing housing. This is something we need to focus on for the near future. The Tribe has plans to expand housing and an elder facility. It's just a matter of money. Planning for population increases kind of fits with what the Tribe and CIHA have got going on already.

Culture and Sense of Community

In response to the cultural fracturing the Tribe has endured as a result of termination and earlier polices, individuals described the Tribe's efforts to restore a sense of community and culture since restoration. One individual mentioned the Southwest Oregon Research Project (SWORP),[9]

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[9] Through the Southwest Oregon Research Project, the Coquille Tribe worked to recover and historical, anthropological, government, and military documents regarding the Coquille and other coastal tribes in western Oregon, and repatriate tribal intellectual property; the information has been integral in the Coquille

> The Tribe hosted cultural conferences. From four of the conferences, books were published on the cultures of the participating tribes. The Tribe started the SWORP project and disseminated the information it collected in Washington D.C. on coastal tribes to other tribes in Oregon in potlatches.

Individuals described also the Tribe's annual activities, which bring people together, including the restoration celebration, family camp, and a youth camp in the summer, the salmon bake in the fall, and the mid-winter gathering. Individuals described also the Tribe's efforts to teach youth cultural activities and language, and to bring back traditional canoeing.

Responses to Climate Changes

When asked about actions the Tribe is taking to address current environmental changes and conditions within the community, individuals provided insight on: policy and legal actions; social institutions, including emergency planning, and health, housing and self-sufficiency; education and cultural resilience; the economy; and natural resource resilience. Several individuals commented that they didn't feel like climate change was occurring on the southern Oregon Coast currently, but would be in the future; the Tribe would need to focus on planning and preparing for impacts to come.

Policy and Legal Actions to Address Climate Change

Regarding policy and legal actions to address climate change, at the national level, individuals described that as a sovereign nation, the Coquille Tribe is in a unique position to affect climate change policy at the national level. One noted that the Tribe has a lobbyist in Washington, D.C., who provides the Tribe weekly updates on legislation and activity in D.C. and conveys information on the Tribe's behalf to legislators.

At national, regional and local levels, individuals described the Tribe's actions to increase its land base, as an avenue to increase economic, natural, and cultural resilience.

Tribe's efforts to strengthen itself politically, culturally, socially, and economically. For more information on SWORP, see Younker (2005).

One individual described that the Tribe is pursuing strategies to increase land access working from a legal standpoint – working for acknowledgement of legal guarantees for tribes in the U.S. Constitution; and working for acknowledgement that the Tribe's treaty was never ratified and inasmuch the Tribe never gave up its rights to hunting and fishing. In addition, individuals described the Tribe's efforts to manage land for the federal government, noting a current policy proposing a co-management agreement between the Tribe and the Bureau of Land Management, which would allow the Tribe to manage more lands and work toward its forest vision. One individual described,

> The Tribe is always looking for new opportunities to purchase lands outside of the Coquille Forest Act. The Tribe is working with consultants to develop land acquisition strategies that promote the Tribe's goals and objectives.

At the local level, individuals described the Tribe's strategic planning process, which incorporates an extensive community survey and multiple community meetings, is the primary way the Tribe engages the community in planning and directing the Tribal Council's focus accordingly. Individuals also described the Tribe's newly formed Climate Change Committee, which demonstrates the Tribal Council's commitment to addressing climate change and provides an avenue for learning, planning, and action. Individuals described that Tribal staff and CEDCO staff make up the committee. One individual described that Tribal Council has also directed the Tribe's natural resource staff to begin looking at climate change adaptation and mitigation, and to get up to speed on what's to come.

Several individuals described how the Tribe is leading by example through its efforts to prepare for climate change. One individual described,

> If the Tribe can provide an example of what can be done, if people see that, it might encourage them to rethink what they're doing. The Tribe's on the right track.

Table 8. describes the Tribe's policy and legal responses to current conditions and preparation for climate changes.

Table 8. Policy and legal responses of the Coquille Tribe to existing environmental stresses and preparation for future change.

Policy and Legal Responses and Climate Preparation – Coquille Indian Tribe
National
government-to-government relationship with Congress, affect federal climate policy
D.C. lobbyist - works on Tribe's behalf
advocating for health care needs (IHS funding)
land access -
better, smarter legal representation
pursuing legal guarantees for tribes in U.S. Constitution
pursuing acknowledgement of hunting and fishing rights
co-management proposal - managing land for fed govt
pursuing land purchasing outside of CFRA
Local
CEDCO, Tribal Council share vision
strategic planning to engage Tribal members in priority setting
Climate Change Committee
Emergency Preparedness and Disaster Mitigation Committee

Social Institutions

In considering the Tribe's existing capacity to address climate change, individuals described the Tribe's will to make change, its resourcefulness, and its numerous existing relationships and partnerships. Individuals described the growing positive relationship between the Tribal Council and CEDCO and efforts to leverage existing skills within the Tribe. One individual noted,

> The Tribe has good capacity. CEDCO and the Tribe try to leverage their human capital and beyond that they're not afraid to use consultants for economic analyses, engineering, etc. We have a good list of consultants – a good network to draw from. The Tribe and CEDCO are currently working on leveraging all of the resources the Tribe has; we are developing better ways to collaborate.

One individual described specifically the health center's resourcefulness in tight financial times, suggesting that in order to address funding and financial issues tribal clinics are very resourceful and are taking political action – to document need and advocate for that need.

Individuals suggested that working to restore the Tribe, and working on economic challenges in the past built capacity within the Tribe; and the experience could offer lessons for addressing future changes. Individuals also suggested that the Tribe's efforts to sustain and strengthen culture enhance its ability to address changes. One individual commented,

> I think a lot of what's being done culturally does enhance the tribe's ability to address changes. Anything that helps build community, I think would help along those lines – preparing for future changes.

Individuals described partnerships among Tribal departments, including between social services, economic development, and education to increase job and job training opportunities. Individuals described also partnerships between the Tribe and county agencies and community organizations, and the State.

Individuals described also a growing sense of awareness about climate change within the Tribe and the North Bend-Coos Bay area.

> The Tribe has become more aware of potential future issues. I think an overwhelming number of people feel a need to understand climate change and what's going on, and understanding that there's more than just one element to climate change, there's variation in impacts.

One individual described the housing authority's efforts to reach out to residents through events and through its orientation process for new residents, to raise awareness regarding resource use and stewardship.

Housing, Health, and Self-sufficiency

Regarding existing efforts to prepare housing for climate changes, one individual described what the housing authority is currently considering. The same individual described that in considering climate changes, the housing authority would anticipate the needs of those more vulnerable to changes such as the elderly and small children and adapt housing to meet those needs. The housing authority, the individual described would consider climate change when making changes to existing housing; currently, it considers climate change as part of green building practices and design, which it tries to integrate as feasible.

Regarding healthcare, one individual described how tribes are banding together to negotiate with providers and make the best use of resources financially. The individual also described how the Tribe partners with the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians for dental care access and with the Klamath Tribe for medical clinic access in other parts of the Tribe's five-county service area.

Individuals interviewed described how a community garden recently created at the reservation will help in increasing community self-sufficiency, providing foodstuffs for Tribal members. One individual commented,

> The Tribe has built a community garden at the reservation. There are people gardening. It is a tangible step people will be encouraged by.

One individual also described the resources that exist within the community to increase self-sufficiency through preserving wild and cultivated foods.

Emergency Planning

Individuals described preparation strategies for natural hazards in place for the Tribe's health center and for the reservation; individuals also described the Tribe's emergency preparation and disaster mitigation committee, and the Tribe's participation on Coos County's emergency preparation committee. One individual described the health center's emergency management plan, noting it is currently being dovetailed into the Tribe's emergency management plan. Individuals described also the reservation association board and the housing authority's work around emergency management planning. One individual described that a tsunami escape route is through the reservation and the community center on the reservation is a place where people could go in a tsunami. Another individual described the housing authority's capacity for handling an extreme event and planning for climate change,

> The housing authority has a draft emergency management plan that has not been formally adopted. The housing authority office has communication equipment for satellite contact, and plans for handheld radios. The office also controls the tsunami warning system. I anticipate the office would be a command facility in an emergency. It has a back-up generator that would last about 11 days. We also have some supplies store

> for residents, but it's something I would like to beef up. Climate change is something we think about and it overlaps with emergency management and disaster mitigation planning. We engage in that way thinking about climate change. However, we're not engaging in a huge master plan, planning for climate change. We're not actively pursuing grants to deal with the impacts of climate change on housing.

Another individual also described the Tribe's efforts to identify and map vulnerable populations in preparation for an extreme event; the Tribe is working with the State to map vulnerable populations and develop GIS coordinates to be able to quickly locate and access vulnerable populations, including the elderly, anyone with medical care needing power, single parents with small children, and the mentally ill. One individual also noted that all elders have tsunami emergency bags with supplies in them.

Education, Cultural Resilience

Individuals described existing educational resources, programs, and actions that are in place that could be built upon to enhance the Tribe's ability to address climate change, including the Tribe's elders program, afterschool youth group, and SWORP. One individual noted also that if the climate is changing, the Tribe's efforts to reintroduce traditional canoeing will help in preparation. One individual described the Tribe's cultural resources program, which works to frame and incorporate culture in a way that's important to Coquille people in education, as a classroom objective. The same individual described how information from SWORP could be useful in understanding climate change and planning to address it.

> I think climate changes, as documented in the past, happened to lots of people in lots of places – a validation that we can learn from the experiences of other people in other places as well as ourselves.

Table 9. lists the social and cultural responses of the Coquille Tribe to current conditions and preparation for climate changes occurring and anticipated.

Table 9. Social and cultural responses of the Coquille Tribe to existing stresses and preparation for future change.

Social and Cultural Responses and Climate Preparation – Coquille Indian Tribe
Social Institutions
CEDCO, Tribe administration leverage human capital
good consultants network to draw from
the will to make change
awareness, outreach, sharing information, developing sales strategy
Resourcefulness
community building, efforts to restore what was lost in governance, culture
interdepartmental, intertribal, intergovernmental, interagency partnerships
identify and incorporate needs of vulnerable populations for housing, emergency planning
lead by example
tsunami emergency kits
reservation board involved in emergency planning, community center is evacuation site
Health, Self-sufficiency
community forums
community garden
local people knowledgeable about food preservation
Housing
plans to expand housing (at higher elevation), elder facility
well-insulated, incorporate protection measures into repairs
Education, Cultural Resilience
elders program
afterschool youth program
culture incorporated into classroom objectives
SWORP - documents past experiences
Tribal education services
teaching culture to youth
annual events, Tribal gatherings

Economy

Individuals mentioned CEDCO's current strategic planning process as one place to incorporate climate preparation. Individuals also described partnerships between the Tribe, local chambers of commerce, tourism offices, and local government to address the economy.

The Coquille Tribe has been working to integrate practices to reduce greenhouse gas emissions. Individuals shared the many initiatives that have recently been put into practice, or will soon be, to mitigate greenhouse gas emissions. Table 10. lists the Coquille Tribe's economic responses to current conditions and preparation for climate changes.

Table 10. Economic responses of the Coquille Tribe to existing stresses and preparation for future change.

Economic Responses and Climate Preparation – Coquille Indian Tribe
Tribe's job contributions to local economy (casino, hotel, etc.)
CEDCO strategic planning
preparing for budget impacts in 2010, 11 now
pursuing econ diversifying, developing long-term financial sustainability
short-term stimulus funds to help offset costs
Mitigation
building awareness about climate change
cost-saving strategies -
integrate green design into new, existing development
energy efficiency, including fuel efficient vehicles
biomass energy production
Recycling
low-income assistance

Natural Resource Resilience

Regarding natural resource management, individuals described the Tribe's capacity in natural and cultural resources staff. Individuals described the Tribe's adaptive management approach to forest management as a mechanism to integrate climate preparation. One individual described,

> Adaptive management provides opportunity to adjust based on what you know. The Tribe does adaptive management and we apply to new actions what we learned in the past. The Coquille Tribe is able to use an adaptive management approach with success, and without adaptive management outlined in the Northwest Forest Plan, the Tribe would be stuck and would have to follow the directions of others to manage its forest. The Tribe

> needs an adaptive management strategy in order to have flexibility in management and to some degree work off of its vision for its forest.

The same individual described the web portal the Tribe is developing for Tribal members and the public to learn about the Coquille Forest and how the Tribe is managing its natural resources; and actions to control Swiss Needle Cast and diversify the species mix planted in the forest to increase resilience.

Regarding monitoring, individuals described activities in the forest and beaches to help document changes. For the Empire and Coquille forestlands, one individual described,

> The Tribe is actively monitoring its forest management to ensure compliance for what it committed to through its interdisciplinary planning team. The Tribe monitors water quality, cultural protection, wildlife habitat standards, etc., to ensure it is managing for a suite of values. The Tribe's monitoring program provides a way to pick up environmental changes. If we pick up changes in environmental processes through monitoring, we can make management adjustments. The Tribe has been monitoring since the 1990s in the Empire Forest Property and since 2006 in the Coquille Forest. At the Coquille Forest, monitoring is only going to get better in the next 10 years because of management changes at the federal government level, Council direction, and climate change.

Along the coast, one individual described volunteer work organized through Oregon Coast Watch and NOAA to help monitor how environmental degradation and climate change are affecting birds and animals on the beach.

> Volunteers get assigned a stretch of beach to monitor. Groups meet at least once a month to walk stretches of the beach. Volunteers look for rainbow fuel (gas, diesel bubbles with a rainbow-colored film) on the beach that indicates fuel is present; and dead birds and take measurements, record species and habitat information; they check seals and sea lions too; they also look for plastics and record their presence. NOAA gets the data the volunteers collect. Quite a few groups do monitoring; it's a way to show interest in keeping the beaches clean.

Regarding culturally important species, individuals described the Tribe's initiatives to restore prairie and savannah on its forest property, and restore eels by developing an eel hatchery. One individual described,

> The Tribe is looking at trying to open a lamprey hatchery at Fourth Creek Reservoir. The Tribe is currently talking with the Federal Government about it. The Tribe's fish and wildlife staff have found lamprey amocetes in creeks on the reservation.

Table 11. lists the Coquille Tribe's natural resource management responses to existing environmental stresses and actions to enhance resilience.

Table 11. Natural resource management responses of the Coquille Tribe to existing environmental stresses and actions to increase natural resource resilience.

Natural Resource Management Responses and Climate Preparation – Coquille Indian Tribe
Planning
forest management plan
forest management web portal
fires - fire protection plan for Coquille Forest
Coquille River Basin Restoration Plan
Management
natural and cultural resources staff
identify cultural values on landscape and how to manage for them
balancing forest values and management approach
adaptive management approach
habitat partnership programs
road agreements
restore prairie, savanna
planting diverse species mix, tolerates climate range
control, remove Swill Needle Cast
salmon habitat restoration
Monitoring
volunteer groups (beach monitoring)
forest monitoring - water quality, cultural protection, wildlife habitat standards

Strategies Proposed

Individuals interviewed described strategies the Tribe could pursue to prepare for climate change that could come from the Tribe's existing capacity and organization. Responses result from questions asking for recommendations for addressing current issues, changes occurring and projected, and increasing resilience. Responses in essence

describe layering efforts to address climate change atop existing initiatives and structure. The responses also point out the barriers that exist or could come to and limit applying adaptive capacity to address climate change. Individuals provided insight spanning: policy and legal actions; social institutions; education and cultural resilience; the economy; and natural resource resilience.

Policy and Legal Actions to Address Climate Change

At the local level, individuals stressed the importance of the Tribe building its capacity as a government; and the local community – the Tribe and surrounding jurisdictions – engaging in community-based discourse that include all points of view, particularly those currently left out. And, at the regional level, individuals described the need to work with stakeholders to address climate risks to the Coquille Forest, and to build collaboratives between the Tribe and local governments to address climate risks to the local community.

Social Institutions

Socially, individuals described a need for building community to strengthen the Tribe's capacity to address climate change. One individual noted,

> I think the Tribe need's to focus on having more of a sense of community, a sense of a Tribe. And to have more of JFK's message – ask not what your Tribe can do for you, but what you can do for your Tribe.

Individuals noted tribal members should become closer knit, more self-sufficient and self-reliant, and work on enhancing preparation for extreme events as strategies to build capacity to address climate change and existing issues. One individual also described, that in the process of planning for future changes, the Tribe should be considerate in all that it does – development, environmental management, etc. because there may not be another chance to recover.

Specifically regarding self-sufficiency, individuals suggested creating more community gardens and local food production and preservation, increasing energy

efficiency and conservation, and producing fossil fuel alternatives, and focusing on ensuring basic needs: food, energy, and healthcare, as opposed to growing profits.

Education and Cultural Resilience

Individuals interviewed suggested education and outreach as important strategies in raising awareness about climate change and building capacity in the process. One individual also described the need to incorporate history into public discourse; describing the lessons history offers to the Tribe today as it considers preparing for future changes. The individual noted that testimony given by Tribal members before Congress leading up to restoration and news articles on restoration could provide lessons and insight important in increasing capacity.

> The Tribe is in the process of rebuilding and learning anew, but it can draw from information documented in the past. Lessons can be learned from what people thought about themselves then, that we may have moved away from as a Tribe. What people thought about themselves as a Tribe could serve as models for us now. The Tribe could revisit earlier history for lessons to use to model how to act now.

Individuals also described opportunities to learn from others and tap existing resources as strategies to prepare for climate change. In addition, individuals interviewed suggested the Tribe needs to focus more attention on reclaiming its culture to bring people together and strengthen its capacity, putting emphasis on preparing future generations and connections to the land.

Economy

Regarding economic strategies, individuals suggested alternative ways to generate revenue and bring in funds, including using the skills and expertise the Tribe has gained in managing Heritage Place, an assisted living and Alzheimer's center, and the Coquille Forest, to manage additional elder facilities and forestlands. Individuals described that the Tribe has already been approached about the possibility of managing additional forestlands. Individuals also stressed the importance of perking up the area economy and increasing job opportunities.

Natural Resource Resilience

Regarding natural resource resilience, individuals for the Coquille Tribe suggested the first step is to get surrounding landowners talking about climate change. One individual suggested several strategies for brining landowners together, including through the Coos Fire Protection Association and Douglas Timber Operators, and through development of a plan similar to the Coquille River Basin Recovery Plan. Yet, individuals also stressed the importance of getting federal land managers talking with the Tribe about climate impacts. Individuals also suggested strategies for gaining access to additional lands, including managing lands for other entities and co-management agreements. They also described that strategies to prepare for climate impacts would require adaptive and site specific measures that would account for different characteristics, needs, and values. One individual described the importance of addressing climate change in the Tribe's forest management plan.

> The Empire and Coquille Forest Management Plans are coming up for 10-year review in 2011. I foresee having to update both plans so that they are more adaptive, and have more flexibility for making changes in management, when we notice impacts from monitoring. The Tribe foresees continuing to harvest and do restoration activities. In the review, the Tribe will look into significant changes to promote biodiversity and other values.

Barriers to Adaptation

When asked what barriers exist to planning for climate change adaptation, individuals for the Coquille Tribe raised questions and concerns revealing uncertainties that need to be addressed in preparing for climate changes, including how to ensure ocean health and protection, how to address a global issue that affects all human interactions with the land, and how to prepare for something that has the potential to manifest in a range of ways. Individuals also raised concerns regarding how to bring diverse landowners and manager together to talk about climate change, how to consider the long-term effects of short-term decisions in light of changing conditions; and how to protect

culturally important species. Individuals described barriers also spanning: policy and legal barriers to addressing climate change; social institutions; education, cultural resilience; the economy; and natural resource resilience.

Policy and Legal Barriers to Addressing Climate Change

At the regional level, individuals described the current lack of cooperation between the Tribe and federal land managers in preparing for climate change, suggesting that cooperation is imperative for adaptation. At the local level, individuals described that the budget is a great barrier to preparation and making changes, along with the potential for financial woes to reduce education and health services and as a result increase vulnerability. They described also that any changes in the Tribe's governing body could affect the Tribe's ability to adapt.

Social Institutions

Several individuals commented on the lack of opportunities for community-based discourse, describing how this affects action to address change. Individuals also described the need for more human resources funding and a clarification of staff roles and responsibilities in order to prepare. Individuals described barriers to addressing climate change resulting from local attitudes – not believing in climate change and paying no regard to media coverage of the issue. One individual described concern for the area's changing demographics and how a lack of young people could affect the area's ability to assist its growing elderly population. Individuals also described the difficulty the Tribe still has in working with some entities within the area.

> The Tribe tries hard to blend in with the community. The Tribe is received well, except for some shop keepers bad-mouthing the Tribe. Mostly they watch their tongues. But, there's still that distinction between Indians and non-Indians. A lot of people feel superior to Indians, but it's not as bad as it used to be. I can't tell if the less bad-mouthing and less feelings of superiority are just a result of the times changing, or something the Tribe has done.

Regarding housing, one individual described the only barrier is funding. Regarding health, individuals described also that the Tribes does not receive adequate funding from Indian Health Services to provide the highest level of care, noting that IHS is grossly underfunded regionally and nationally. And, individuals described that the lack of family-wage jobs affects Tribal members' self-sufficiency.

One individual described two barriers that exist regarding emergency preparation for the Tribe. One is challenges related to jurisdiction and sovereignty, determining who has the authority and jurisdiction to do what during an event or emergency; currently there is confusion among staff and agencies. Second is a lack of human resources, particularly one or more staff to focus on emergency management instead of fragmenting the responsibility among staff that have many other responsibilities also.

Education, Cultural Resilience

One individual described that the Tribe has opportunity to explore community recollection and incorporate it in planning for climate change; however, currently the Tribe doesn't have a reservoir of past experience to draw from, and in general, it is difficult for people to understand how history is useful today. Individuals also described feeling that to sustain and focus efforts on strengthening culture, more, new voices are needed to advocate for it; it may also require a change in Tribal leadership, new leadership to make culture more of a priority. Another individual described how the Tribe's membership is dispersed and a lot of Tribal members live far away as a result of past federal policies fracturing the Tribe and the lack of job opportunities in the area.

Economy

Individuals described also how money bars economic activity and development, and how this in turn affects natural resource management and species, culture, health, education, housing, and self-sufficiency.

Natural Resource Resilience

Individuals suggested the primary barriers to managing the Coquille Forest in the face of climate change stem from the Tribe's connection to adjacent landowners and through the Coquille Forest Restoration Act, which mandates that the Tribe mange its land using the same standards and guidelines as adjacent federal lands. One individual described that because of connectivity to federal forest management standards and guidelines, the Tribe is limited in getting to its vision when it is directed by and has to follow the federal government's plan. The same individual described,

> A matrix of ownerships surrounds the Coquille Forest and really limits the effects the Tribe can have. Adaptation and mitigation are really limited by adjacent land owners. It makes adaptation really in the hands of adjacent land owners and local partnerships. It will be hard for the Tribe to do what it needs to and make a difference preparing for climate change if local partnerships and private landowners are not also acting.

Individuals described the difficulty in brining landowners with diverse interests and goals together to address climate change. Currently, the Tribe isn't involved in any partnerships specifically aimed at climate change adaptation and mitigation.

Individuals described how proposed forest management legislation at the federal level could affect the Tribe's ability to monitor for changes and impacts if it does not incorporate adaptive management. The same individual described also how finances and changes in Tribal leadership could further affect balancing forest management goals.

> Right now, finances are becoming an even bigger issue. The Tribe's financial situation could shift forest management to an even greater focus on economic value. The shift would come from Tribal Council, but staff would develop recommendations and a series of alternatives for the Council to consider or adopt. Staff would advise the Council on what they prefer.

Table 12. lists all of the barriers individuals for the Coquille Tribe described that exist in addressing current issues and planning for climate change.

Table 12. Barriers to addressing existing issues and planning for climate change adaptation for the Coquille Tribe.

Existing Barriers to Climate Change Adaptation – Coquille Indian Tribe
Political and Legal
National
uncertainty regarding how federal legislation will affect local
federal forest management plan
Regional
ideas excluded from public discourse; other interests drive conversations
any change in local government coul affect priorities
matrix of landownership, jurisdiction, goals and objectives
how to get federal land ownership talking with Tribe about climate change
potential for legal action to block response
Local
any change in Tribe's governing body could affect priorities
Social
lack of preparation, people don't act until react - when interests affected
bad-mouthing Tribe in local community
how to bring diverse landowners together
clarifying staff roles and responsibilities (ambiguities related to duties)
the attitude of life in the area - against change
fewer opportunities for public discourse
not enough you people to support elder population
Health, housing, self-sufficiency
funding from IHS, HUD
reservation lacks access to county services – recycling
Emergency management
issues related to jurisdiction and sovereignty in emergency response
human resources
lack of strategy for sea level rise
Cultural
lack reservoir of past experience
lack of people advocating for cultural emphasis
disbelief, lack of outreach, attention to climate change
priorities other than culture
a lot of tribal members live far away
lack of history incorporated into today
Financial/Economic
current budget challenges

Existing Barriers to Climate Change Adaptation – Coquille Indian Tribe
less revenue coming in; debt
can't check cost of healthcare provision
high unemployment, low socioeconomic status
lack of family wage jobs
state economic reductions
Energy
Tribe ineligible for tax credits, incentives
actions have to make economic sense
lack of viable alternatives to produce power on the coast
caution in using cutting-edge technology; rather use proven tech
Environmental
surrounding landowners and potential for impacts to spread (pest, disease, fire)
lack of partnerships specific to address climate change
language in Coquille Forest Restoration Act directs managing for econ value, mandates managing under federal forest plan standards and guidelines
disconnect between tribal members and natural resource management
primary value as economic leads to other values falling off; Tribe's financial situation could shift further
lack of approach for uncertain future
people dependent on fishing industry for livelihood (affects salmon recovery)

Findings for the Coquille Indian Tribe

Past and Current Experience

The interview questions which focused on past and current experience and response offered the opportunity to learn how responses to past and current impacts to well-being, livelihood, and natural resources provide insight on the Coquille Tribe's adaptive capacity to prepare for future changes.

The descriptions individuals provided suggest the Tribe has built considerable capacity since it regained federal recognition in 1989. The Tribe has built capacity in culture: reestablishing values, worldviews, and regaining control of knowledge and history through SWORP, and rebuilding bonds between coastal tribes. The Coquille Tribe has built capacity politically: developing its organizational structure, strengthening and asserting its ability in government-to-government relationships with federal landownership in the region and federal policymakers in Washington D.C. Locally, the

Tribe has developed a strategic planning process that engages Tribal membership in priority setting. In addition, the Coquille Tribe has taken specific action on climate change: through the formation of a climate change committee; instituting measures to mitigate greenhouse gas emissions and in the process raising awareness about climate change; and directing staff to become more informed about climate change and to incorporate that information into management decisions and actions. These efforts contribute to the Tribe's adaptive capacity to address climate change.

Regarding finances and economy, the Tribe has built economic enterprises through the Coquille Economic Development Corporation (CEDCO) and now contributes substantially, jobs and resources, to the local economy. Socially, the Tribe has developed avenues for sharing information, pooling resources, and reestablishing bonds and support networks among and across tribal and community members. The Tribe has also built capacity environmentally through natural resource management: developing a management plan and process that balances economic, cultural, and ecologic values; building technical capabilities in monitoring and management; and creating partnerships among landowners and managers for aquatic habitat restoration, land management, and road access.

Understanding past and current experience and response also provides context for what adaptive capacity existed in the past as compared to today, and what barriers prevented applying adaptive capacity in the past as compared to today. Overall, considering recent past experience shows a trend toward building adaptive capacity across community characteristics. In addition, comparing more distant past experience, more than 150 years ago, experience 150-20 years ago, and present experience suggests resilience in the Tribe's ability to maintain community identity through disturbance.

Today, as in the past, external influencing factors such as reliance on federal funding and federal legislative mandates prevent the application of adaptive capacity at the local level, which suggests that to strengthen adaptive capacity, the Tribe should focus on building self-sufficiency. The barriers to doing so are strong, but the Coquille Tribe continues to work to address those barriers.

Observed Climate Changes and Impacts to Well-being

Individuals for the Coquille Tribe suggested that they are observing environmental changes and those changes are affecting the Tribe's well-being, and in the future, could exacerbate existing environmental stresses and introduce new issues. Changes are affecting and could affect the economy – tourism, timber, and cranberries; future population growth and demographics; emergency response; cultural values – in the forest, streams, and ocean; subsistence; and cultural food and social traditions. Determining what changes are occurring on the landscape and how the changes are affecting (and could affect) well-being helps to identify current limits to adaptive capacity; it helps to point out existing barriers to applying adaptive capacity.

Barriers

The descriptions individuals provided regarding existing barriers to addressing current issues and planning for climate change adaptation help in understanding what prevents applying adaptive capacity. Individuals described considerable barriers in addressing current issues and climate change posed by current financial and economic challenges, including the Tribe's budget and lack of family wage jobs in the area, which points out the incredible effect finances and the economy have on adaptive capacity. The economy connects to social and cultural characteristics of adaptive capacity as it forces Tribal members and families to leave the area to find work; it also could affect health and education service provision. Finances connect to political characteristics as the Tribe depends on federal funding sources that are inadequately funded; it also influences the priorities the Tribal Council sets. Finances also connect to environmental characteristics as natural resource management puts economic value as the primary goal, and this can push other values off the table.

In addition to the economy and finances, individuals described considerable barriers posed for natural resource resilience by surrounding landowners and land management practices, and the current lack of partnerships among landowners to address

climate change. Individuals noted a lack of human resources and issues related to sovereignty and jurisdiction create barriers in emergency management planning, which in the future could affect natural resources, community, and culture if preparation, response, and coping strategies are lacking.

Politically, individuals described a lack of opportunities for public discourse that incorporates all voices and perspectives as a barrier at the local and regional level. In addition, at the federal level individuals described how current federal forest management standards and guidelines limit the Tribe's ability to manage the Coquille Forest based on its vision and goals. At the federal level, uncertainty regarding federal climate legislation and a future federal forest management plan pose barriers to building resilience and planning for climate change. One individual suggested this in describing the Tribe's role in federal policymaking,

> The Tribe is in a unique position, with a government-to-government relationship with Congress. We are at the forefront of being able to provide input. The Tribe has an opportunity to play a role in climate policy, at least the Tribe is on the first list of parties to be talked to.

Another individual suggested this in describing the Tribe's ability to manage the Coquille Forest,

> Because of the language in the Coquille Forest Restoration Act the Tribe has to manage its forest lands with the same standards and guidelines as adjacent federal lands. The Tribe was managing under the Northwest Forest Plan, the WOPR, and now is back to the Northwest Forest Plan. Every time there's a change at the Coos Bay BLM District level if affects the Tribe. Now, there are two to three proposals being put together by local Congress people for a new forest management plan. These have the potential to affect the Tribe. The Tribe has very little say in the final plan decision because of the language of the legislation. Although the BLM has to have a consultation process with the Tribe, the federal government has the ultimate say.

The Tribe has rebuilt considerable capacity to affect federal policy. However, the responses of individuals interviewed suggest the Tribe is still to some extent reactionary to federal action as opposed to involved from the beginning and given proper weight in final decisions, as it should be as a sovereign nation.

Adaptive Capacity to Inform Planning for Climate Change Adaptation

The information individuals for the Coquille Tribe provided regarding past and current responses to well-being and environmental changes point out actual starting points – programs, practices, policies, and partnerships, adaptive mechanisms that could help facilitate adaptation. These are actions and relationships the Tribe has in place, which suggest the Tribe is already adapting to climate change. The next, step is incorporating strategies to address key uncertainties such as sea level rise, surrounding land owners and management practices, economic challenges, and risks to culturally important species and social traditions. With understanding of its adaptive capacity, existing gaps in capacity and knowledge, and the external influences that affect the Tribe in applying adaptive capacity, the Coquille Tribe can consider planning for climate change adaptation and building its capacity to address climate change. In so doing, the Tribe can consider connecting strategies with existing adaptive mechanisms, along with incorporating measures to address key uncertainties.

Summary of Cases

In this chapter, I describe the responses individuals for the Hoopa and Coquille tribes offered in interviews. The responses provide insight on past and current experiences and responses to impacts to well-being, livelihood, and natural resources. They also suggest climate changes the tribes are observing and are concerned about for the future, including how the changes are affecting and could affect them socially, culturally, politically, and economically. In addition, the chapter includes descriptions for addressing climate changes occurring and projected through existing plans, practices, and relationships, and the barriers that limit the tribes' abilities to plan for climate change adaptation. Finally, the findings for each case consider: the tribes' adaptive capacities based on past and current experience and response; and how their capacity can inform planning for climate change adaptation. In the next chapter, I draw comparisons across cases regarding the tribes' experiences and adaptive capacities to address climate change.

CHAPTER V
DISCUSSION OF FINDINGS

In total, the intention of the cases is to understand the climate risks the tribes face and their abilities to address the risks. They provide insight on climate changes occurring and associated impacts to well-being, and on the tribes' adaptive capacities. They also offer perspective on factors influencing the tribes' capacities through the lens of past and current experience and current issues affecting well-being. For each tribe, experiences, strategies, and responses are unique. However, similarities do exist in experience, strategies, adaptive mechanisms, and barriers. Comparing across cases allows for identifying similarities and differences. It allows also for identifying key considerations regarding the abilities of the two tribes to plan for climate change adaptation and address future changes.

Differences between the Tribes' Experiences

Differences exist in the tribes' past and current experiences, their goals and worldviews, and ways of interacting with the landscape surrounding. These differences influence the tribes' adaptive capacities today and their abilities to apply adaptive capacity in the future to address climate change. They are important to consider in policymaking and planning at local to global levels.

Rights

As a result of past policies and actions, the Coquille Tribe possesses unadjudicated rights to hunting and fishing. The Hoopa Valley Tribe's rights to fishing are recognized and these rights contribute to the Tribe's ability to advocate for protection of important cultural and subsistence resources. In addition, federal agencies and land managers have the responsibility to uphold the Hoopa Valley Tribe's rights to fishing; whereas currently,

they haven't the same responsibility to uphold the Coquille Tribe's rights. These considerations are important in planning for climate change because future climate impacts could affect resource availability and access for a wide variety of users. For both tribes, it could affect cultural resilience. However, the Coquille Tribe's rights could be at more risk because they are currently unadjudicated.

Land Access

As a result of termination and other past federal policies, the Coquille Tribe's current land base makes up less than one percent of its ancestral territory, and consists of noncontiguous parcels dispersed across its ancestral territory. Urban areas and private, industrial, and federal landowners surround the Tribe's lands, including Kilkich Reservation and the Coquille Forest. As a result of the reservation and allotment policies of the federal government, the Hoopa Valley Tribe's current land base comprises one quarter of its traditional territory and within the reservation boundaries non-tribal members own land parcels. Federal and private landowners and managers surround the Hoopa Valley Reservation. Because current land bases for both tribes exclude parts of their traditional territories, areas important for subsistence and culture now exist on federally managed and privately owned lands.

For the Coquille Tribe, planning for climate change will have to incorporate conditions affecting each of its current land parcels such as sea level rise for Kilkich Reservation and the Mill Casino and Hotel, and changes in species diversity for the Coquille Forest. It will have to consider the five-county area the Tribe provides services to: Jackson, Coos, Curry, Douglas, and Lane counties. The Tribe will have to consider partnerships with landowners and jurisdictions surrounding each of its parcels. It will also have to consider its plans to acquire additional lands in light of changing future conditions. For the Hoopa Tribe, planning for climate change will have to consider changes affecting the Hoopa Valley Reservation. It will also have to consider partnerships with landowners and managers on and surrounding the reservation.

Additionally, both tribes will have to consider changes affecting important areas outside of their current land bases.

Tribal policies and plans for climate change will need to consider all areas important to the Tribe and the potential impacts climate changes pose to those areas. They will need to consider the risks posed by surrounding lands and activities on those lands. In addition, with knowledge that climate change poses risks to species within current land bases and important areas outside of current land bases, tribal policies and plans will need to consider how to build resilience and protection for tribal interests within and outside, with tribal members and outside stakeholders and landowners.

Similarities between the Tribes' Experiences

Past and Current Experiences

The Hoopa and Coquille tribes' past and current experiences provide a basis for considering adaptive capacity and responses and strategies that could facilitate adaptation to climate change, and barriers that could constrain it. Each tribe described experiences addressing recent events – for Hoopa it was the 2006 winter storm event, the 2002 fish kill on the Klamath, and the 2005 and 2008 fires in the area; for Coquille it was the organic cranberry fire worm outbreak and the Swiss Needle Cast outbreak in the forest at Kilkich Reservation. These events provide context for considering future events in the forest, cranberry bogs, and watershed, and preparing for them.

Individuals from both tribes also described the effects of past natural resource management activities on the landscape and species of concern. Individuals interviewed from the Hoopa Valley Tribe described past federal forest land management on and adjacent to the reservation which contributes to wildfire risk; a bug infestation in the 1940s-70s that decimated long-term timber revenue; the federal policy instated in the 1920s-30s which banned all burning and prohibited the Tribe from managing the land using traditional practices and maintaining cultural and subsistence resources; and the 1963 dam installations on the Trinity River which affect salmon and other aquatic species, and their habitat.

Individuals interviewed from the Coquille Indian Tribe described past and current impacts from logging on industrial and federally managed lands in part of the Tribe's traditional territory, the Coquille River Basin; impacts from commercial fishing on salmon and other freshwater and saltwater aquatic species; and impacts from sawmills on estuaries and in turn clams and bottom-feeding fish. Experiences from past natural resource management practices provide insight on impacts to community well-being that result from environmental degradation and change, and from managing resources with economics as the sole value. The experiences are useful in considering the balanced approaches, incorporating cultural, ecologic, and economic values, which the two tribes manage resources under today. However, the tribes still live with the consequences of past management actions and the continued need for jobs and livelihoods to replace those provided in the past, which increase risk to climate change, create conflicts between cultural and economic values, and form barriers to adaptation.

Both tribes described the importance of traditional knowledge and cultural values in forest management. In Hoopa, individuals described impacts to traditional knowledge through changes in socioeconomic conditions and federal policies; and efforts to strengthen and rebuild it through education, Tribal forest management, and governance. For Coquille, individuals described impacts to traditional knowledge and culture through federal policies pushing assimilation and fracturing and terminating the Tribe; and efforts since restoration to strengthen and rebuild through annual events, education, and Tribal forest management.

Both tribes described the past economic changes resulting from declining natural-resource-based industries, and the effects of those declines on livelihoods, health and self-sufficiency, and culture. In addition, both tribes described changes in governance and their abilities to strengthen values, practices, and culture as a result. For Hoopa it was regaining self-governance in 1988 and for Coquille it was gaining federal recognition in 1989. Past and current experiences provided context for understanding the tribes' adaptive capacities.

Observed Climate Changes

Both tribes described noticing changes in climate and the environment, but it is difficult to determine if the changes are solely attributable to climate change and not a combination of human actions and land use changes. Observations the tribes described, particularly those of elders in the communities in general seem to align with general future climate projections for the Pacific Northwest, including warmer, wetter winters; more variability and intense storm events; warmer summers; increased drought and wildfire risk; increased pest and disease outbreaks; changes in seasonal timing; and changes in species distribution (Climate Impacts Group 2004; Saunders et al. 2008). However, changes in weather observed could be attributable also to local variation such as El Niño Southern Oscillation (Mote 2003). Yet, changes are impacting community well-being and as a result deserve attention in preparing for increased risk and future change, and the potential for climate change to exacerbate existing environmental and social stresses.

Climate Impacts to Well-being

Individuals for both tribes described observing changes that directly affect community well-being. Individuals for the Hoopa Tribe described observing changes, including drought which affects drinking water and aquatic species, and increasing prevalence of wildfires and wildfire risk which affects human health and culturally and economically important forest species. Individuals for the Coquille Tribe described observing changes, including declines in fresh- and saltwater species, trees, shrubs, herbaceous species, and roots and berries all important for subsistence and health, culture and social traditions, and the economy in the area. In their responses, individuals for both tribes noted and described climate impacts of concern projected for the future, including drought, intense storms, impacts to forest and aquatic species, pest and disease outbreaks, and wildfires for Hoopa; and in addition for Coquille, sea level rise, tsunamis, red tides, and population in-migration.

Adaptive Mechanisms to Address Current Conditions and Climate Impacts Occurring, and Prepare for those Projected

Both tribes described responses in place to address current environmental changes and projected future changes – actions that demonstrate adaptation in practice and that could facilitate future preparation, response, and coping. The descriptions provide insight on the tribes' existing adaptive capacity to address climate change. Individuals for both tribes described the following:

- *ecologic responses:* spanning natural resource planning, monitoring, and management practices and approaches
- *economic responses:* considering how to diversify and continue timber extraction sustainably
- *political responses:* taking legal and policy action at national, regional, state, and local levels to address inequities and protect rights, including asserting sovereignty in developing climate policy and as environmental co-regulators; and locally engaging tribal and community members in planning
- *social responses:* planning for emergencies, considering existing partnerships and collaborative land management approaches, educating tribal and community members about land stewardship and culture, and considering health and housing needs and local resources for enhancing self-sufficiency
- *cultural responses:* strengthening community through events, ceremonies, and traditional practices, and knowledge transfer

In forest management, one individual for the Coquille Tribe described incorporating an adaptive approach and planning for a range of future conditions, and planting species now that can withstand a range of conditions. One individual described the CEDCO's plan to consider climate change in its upcoming strategic planning process. One individual described the efforts of the Tribe's lobbyist in Washington D.C. to uphold and advocate for the Tribe's rights. Individuals described the Tribe's efforts to increase its land base and access to lands through legal, policy, and purchasing means. Individuals also described the Tribe's local policy actions to address climate change, including forming the Climate Change Committee. Individuals described that the Coquille Tribe is already considering the potential for an increase in population on the coast and a need for additional housing. Within this consideration one individual noted the potential for the elderly and small children to be particularly vulnerable and how the Tribe would

incorporate needs of specific populations into its housing, along with incorporating green design principles such as water catchment devices when updating existing housing. One individual also described the Coquille Tribe's efforts to map vulnerable populations for emergency preparedness and response. Individuals described the Tribe's efforts to increase self-sufficiency through a community garden. Individuals also described the Tribe's resourcefulness and ability to leverage human resources and raise awareness as adaptive mechanisms.

Individuals for the Hoopa Tribe described how the Tribe is already considering the potential for increased wildfires through its smoke management plan, fuels management plan, and associated activities. Individuals described many strategies for diversifying the economy, including developing green modular homes. One individual described efforts at the national and regional level to advocate for funding for tribes to research and adapt to climate change. One individual described the Tribe's efforts to protect its rights to subsistence fishing. Individuals suggested community members who are working to advocate for water rights and mobilizing other community members to act. Individuals also described efforts to education youth about traditional practices and cultural values through teaching as mechanisms useful in building natural and cultural resource resilience.

All of these existing efforts suggest both tribes have mechanisms in place to address impacts to well-being and adapt to changing conditions. They suggest both tribes have built considerable adaptive capacity since regaining self-determination, 1988 for Hoopa and 1989 for Coquille, in political, cultural, social, economic, and environmental characteristics. These mechanisms provide starting points to build upon to strengthen adaptive capacity and natural and cultural resource resilience.

Strategies to Plan for Climate Change and Enhance Resilience

In addition to the responses and adaptive mechanisms in practice, to strengthen planning for climate change adaptation both tribes suggested strategies that could enhance existing efforts and build adaptive capacity. Individuals for both tribes suggested

enhancing national, regional, and local policymaking and governance; emergency management preparedness and response planning; and education, social services, and sense of community and culture. Individuals for both tribes suggested strategies to diversify their economies. They also suggested strengthening environmental monitoring and research, and developing landscape-level, collaborative planning and management approaches. Individuals for both tribes described planning initiatives, including incorporating climate change standards and guidelines into their forest management plans; monitoring strategies, including monitoring culturally important species and potential indicators of climate changes such as tributary streams; and management practices, including diversifying the species mix planted.

Individuals for the Coquille Tribe described the importance of an adaptive approach to forest management and individuals for both tribes described co-management as an important strategy to addressing climate risks and planning for future climate changes. Individuals for both tribes also stressed the need for adjacent landowners and land managers to address climate change to reduce the tribes' vulnerability and regional vulnerabilities. For the Hoopa Tribe, individuals described a stewardship contract to create a shaded fuel break along a road adjacent to the reservation on federally managed lands and other work the Tribe could do through additional partnerships on adjacent lands to treat fuels and reduce fire risk. For the Coquille Tribe, individuals described a proposal the Tribe has developed to establish a Coos County and Coquille Indian Tribe cooperative management area. In addition to collaborative forest management strategies, individuals for both tribes described fisheries projects that could reduce climate risks to aquatic species and habitat that provide environmental, social, cultural, and economic values to the tribes. Individuals for the Coquille Tribe described an initiative to develop a lamprey hatchery at Fourth Creek Reservoir; and one individual for the Hoopa Tribe described an initiative to develop cool-water refugia in the Trinity River, a partnership that could involve tribal departments and business ventures, federal agencies, and local organizations.

Barriers to Climate Adaptation Planning and Cultural and Natural Resource Resilience

Although both tribes have built up their adaptive capacities and outlined strategies to further build their capacities, individuals for both tribes described that existing barriers which stem from current issues regarding well-being, past federal policies and land management practices, and external influences limit and in some cases prevent the tribes from applying and increasing their adaptive capacities to address changes occurring and anticipated.

Political

Regarding political capacities, both tribes described barriers in access to federal and regional policymaking and planning. At the national level, both tribes described limits posed by inadequate and inequitable funding resources for housing, health, and environmental protection; they also described a reactionary approach to legislation and policymaking as opposed to upfront involvement and balances in decisionmaking power between nations. Individuals for both tribes described the lack of federal agency action and uncertainty regarding federal action at the national and regional level to address climate change as barriers. And at the local level, individuals described Tribal government regulations and the lack of community input in planning and decisionmaking as barriers to applying and increasing adaptive capacity and planning for climate change.

Individuals for the Coquille Tribe described the uncertainty regarding federal climate policy and the potential impacts at the local level. Individuals for the Coquille Tribe also suggested the need for federal forest management plans to incorporate adaptive management, and the potential otherwise for federal forest management standards and guidelines to affect the Tribe's forest management goals and objectives. Individuals for the Hoopa Tribe described uncertainty regarding federal agency water allocations on the Trinity River as a great barrier to addressing climate change, and the impacts of the Endangered Species Act on forest management and economic self-sufficiency. Individuals also described the limits to action posed by the BIA, which can be slow in

fulfilling its signatory authority in the Tribe's forest and fuels management plans. Individuals for both tribes also suggested the lack of partnerships to address climate change as barriers; and the inaction of adjacent landowners as the primary barrier to planning for climate adaptation on their forest lands. And, at the local level individuals for both tribes suggested the lack of community-based discourse that incorporates all perspectives and ideas as a barrier to addressing climate change.

Social

Individuals for both tribes suggested that current issues take priority and therefore act as barriers to addressing and planning for climate change adaptation. Current issues, including the economy and jobs and resulting social and cultural effects. For Coquille, one individual also described challenges related to sovereignty and jurisdiction as a barrier in emergency preparedness and response planning. Individuals also described a lack of funding for human resources and lack of funding from federal sources as barriers to addressing current issues and in turn climate change. For Hoopa, individuals also described a lack of funding for human resources and conflict existing between Tribal departments as barriers to reducing climate risk. Both tribes described the differences in goals and objectives of adjacent landowners and land managers as barriers also.

Cultural

Individuals for the Coquille Tribe described the need for more voices advocating for a focus on culture. And, one individual also described the lack of incorporating history into current discussions and the lack of a reservoir of past experience to draw from as barriers to cultural resilience. Individuals for the Hoopa Tribe described current socioeconomic conditions and conflicts between tribal departments – Fire and the Forestry department's fuels management program – as barriers to continuing cultural practices; in addition, low water levels in the river could serve as a barrier to continuing summer ceremonies. For Hoopa, individuals also suggested the lack of funding for culturally important species as a key barrier to their protection and resilience. And, for

both tribes, existing environmental stresses, including declines in species important for culture and subsistence, pose barriers to building adaptive capacity and cultural resilience. Climate change could exacerbate these existing stresses and further reduce the tribes' abilities to build capacity and resilience.

Economic

Both tribes stressed current economic challenges as barriers to addressing climate change and building adaptive capacity.

Environmental

Both tribes stressed the conditions of surrounding lands and land management practices as constricting their abilities to adapt to (and mitigate) climate change. Both tribes also stressed the impact of tight finances and reliance on the forest for economic self-sufficiency as barriers to climate adaptation and to sustaining management practices that balance economic, cultural, and ecologic values. Both tribes manage their forest lands primarily for economic value; timber revenue supports tribal government, economy, and community – for Hoopa through per capita payments and for Coquille through social services.

Gaps in Knowledge and Adaptive Capacity

In addition to existing barriers to applying adaptive capacity, both tribes described knowledge gaps in considering planning for climate change adaptation, which also limit the tribes' adaptive capacities to address climate change. Individuals for both tribes suggested the following knowledge gaps:

- how to address a global issue locally
- how to address climate change across landowners with mixed goals and objectives and understandings about climate change
- how to consider the effects of short-term environmental management decisions in the long term in the face of changing and uncertain conditions

- how to manage the forest in the face of potentially more variable, wetter winter, and drier summer conditions
- how to plan for subtle changes over time and extreme events
- what a lack of moisture will mean for forest species
- what climate change will mean for culturally important species

In addition, individuals for the Coquille Tribe mentioned concern for ocean health, how sea level rise will affect the community and infrastructure, and ground truthing the potential impacts of federal climate legislation. Individuals for the Hoopa Tribe described concerns also for how water will be allocated under changing climate and drought conditions.

External Influences Affecting Adaptive Capacity

Both tribes described the limits to applying adaptive capacity posed by external political and economic influences, and external land management objectives and actions. Based on descriptions individuals provided for both tribes, these limits deserve consideration in planning for climate change adaptation at local to national levels and in strengthening adaptive capacity, for the Tribe and for additional stakeholders and local, state, regional, and national levels of decisionmaking.

Key Considerations in Planning for Climate Change Adaptation, Particularly Natural Resource and Cultural Resilience

In considering the current and anticipated climate impacts, the Tribe's adaptive capacities, and the barriers and external influences that limit applying and enhancing adaptive capacity, key considerations arise. Below, based on the responses collected in interviews, I identify the key considerations for the Coquille and Hoopa Valley tribes in planning for climate change adaptation. Table 13. displays the key considerations.

Table 13. Key considerations in planning for climate change adaptation for the Hoopa Valley and Coquille Indian tribes.

Key Considerations in Planning for Climate Change Adaptation in two Native Nations in the PNW
Political (national, regional, state, and local efforts to affect climate policy and planning)
National –
Action as a sovereign nation to inform federal climate policy and natural resource policy
Action to motivate federal agency action to reduce risks posed to the Tribe and uphold the trust responsibility
Action to advocate for adequate federal funding for housing, healthcare, and environmental management
Action to protect rights
Action to increase and protect land access and ownership
Regional –
Consultation with federal land management agencies regarding climate policymaking and planning
Collaboration among adjacent landowners and jurisdictions to plan for climate change adaptation
Action to increase and protect land access and ownership, and rights
State –
Consultation with the State regarding climate policymaking and planning
Local –
Engaging tribal and community members in planning how to address existing impacts to well-being and future climate changes
Considering the role of Tribal governance processes and policies in addressing climate change and maintaining function through uncertain impacts
Social
Addressing existing issues
Enhancing emergency preparedness planning
Planning for changes in water resource availability and wildfire risk as part of housing development and population growth
Increasing self-sufficiency, including support networks among Tribal and community members
Building capacity by building on existing strategies and adaptive mechanisms to facilitate adaptation
Increasing regional partnerships to prepare for climate changes
Addressing existing conflicts and defining roles and responsibilities among Tribal staff, administration, committees, and members
Cultural
Building resilience of culturally important species (terrestrial and aquatic)
Incorporating cultural values and practices into climate adaptation strategies
Planning for future generations
Economic
Addressing existing economic and financial challenges
Diversifying revenue streams and planning for long-term sustainability
Increasing family-wage job opportunities

Key Considerations in Planning for Climate Change Adaptation in two Native Nations in the PNW
Environmental
Considering occurring impacts and projected impacts of concern in planning, monitoring, and management
Considering consistency across natural resource management plans
Water
Protecting and restoring stream health
Considering and planning for drought, reduced water resources for humans and aquatic species
Forest
Considering potential impacts to and building resilience of culturally important species and habitat
Considering potential impacts to economically important species and habitat
Considering balancing short-term and long-term economic, cultural, and ecologic values
Monitoring for changes in climate and species
Instituting flexible (adaptive) management strategies and approach that prepare for a range of potential future conditions

CHAPTER VI
CONCLUSION

This study seeks to answer: what are the key considerations in planning for climate change adaptation, particularly natural resource and cultural resilience? In considering the current and anticipated climate impacts, the Tribe's adaptive capacities, and the barriers and external influences that limit applying and enhancing adaptive capacity, it accomplishes this. In so doing, its primary objective is to make planning for climate change tangible for the two tribes – to understand how climate change manifests at the local level and how it interacts with well-being – social, cultural, economic, environmental, and political characteristics. Its secondary objective is to inform climate policymaking and planning at local to global levels by considering the climate risks the two tribes face and their adaptive capacity to address the risks.

The findings suggest that it accomplishes the primary objective by revealing how past and current experiences provide context and insight for considering the adaptive capacity of the tribes. It reveals how adaptation is a part of existing activities and how existing activities can be built upon or revised, or can serve as best practices in adapting to climate change. It accomplishes this also by identifying knowledge gaps and barriers to climate change adaptation, including external influences which require attention from not only the two tribes, but policy- and decisionmakers at large. Additionally, information on observed climate changes and impacts to well-being help to identify key climate concerns and community priorities for adaptation. And, information on current issues and conditions helps to identify primary community priorities and to consider these priorities in light of climate changes (observed and anticipated) and impacts to community well-being so that planning for climate change can serve as an opportunity to address current issues (and vice versa).

The findings suggest that it also accomplishes its secondary objective by indentifying climate changes occurring and projected, and the impacts of those changes on the tribes' well-being; and the tribes' adaptive capacity to address the changes and impacts. Climate changes occurring and projected affect and threaten to continue affecting natural-resource-based economies; subsistence activities such as fishing, clamming, and crabbing, harvesting roots and berries, and hunting deer, elk, and other game; cultural practices, ceremonies, and culturally important species (forest and aquatic species); health and housing; and rights, including water rights and land access which could be diminished by climate impacts such as drought, disease, and wildfires. However, adaptive mechanisms, including local, regional, and national policy initiatives, local and regional partnerships, and local plans and practices exist to address climate changes and impacts. Yet, in order for these adaptive mechanisms to be effective in building resilience and facilitating adaptation, existing barriers and external influences limiting the application of adaptive capacity need address. Addressing existing barriers and external influences presents opportunity also to address existing inequities in access to and processes and outcomes of climate policymaking, planning, and action.

To address existing barriers and inequities, I suggest the following policy recommendations to aid the two tribes in planning for climate change adaptation and building natural resource and cultural resilience. I also relate these recommendations back to existing literature on climate change adaptation at the local level. I divide the recommendations by decisionmaking scales because tribes as sovereign nations act at multiple scales.

Local Level Recommendations

Incorporate Existing Environmental, Social, Economic, Political, and Cultural Issues into Climate Change Adaptation Planning

Both tribes described how current issues, particularly finances, the economy, and jobs, are the tribes' first priority. One individual for the Hoopa Tribe described this,

> Until climate change affects the Tribe's ability to manage timber, harvest fish and harvest traditional foods, the priority from the Tribal Council here is economics, keeping people employed.

Yet, individuals for both tribes described climate impacts that could decimate timber and wipe out traditional and subsistence food species. Thus, a key consideration for tribes is incorporating climate change into efforts to address existing issues and vice versa. Challenge does lie in aligning climate impacts (occurring and projected), current issues, strategies and adaptive mechanisms, and barriers. Yet, the outcomes of doing so could enhance the resilience of the tribes, and the landscapes they rely on, to climate change.

Individuals for both tribes provided examples of incorporating climate change into current planning. For Coquille, one individual described the housing authority's plans to build additional housing and higher elevation and to retrofit existing housing to withstand climate changes. For Hoopa, one individual described how the Tribe is developing a smoke management plan to address air quality concerns. For both tribes, individuals described incorporating climate change standards and guidelines into their forest management plans. However, in order to address the suite of impacts climate change poses on community well-being, climate adaptation planning needs to link sectors and consider the potential for impacts and opportunities across sectors: economic, cultural, social, environmental, and political. It could also link to climate mitigation planning.

This recommendation aligns with existing literature on climate adaptation planning. Burton et al. (2002) describe the importance of understanding how to address immediate concerns within planning for climate change adaptation. Others (Smit and Wandel 2006; Ogden and Innes 2009) suggest also the importance of 'mainstreaming' efforts to address climate change into existing plans, programs, and initiatives.

Consider Economic Flexibility and Diversity

Both tribes stressed concerns regarding economic reliance on timber revenue and high unemployment rates and a lack of family-wage jobs. Individuals for each tribe shared the past experiences they endured as a result of collapsing timber and fishing

industries in their regions, and their continuing efforts to make up for the jobs lost. Individuals for both tribes described efforts of the tribes and other stakeholders in their regions to address unemployment and the lack of family-wage jobs. They also described the impacts of the current global economic downturn and environmental degradation on their economies. Climate change adaptation planning provides another opportunity to consider strengthening local economies, including building in flexibility and diversity so that future impacts to natural resources do not decrease the tribes' adaptive capacities. Individuals for the Hoopa and Coquille tribes described multiple strategies to diversify the local economy. In climate adaptation planning, the current barriers to implementing these strategies, and the short and long-term impacts of these strategies should be considered in light of climate impacts occurring and projected.

Identify and Build on Existing Capacity

Adaptive mechanisms in place, including plans, processes, programs, and partnerships, provide starting points to consider climate change adaptation. Both tribes described numerous activities in which climate considerations are being and could be incorporated. In making climate change adaptation tangible, it is important to identify and consider building upon existing efforts instead of developing new, separate efforts to address climate change.

This consideration aligns with the literature which suggests the importance of adaptive capacity in climate change adaptation at the local level (Tompkins and Adger 2004; Wesche and Armitage 2006).

Engage Tribal and Community Members in Planning for Climate Change and Addressing Existing Issues

Both tribes described barriers related to tribal regulations and the lack of community-based discourse that incorporates all perspectives. Climate adaptation planning, particularly if its basis is in community experience, concerns, and insights,

provides an opportunity for strengthening community engagement in planning. Considering community engagement to some conjures funding and time-consuming fears. Yet, as individuals for the Hoopa and Coquille tribes demonstrated, community members hold important insights, ideas, and capacities for addressing climate impacts and existing issues. In addition, engaging community members in planning could lead to new adaptive mechanisms to build capacity to address climate change at the local level and other levels of decisionmaking. For example, community members could contribute to monitoring climate changes by sharing their experiences through public discourse and documenting their observations with the aid of tribal departments that could use the information in planning and priority setting. Engaging community in planning could also help to set priorities for addressing existing issues and climate changes.

In planning for climate change at the local level, tribal governments may consider developing climate change charters, policies, and programs. Cordalis and Suagee (2008) point out that tribal sovereignty provides tribal governments the ability to implement plans and initiatives to address climate change with or without federal action; however, they note federal inaction does limit the ability of tribes to address climate change.

This recommendation also aligns with recommendations put forth by Conway (2004) who suggests engaging the community in planning for climate change, and incorporating climate change into decisionmaking at the local level.

Establish Baselines for Natural Resource and Cultural Resilience

In considering climate impacts occurring and projected to natural and cultural resources of concern, tribes could consider developing baselines for assessing natural and cultural resilience. These baselines could help also in setting priorities for adaptation. Both tribes described how traditional knowledge, cultural and social practices, and a sense of community have been fractured through the federal policies that Indian tribes have endured in this country. Yet, both tribes also suggested the importance of reestablishing a sense of community and connection to the landscape and strengthening culture and community as part of building adaptive capacity. In order to plan for cultural

and natural resource resilience, indentifying what is essential to community identity and culture, including social functions and landscape identity could serve as an opportunity to build community and define priorities for climate change adaptation planning and action.[10] Williams and Hardison (2008) suggest developing cultural sustainability plans as part of climate change adaptation for tribes, plans that consider the social, cultural, and economic impacts of climate change.

Acknowledge and Address Conflict, including Conflict among Tribal Departments and Conflict among Tribes and Adjacent Landowners and Land Managers

To reduce their vulnerabilities to climate impacts, both tribes suggested the importance of climate change planning on tribal lands and adjacent lands, and regarding resources that flow through tribal lands, including streams and species. Climate adaptation planning should incorporate addressing differences among landowners' and managers' goals and practices, and how they currently affect each other and could affect each other under changing climate conditions. Brook et al. (2006) also acknowledge the importance of addressing existing conflict in preparing for climate change. At the local level, this study suggests, climate adaptation planning should also incorporate addressing existing conflicts between tribal departments and to consider how human resources, and roles and responsibilities are allocated. The heightened wildfire risk potential in Hoopa could serve as an opportunity for dialogue between the Tribe's Forestry and Fire departments regarding the use of fire as a management tool. The heightened risk of tsunamis, strong winds, and flooding for Coquille could serve as an opportunity to consider how human resources are allocated for emergency preparedness and mitigation within the Tribe, and to address issues between the Tribe and local governments and the State related to jurisdiction and sovereignty.

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[10] I want to stress here the importance of considering equity in sharing knowledge compiled to establish baselines for cultural and natural resource resilience outside of the tribe, if this knowledge is shared outside of the tribe. See Hotain (2006) for a description of creating ethical space for knowledge-sharing and Gilligan et al. (2006) for a description of Intellectual Property Rights.

Regional (Landscape Level) Recommendations

Planning at the Landscape Level across Jurisdictions and Knowledge Systems

In order to address climate impacts to ecosystems and species that cross political and jurisdictional boundaries, climate change adaptation planning must occur at the landscape level and involve all voices and knowledge systems in the process. For the Hoopa Tribe, individuals described the Tribe's vulnerability to catastrophic fire that could spread from surrounding lands with high fuel loads. They described the need to plan for a fire-resilient landscape to reduce wildfire risk and address other issues shared in common among landowners such the damage bears are causing to young timber stands. Individuals from the Hoopa Tribe also described the Tribe's vulnerability to decisions regarding water allocations on the Trinity River and corresponding impacts to fisheries and well-being that result from reduced water flows currently and that climate change could compound.

For the Coquille Tribe, individuals described the vulnerability of the Coquille Forest to future wildfire and pest and disease outbreaks. They described current partnerships among industrial, federal, and tribal landowners to address watershed health and riparian habitat for aquatic species. However, they stressed the importance of landscape level planning and action to address climate change because of the potential for impacts to affect all landowners and managers. In addition, individuals for the Coquille Tribe noted relationships, financial and cooperative, that exist among the Tribe and local governments, including counties and cities, and agencies and organizations within them, all of which the Tribe will need to work with in planning for climate change.

Therefore it is important to consider climate adaptation planning at the landscape level; and developing partnerships with adjacent landowners to address wildfire, drought, species, and water resource risks. In addition, it is essential that these partnerships incorporate and attempt to balance the knowledge, values, and goals of all stakeholders in the context of long-term natural resource resilience. Houser et al. (2000) suggest the need for Native voices in plans concerning regional landscapes that include Native homelands.

National Level Recommendations

Act to Affect Federal Climate Policy

As sovereign nations, tribes have the power to affect federal climate policy. Individuals interviewed for both tribes described how the Hoopa and Coquille tribes (along with other tribes across the U.S.) are doing this through a lobbyist in Washington D.C., through monitoring proposed legislation, and through participation in unified action among tribes requesting equitable funding for tribes to address climate change and the creation of a federal-tribal advisory committee to jointly craft policy. However, the federal government has yet to take substantial action on climate change, including passing climate policy. Tribes should continue efforts to educate policymakers and federal agency administrators about the climate risks tribe face and to ensure their rights are protected and their interests and needs incorporated in climate policy proposed. However, because climate change is a global issue and because the climate risks tribe face pose risks to others, the effort should not be that of tribes alone. Other stakeholders should act to support tribes in their efforts to affect federal (and state, regional, and local) climate policy, understanding that if some are unable to address climate change it will affect the ability of all to address climate change.

Acknowledge and Appropriately Integrate Traditional Knowledge into Climate Adaptation Policy and Planning, including Funding Support for Culturally Important Species

Both tribes described the importance of cultural values in forest and fisheries management. They also described the importance of species to their cultural survivability and sense of community. Yet, individuals for the Hoopa Tribe stressed that culturally important species currently receive inadequate attention and funding in research and protection. In considering the climate change impacts to tribes and their lifeways, climate adaptation policy and planning could consider ways to conserve, restore, and increase the resilience of culturally important species. However, to protect the cultural value of these

species it may be important to allocate funding for which tribes could determine its appropriate application as opposed to efforts to identify culturally important species which could receive funding. Both tribes described species, including Pacific lamprey which could serve as indicator species for climate changes. In addition to local efforts to protect culturally important species, regional efforts could consider climate impacts to cultural and subsistence species of concern and in so doing incorporate multiple knowledge systems. In considering the variety that exists in federal-tribal collaborative agreements, Donoghue et al. (forthcoming) find that traditional ecological knowledge can play an important role in initiating collaborative projects.

As the literature suggests (Menzies and Butler 2006), definitions of traditional and local knowledge evolve and change through time. Current conditions and past impacts to traditional knowledge affect its continuity and application today for the Hoopa and Coquille tribes. However, the knowledge itself links tribal members together and acts as an important part of capacity – contributing to common understanding, common values, and a sense of community. Both tribes look to strengthen their communities through its application in forest and fisheries management, annual events, ceremonies, and subsistence activities, and in rebuilding their governments. Therefore, it is important to consider strategies to protect and enhance traditional knowledge as part of planning for climate change adaptation.

Adequate Funding for Tribes to Address Climate Change

To ensure all people are able to appropriately adapt to climate change, the federal government must allocate adequate funding and resources for tribes to address climate change. As demonstrated in concerns raised by individuals for the two tribes, climate impacts could spread from one landowner to the next, and therefore strategies to reduce risk and build resilience in the face of climate change should consider the capacities and needs of all landowners, and the links between landowners. The federal government should consider the risks posed by federally managed lands and federal land management decisions surrounding to the two tribes and act to address and reduce those risks. This

recommendation aligns with the recommendations of Hanna (2007) who calls on the federal government to respond to the climate impacts Alaska Native villages are already experiencing as a result of climate change. The results of this study suggest the importance also of preparing now for the occurring and so-to-be exacerbated impacts and the costs of those impacts to tribes in the Pacific Northwest U.S.

Act to Uphold the Federal Trust Responsibility

As demonstrated by the findings of this study, climate impacts occurring and projected are affecting, and threaten to continue to affect, the rights of tribes to natural and cultural resources and culturally important sites. The federal government has the responsibility to protect the rights and interests of tribes as part of its trust responsibility (Getches et al. 2005). As part of its responsibility to tribes, the federal government should take action to address climate change and the risks it poses to tribes. This includes for federal agencies, incorporating actions to address climate change into management plans and policies. The federal government should also take action to ensure climate legislation in the U.S. upholds the federal trust responsibility, along with tribal sovereignty and the rights and interests of tribes. Recent action on climate legislation (H.R. 2454, the American Clean Energy and Security Act of 2009) in the U.S. speaks to the importance of this, as language incorporated into drafts of the bill posed risks to tribal rights (John Phillips, June 1, 2009, email to the Coquille Tribe). To ensure protection for tribal rights, language such as the following, considered 'tribal savings provisions,' should be incorporated into all federal climate legislation so that the rights of all tribes are not altered, modified, diminished, or abrogated (Phillips 2009) through climate policymaking and planning. This recommendation aligns also with the recommendations put forth by Hanna (2007) and Krakoff (2008) who describe the disproportionate climate risks that American Indian and Alaska Native tribes face and suggest the federal government take actions for reasons of trust responsibility, treaty rights, statutory rights, common law rights, and environmental justice. Hanna (2007) suggests also that the federal government

should manage programs to ensure protection for tribal and treaty rights in the face of climate impacts.

Recommendations across Multiple Levels

Incorporate Flexibility into Planning, Natural Resource Management, and Policy and Governance at Multiple Levels of Decisionmaking; in so doing, Uphold Tribal Sovereignty, the Rights of Tribes, and the Federal Trust Responsibility

At the local level, both tribes described their forest management plans as guiding documents in forest management. However, individuals for the Hoopa Tribe described how the forest management standards and guidelines currently create conflict among values. And, individuals described that updates can be made to the forest management plan, yet the Tribal Council approval process takes time, as does BIA review and approval for the forest and fuels management plans. For the Coquille Tribe, individuals described how the Coquille Forest's connection to adjacent federal land management standards and guidelines creates barriers to managing the forest based on the Tribe's vision, goals, and objectives. The uncertainty of climate change presents a need for flexibility within the forest management plans at the local, regional, and federal level. It presents a need for room to incorporate changes if climate conditions alter forest management goals and practices in a timeframe faster than that required for local and federal approval processes.

Community-based natural resource management and adaptive management approaches offer the flexibility required for managing under changing conditions. Armitage (2005) suggests this in describing CBNRM's self-organizing properties, emphasis on learning by doing, recognition of uncertainty, and through its social organization and structures for decisionmaking. Hibbard et al. (2008) suggest this also in describing CBNRM's place-based, collaborative, and balanced nature. Tompkins and Adger (2004) suggest also that CBNRM offers opportunity to enhance adaptive capacity by building social networks and resilience in social-ecological systems. And, Berkes and

Jolly (2001) suggest CBNRM offers opportunity to make links across decisionmaking scales.

Although the federal government's attempts to adaptively manage forest lands under the Northwest Forest Plan largely failed, individuals for the Coquille Tribe described the importance of adaptive management on a small-scale, in the Tribe's forest management practices and its continued importance in achieving future forest management goals and preparing for climate change. In addition, the Tribe described the importance of adaptive management being a part of federal forest management standards and guidelines because of the Coquille Forest's links to federal forest management plans.

As mentioned above, in considering incorporating flexibility into adaptation planning it is important to ensure tribal sovereignty, the rights and interests of tribes, and the federal trust responsibility are upheld.

Consider Access to Land in the Face of Changing Conditions

Individuals for the Coquille Tribe described actions to increase land access and ownership as strategies to build adaptive capacity to address climate change. Individuals describe a proposal the Tribe has developed to co-manage lands currently managed by the Bureau of Land Management. The proposal offers an opportunity to increase access to lands and to manage those lands using an approach that incorporates the Tribe's and federal agency's interests and goals. Individuals for the Coquille and Hoopa Valley Indian tribes described how the tribes have capacity in natural resource management staff and could put that capacity to use through co-management agreements on federal lands. These agreements offer opportunity to reduce the risks posed by federal lands surrounding the tribes, create jobs, and incorporate traditional and local knowledge, and cultural and social values important to the tribes. As Wilson (2002) suggests also, co-management offers the opportunity for tribes to contribute human resources and financial resources to land management. In addition, in preparing for uncertain and potentially rapidly changing conditions, across the landscape, co-management offers the opportunity

to combine the goals and objectives of multiple landowners to work toward a common vision at the local level.

Tribes and federal land managers and policymakers should consider the potential for climate change to affect species distributions and existence and the impacts such changes pose to tribal sovereignty, culture, and rights. This recommendation aligns with the recommendations of Williams and Hardison (2008), who describe the connection between the rights of tribes and specific lands with fixed boundaries, and specific language in treaties which consider the environment in a fixed state. Williams and Hardison (2008) suggest the critical importance of considering what will happen to the rights of tribes when species shift in range or go extinct and when other impacts threaten tribal land bases, current and ancestral. And in so doing, Nilsson (2008) highlights the importance of incorporating equity. However, the literature lacks suggestions on how to protect tribal lands and rights from the risks climate impacts pose. Because of this, preparation should begin now to address the risks to tribes and consider how to cope with them. Co-management agreements and community-based natural resource management approaches offer one avenue worth exploring and building upon, particularly for tribes and surrounding landowners and managers. However, there will need to be others also. And, as Spak (2005) notes great effort should be taken to understand the knowledge, worldviews, needs, and objectives of all parties involved; and to balance them in planning and management.

Upfront Tribal Involvement at All Levels of Decisionmaking

The experiences of both tribes and the climate impacts to well-being are unique and deserve consideration in local planning within the tribe(s) and within the cities, counties, and federal jurisdictions surrounding the two tribes. However, comparing the two cases suggests similarities in climate impacts and strategies and barriers for adaptation. Therefore, the experiences of the two tribes individually and collectively should inform climate policymaking and planning at multiple scales of decisionmaking. As one individual in Hoopa described, tribes are working nationwide to build a unified

voice in advocating for equitable funding for tribes to address climate change. The experiences of the Hoopa and Coquille tribes individually and collectively could contribute to regional and national efforts to ensure that tribes receive adequate resources to address climate change and to use those resources appropriately within their communities based on unique cultural, economic, social, political, and environmental concerns. Hanna (2007) suggests through tribal involvement in policy and legislation, policymakers can craft fair and equitable strategies to address climate change.

Considering Scales for Action: Local, Regional, State, National, International

By outlining key considerations for climate change adaptation planning at different scales, I intend to highlight also the importance of considering climate change adaptation strategies and planning at multiple scales and across scales. There is fluidity in these scales and there will likely need to be some consistency in climate policy through these scales. Therefore it is important for tribes to consider climate policy and governance at multiple scales and for policy- and decisionmakers to consider climate change impacts to tribes and the capacity of tribes to address climate change at multiple scales. Williams and Hardison (2008) also suggest the importance of tribes and others working at multiple scales to address climate change collectively. "Climate change occurs on a scale that is beyond the ability of a single community to control, and managing its impacts requires collective action on a large scale. Actions taken locally will have little impact unless accompanied by positive actions by others" (Williams and Hardison 2008, p.2-3).

Summary and Steps for Furthering this Research

The focus of this study is on the experience and insight of the Hoopa Valley and Coquille Indian tribes. To provide the tribes a reflection of the information collected through interviews, this study summarizes the insights of tribal members, staff, and leadership for the two native nations in the Pacific Northwest U.S. regarding the climate risks the tribes face and their adaptive capacity to address the risks. For each tribe, this

study provides a start to step one of a vulnerability assessment: an initial assessment of past experience, observed climate changes, climate impacts of concern, current priorities, and barriers to planning for climate change adaptation. It provides a starting point for the tribes to consider how to strengthen their adaptive capacity to address climate change.

To build on the information presented in this study, the tribes could work to further vet and validate it through community review; and thereafter work with other stakeholders in the region in planning for climate change. The tribes could consider adding to it through step two of a vulnerability assessment: working with climate scientists to consider climate projections in light of community conditions, priorities, and concerns. The tribes could also use the information in developing policy at the local, regional, national, and international levels, and in working toward funding allocations and resources to support addressing key uncertainties and barriers to adaptation. In addition, policy- and decisionmakers at multiple levels could use the information in developing climate policy, ensuring that it incorporates tribal needs and interests.

In addition to step two of a vulnerability assessment, possible next research steps to strengthen and validate each case are: to conduct interviews with additional stakeholders in the regions, including federal agency staff, nonprofit organizations, and policymakers; to review additional local historical and planning documents, and published research regarding climate science; and to put in further effort into incorporating equity and ethical considerations for integrating knowledge systems. Additional research will allow for strengthening the information and analysis, and incorporating additional perspectives and insight, and projected climate impacts and changes in community demographics. To build on the information and analysis presented in this study, additional research focused on climate adaptation planning at the local level could consider how the vulnerability and adaptive capacity of the tribes involved in this study compares to surrounding rural and urban communities in order to provide policy- and decisionmakers additional insight on how vulnerability and adaptive capacity are socially differentiated. It could also consider how to mainstream climate change into existing planning efforts and initiatives to address existing impacts to well-being.

However, as this study suggests, it was important to first understand community experience regarding observed climate changes, impacts to the Tribe, and adaptive mechanisms for preparation, response and coping; and to receive feedback from the tribes on appropriately conveying their knowledge and experience. With hope, the information presented in this study will be useful in information climate adaptation planning and policymaking from the local to global level.

APPENDIX A

INTERVIEW GUIDE

Adapted from Ford et al. (2006), Brklacich et al. (2007), and Burton et al. (2002)

The Past as a Means to Understand the Current Conditions

- What major changes have occurred within your community over the past 25-50 years and what prompted these changes?
- How have these changes affected your community, especially overall community well-being?
- How has your community coped with and if necessary adapted to these changes?
- What strategies worked best in your community to deal with the changes and move ahead?
- What strategies failed or what barriers made it difficult to move ahead?

Current conditions as a Basis for Future Planning/
Current Community Well-being and Climate Sensitivities

- Do you feel that climate has changed in your region in the recent past (climate variability and extremes)? If so, how?
- Have current or past climate changes impacted your community and how?
- Has economic damage resulted, and if so how has it been distributed spatially and among socio-economic groups?
- Have other non-economic impacts resulted, such as social, cultural and environmental impacts?
- What adaptation policies and measures have been used to reduce vulnerability to climate changes? How successful have these measures been?
- What is the extent of adaptation in practice to current climate changes and what are the barriers, obstacles or incentives to adaptation?
- What aspects of your community's plans and/or well-being are/are not sensitive to future climate changes?

Cultural and Natural Resources and Climate Sensitivities

- What aspects of environmental management are sensitive to climate changes (e.g. natural and cultural resources depended upon for community well-being)?
- What geographic locations are sensitive?
- What seasonal activities are sensitive?
- What knowledge exists to prepare for or respond to changes?
- What programs or mechanisms exist to prepare for or respond to changes (e.g. natural resource plans, partnerships, etc.)?
- What knowledge is needed to prepare natural and cultural resources for climate changes?
- What additional resources are needed?

Governance, decision-making structure and process

- Describe the community. (who makes up the community, what are its boundaries?)
- What is the process for formal decision-making and policy making in the community?
- Who is or what organizations are involved in decision-making within the community and outside of the community? (who do you have to work with to get things done around here and in the region?; planning not in isolation of surrounding jurisdiction: county, region, state)
- What roles do any of these organizations play in shaping policy more broadly in the community?
- What are the issues that exist in working with these organizations?
- How does public policy (in any and all domains) affect climate impacts and adaptation?
- How do public policies for climatic extremes (natural hazards) relate to economic and sustainable development policies and strategies in place?
- How do public policies for climate extremes (natural hazards) relate to other natural resource management and environmental policies?
- To what extent have stakeholders (including those at risk) been involved in the policy development process, and how can this be facilitated?
- What are your concerns about climate change and climate change policy?

Looking to the Future

- What are the priorities for your community over the next 25-50 years?
- What are the long-term prospects for community well-being over the next 25-50 years?
- How would you like your community to look 25-50 years from now?
- What are the challenges or barriers to the future development of your community or improvement of community well-being?
- What are the major planning initiatives and policies (local, regional & federal) that will effect and influence the development of your community over the next 25-50 years?

Climate Change Impacts, Community Development and/or Resource Management

Communities and ecosystems are dynamic and have been responding to climate changes for centuries. Regarding current climate changes, the scientific work being done includes projections of potential changes that could result from increases in greenhouse gas concentrations in the atmosphere. Projections suggest climate changes could occur more rapidly; they could increase global surface temperature 4 degrees Fahrenheit in the next 30 years. They could lead to warmer, drier conditions in the summer and warmer, wetter conditions in this area.

Warmer conditions could increase the amount of winter precipitation falling as rain instead of snow, which could increase winter stream flow and flooding potential, reduce annual snowpack and available summer stream flow, and lead to earlier snowmelt and longer periods of summer drought. These conditions could increase the potential for wildfires, for example, which could also increase the potential for smoke-related health problems. They could increase the potential for disease in salmon and other aquatic species brought on by crowding and warm water temperatures. They could also lead to shifts in the ranges of plant, animal and mushroom species, and in the timing of flowering, pollination, mating and migration.

While we don't know with certainty that these projected impacts will occur, the potential for them, from a planning perspective, requires some attention so that if the projected changes do come to be, your community will be better prepared.

- Would potential impacts alter future plans in your community or overall community well-being and how?
- What impacts would cause the need to alter future development and/or management plans?
- What existing barriers might hinder your community's capacity to cope with or adapt to climate changes?
- What strategies would you employ to adapt to the future (either to reduce negative effects or gain from emerging opportunities?
- What else is needed to prepare your community and increase your community's ability to adapt?

APPENDIX B

ANALYSIS – LIST OF CODES AND DEFINITIONS

Code	Definition
Adaptive Capacity	The nature/characteristics of the Tribe and its ability to adjust to, cope with, or benefit from any aspect of climate change
Past Experience	Past (150 years) community experiences that could inform preparing for future change, building resilience
Past Response	Past (150 years) responses to events that could inform responding to future change
Current Experience	Current community experience that could inform preparing for future change, building resilience
Current Response	Current responses to events that could inform responding to future change
Climate Changes Observed	Any changes in the environment people have observed that are positively or negatively impacting the tribe
Impacts of Concern	Projected climate impacts of concern such as sea level rise and current conditions vulnerable to or potentially exacerbated by future change such as low stream flows, accumulated brush or blow down in the forest
Current Issues	issues such as high unemployment and needed job opportunities or human resource needs for emergency management planning; these issues shape future strategies and contribute to adaptation barriers
Community Vision	How community members would like the community to look in 25-50 years
Climate Changes	Aggregation of climate changes observed, impacts of concern, and literature projected climate impacts
Impacts Tribe	How could environmental changes impact the Tribe?
Social	Could changes in climate affect health, safety, recreation, housing, social organization or self-governance?
Cultural	Could changes in climate affect language, ceremonies, or traditional practices?
Economic	Could changes in climate affect: economic opportunity positively or negatively; costs to tribal administration; costs to the traditional or subsistence economy; or the cost of living?
Environmental	Could changes in climate affect the physical environment – air, land, water – positively or negatively; could changes affect plants, animals, fungi, and insects negatively or positively?
Political	Could changes in climate affect rights? (sovereignty, land access, land ownership)
Strategies	Ideas community members shared for addressing impacts and preparing for future change
Adaptive Mechanisms	Includes contact networks, partnerships, internal (e.g. between departments) and external links (e.g. with federal agencies), programs (e.g. natural resource management) and practices (e.g. potlatches) that could help facilitate adaptation or be built upon to address future changes
Internal Links	Intra-tribal contacts, connections, and partnerships
External Links	Inter-entity (governmental, etc.) contacts, connections, and partnerships
Existing Programs	Programs that could help facilitate adaptation or be built upon to address future changes
Existing Plans	Plans that could help facilitate adaptation or be built upon to address future changes

Existing People/Positions	Positions that could help facilitate adaptation or be built upon to address future changes
Existing Practices	Practices that that could help facilitate adaptation or be built upon to address future changes
Barriers	Existing issues that constrain adaptation
Collaboration	Partnerships exist for co-management; collaborative regional planning
Institutions/Governance Process	institutions, governance flexible and adaptive; tribal members engaged in planning and decisionmaking
Sovereignty	Protecting tribal sovereignty in climate adaptation planning
Observers–Who is observing changes and why	Contribution of community observations to understanding climate change locally
Natural Resource Resilience	Informs defining/developing baseline
Cultural Resilience	Informs defining/developing baseline
Public Perception	Considering community members' comments about climate change (is it occurring, how can people address it, and in what timeframe, …) and how it relates to taking action to address it

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