Chapter 11: Tribal Ecocultural Resources and Engagement

Introduction

In this chapter, we review scientific information regarding the conservation and restoration of attributes of forest ecosystems that are highly valued by tribes and American Indians within the Northwest Forest Plan area. Such highly valued elements include various species of plants and wildlife, artifacts, sites, and associated intangible qualities. By synthesizing a range of recently published, peer-reviewed findings, including those assembled in other chapters, as well as some theses and dissertations, we highlight advances in understanding how historical and current factors, including changes in climate, fire, hydrology, vegetation, and resource management regimes, have affected many of these ecocultural resources. We consider strategies to promote these resources and how such efforts relate to topics considered in other chapters. In particular, we examine how distinctive strategies for engaging tribes can promote ecocultural restoration in ways that uphold tribal rights and federal responsibilities (fig. 1)

1Jonathan Long is an ecologist, U.S. Forest Service, Pacific Northwest Research Station, 1731 Research Park Dr., Davis, CA 95618; Frank K. Lake is an ecologist, U.S. Forest Service, Pacific Southwest Research Station, 3644 Avtech Parkway, Redding, CA 96002; Kathy Lynn is a faculty researcher, University of Oregon Environmental Studies Program, 5223 University of Oregon, Eugene, OR 97403; and Carson Viles is a research assistant, University of Oregon Environmental Studies Program, 5223 University of Oregon, Eugene, OR 97405.
Figure 1—Sign commemorating the "handshake agreement" that provided for exclusive access by American Indians to gather huckleberries (*Vaccinium* spp.) in an area on the Gifford-Pinchot National Forest. Photo credit: Team Hymas at Flickr.

Defining Ecocultural Resources

We focus on “resources” in the title because that term describes assets for which the federal government has a particular responsibility to tribes to protect (see “The Federal-Tribal Relationship”). However, “resources” may connote that tribal values are primarily derived from material uses. It is important to recognize that tribes also regard many places, animals, plants, and fungi for non-material values, including sense of place and other dimensions of cultural significance (Burger et al. 2008). In a similar vein, we refer to the concept of ecosystem services (see Chapters 1 and 9), while emphasizing the importance of “cultural ecosystem services” that encompass both subsistence values and nonmaterial values important to native peoples (Burger et al. 2008). Such an emphasis can respond to criticisms that ecosystem services places too much emphasis on anthropocentric and material values in ways that might contradict more holistic perspectives of indigenous peoples (Schröter et al. 2014).

We use the term “ecocultural resource” to emphasize that more integrated perspective, consistent with use of the term by Tomblin (2009), the Karuk Tribe (Lake et al. 2010), and many others in recent years. Rogers-Martinez (1992) was an early advocate for recognizing the need for ecological and cultural
integrated in restoration in a tribal context: “In other words, what we aim to restore is not only the land, but our relationship with it” (P. 69). Similarly, Harris and Harper (2000) used the term “eco-cultural dependency webs” in characterizing interactions between tribal people and their environment. A key theme in this chapter is the interconnection of ecosystems and tribal communities. The term “ecocultural resources” avoids the inappropriate division between “ecological” (or “natural”) and “cultural” resources, which is particularly problematic when considering socioecosystems that have developed with indigenous people over millennia (Burger et al. 2008).

Background

Over 70 federally recognized American Indian tribes, and many more tribes that are not currently recognized, have tribal lands and/or ancestral territory within the NWFP boundary. Many tribes that are now called “unrecognized” were formerly recognized prior to termination in the 1950s, especially in California, and many tribes that were re-recognized starting in the latter part of the 20th century did not regain control over their former reservations (Slagle 1989). Much of their ancestral territory was transferred to the U.S. Forest Service and Bureau of Land Management over a century ago. However, that process of land transfer continued even into the 1960s, when most of the Klamath Tribe’s reservation was transferred, following termination of the Tribe, to form much of the current Fremont-Winema National Forest (Catton 2016). Some public lands have been transferred back to tribal control in recent decades (Catton 2016), with legislation proposed to make more such transfers within the NWFP area, including parts of the former Klamath Reservation.

Each tribe has a unique history and relationship with the federal government, as well as unique environmental and economic needs that influence how they are affected by forest management in the NWFP area. Federal land management and policy affects lands and resources that are critical to tribes, and the federal government has a trust responsibility to consult with federally recognized tribes when managing for tribal resources on federal lands that include ceded and ancestral territories (see “The Federal-Tribal Relationship”). The Record of Decision for the NWFP requires federal agencies to consult with tribal governments whose treaty-protected resources may be affected. It also calls for resolving conflicts collaboratively with affected tribes because of the potential for the plan to affect tribal activities, such as gathering and harvesting in areas subject to tribal treaty off-reservation gathering rights (Espy and Babbit 1994).
Sidebar: The Federal-Tribal Relationship

The United States has a trust responsibility to the 567 federally recognized American Indian and Alaska Native tribes to protect their tribal treaty rights, lands, assets and resources (USDI-BIA 2016). Federal recognition acknowledges tribes as political sovereigns with inherent rights to self-governance. When the U.S. entered into treaties with American Indian tribes, it made commitments to provide tribes with goods and services, and to preserve their ability to exercise reserved rights such as fishing, hunting, gathering, and trapping on open and unclaimed land or “usual and accustomed” areas within territories beyond their reservations, which are often described as “ceded lands.” These areas, often overlap and represent enormous areas stretching across the NWFP area in Oregon and Washington (fig. 2). In California, the U.S. Congress refused to ratify the treaties that had been negotiated with many tribes (Slagle 1989). Given that the federal government controls most tribal ancestral lands, and many tribes have small land bases under their direct control, federal management actions profoundly affect tribal access to, and the use of, such lands and resources (Dobkins et al. 2016).

The unique status of federally-recognized tribes requires that U.S. government entities consult directly with these tribal governments when addressing issues that may affect trust resources and the welfare of their tribal members. Consultation is a cornerstone of the government-to-government relationship, which clearly distinguishes the tribes from interested members of the general public (Nie 2008). Executive Order #13175, Consultation and Coordination with Indian Tribal Governments, sets requirements for the consultation process to ensure meaningful and timely input by tribal officials when federal action may affect tribal lands and resources. In addition to the executive order, consultation obligations are found in numerous statutes, including the National Historic Preservation Act of 1966 to the Federal Land Policy and Management Act of 1976 (Galanda 2011).
Figure 2A—Present-day and ancestral tribal lands within the NWFP boundary in Washington and Oregon. Asterisk denotes tribal lands outside the boundary belonging to tribes that have ancestral lands within the boundary.
Figure 2B—Present-day and ancestral tribal lands within the NWFP boundary in California. Asterisks denote tribal lands outside the boundary belonging to tribes that have ancestral lands within the boundary.
Guiding Questions

Managers from the Forest Service requested that the synthesis report address the two-part question of “What is the capacity of the Northwest Plan area to provide for Native American first foods (e.g., salmon, elk, huckleberry, camas), and is active management called for?” This chapter addresses that question as part of a larger examination of opportunities to promote ecocultural resources, while also considering scientific information regarding tribal consultation, or the broader issue of engaging tribes in managing federal lands. In addition to addressing questions of how forest management can promote tribal resources such as first foods, the synthesis needed to explain how changes in the relationship between American Indians and the ecosystems in the Northwest Forest Plan area have altered ecological conditions. Restoring or emulating historical cultural practices, such as tribal burning, could have important implications for wildlife, plants, and the general public. After first considering the general context for land management and restoration to support values important to tribes, we delve into recent science to address several questions in more detail:

1. What are resources of special value to tribes, and what factors are influencing the quality and availability of those resources, as well as the ecosystems that sustain them? In particular, how has the reduction in American Indian influence affected those resources and ecosystems?

2. What land management strategies, including active interventions, can promote tribal ecocultural resources, and how do those strategies integrate with management, research, and monitoring for economic, social, cultural, terrestrial and aquatic systems more broadly?

3. What strategies for engaging tribes in forest planning and management can address their concerns regarding access to and management of federal lands, including providing for government-to-government relationships and consultation?

Source Materials

This chapter, as with others in this science synthesis, draws primarily from peer-reviewed publications, focusing on relatively recent publications. However, considerable information regarding particular tribal resources and federal-tribal relationships has been documented in other kinds of publications, including theses, dissertations, and agency and tribal reports. This chapter refers to some of these publications as an aid to understanding particular topics that are not well-addressed in peer-reviewed literature. This chapter also draws upon findings from related chapters in this report to highlight how broader strategies being
considered in forest management and planning may support or might be modified to promote resources of special concern to tribes.

Key Findings

Our synthesis starts by considering important concepts that help to frame the context for forest management to promote tribal well-being.

What is the Tribal Context for Integrated Social and Ecological Restoration?

As discussed throughout this report, scientific research has recognized the deeply interwoven relationships between American Indians and the nonhuman elements of ecological systems in the region. Efforts to promote resources valued by tribes can be described as attempts to promote integrated socioecological benefits within ecological constraints. This framing contrasts with a more simplistic characterization of trading off ecological values against socioeconomic values (McDonald and Lane 2004), which was formerly popularized as a “jobs-versus-owls” debate. Using an integrated framework based upon socioecological benefits is more likely to yield collaborative solutions to problems (Kearney et al. 1999).

Land management plans intended to promote socioecological resilience will not be as effective if they do not consider uses of ecocultural resources by American Indians (Lake and Long 2014). It is particularly important to understand how ecological conditions influence tribal well-being (Stumpff 2006), including food and health; economic prosperity, security and sovereignty; ability to maintain tribal spiritual and ceremonial practices and observances; heritage and cultural identity; tourism; and maintenance of traditional knowledge systems, beliefs, and intergenerational exchange (Burger et al. 2008, De Groot et al. 2002, Fisher et al. 2008, Tengberg et al. 2012). Tribal socioeconomic systems are particularly dependent upon harvesting traditional foods (Richards and Alexander 2006), timber and other forest products, while sociocultural well-being is linked to less tangible qualities such as sense of place, immersion in natural forest environments, and ability to pass on cultural traditions (Satterfield et al. 2013). Many species may be recognized as “cultural keystones” because they have prominent roles in maintaining tribal identity and cultural traditions (Garibaldi and Turner 2004). Recently, researchers have extended that concept to describe “cultural keystone places” where cultural keystone species often occur,
and which also have particularly great cultural, historical, social, ecological and economic values (Cuerrier et al. 2015). Many tribes are working to increase their access to traditional foods (fig. 3) as part of a food “security” or “sovereignty” movement, and these efforts depend heavily on having influence over management of public lands (Turner and Turner 2007). These revitalization efforts are intended to increase resilience of tribal landscapes and contribute to the traditions, livelihoods, and well-being of tribal communities (Daniel et al. 2012, Hernández-Morcillo et al. 2013).

Figure 3—A traditional meal of lamprey (Lampetra tridentata) and Chinook salmon (Oncorhynchus tshawytscha) is prepared on coast redwood (Sequoia sempervirens) and western red cedar (Thuja plicata) sticks over a madrone (Arbutus menziesii) wood fire along the Salmon River, California, April 2016. Photo credit: Frank K. Lake.

The concept of ecosystem services (see Chapter 9) helps to understand the importance of “provisioning services” that support fishing, hunting, gathering, and other tribal harvesting activities, as well as less tangible “cultural ecosystem services”, which are distinctively important to tribes and often under-accounted in conventional analyses (Asah et al. 2014). Vulnerability and risk assessments for tribal communities often need to be distinctive from efforts designed for the general public, in order to adequately consider risks to American Indian tribes and their members who have traditionally relied more heavily upon wild fish, game, and other foods, as well as other natural materials that are processed, stored, and used in homes (Burger 2008, Donatuto et al. 2014, Donatuto et al. 2011, Kerns and Ager 2007). In particular, Harris and Harper (1997) reported that mean exposures to various contaminants for an average traditional-subsistence person may be 2 to 100 times greater than an average suburban resident due to greater ingestion and exposure. These factors increase the need for both protective standards and management designed for the distinctive characteristics of tribal communities.
Cross-boundary and broad-scale perspectives—

Tribes in the Northwest Forest Plan area are connected to a diverse range of ecosystems from the mountains to the sea, encompassing marine, estuarine, riverine, valley, wetland, grassland, foothill, montane and alpine environments that collectively offer a wide range of places and resources valued by tribes (Suttles 1990, Turner et al. 2011). This synthesis focuses on forested ecosystems, but the forests are connected to other ecosystems including grasslands, wetlands, estuaries, bays and the Pacific Ocean. These other ecosystems are also critical for sustaining many species of special concern to tribes, including anadromous fishes, waterfowl, wetland plants (such as wapato, Sagittaria spp.), and migratory birds. Tribal well-being is strongly connected to the condition of entire terrestrial and aquatic ecosystems across federal, tribal, state, county, and private lands. Consequently, cross-boundary and broad-scale perspectives are critical for managing tribal resources. A focus on watershed processes is particularly important because many tribal resources depend on flows from mountain peaks to coastal zones and because many tribes in the NWFP area reside in coastal areas and river valleys (fig. 2). Forest Service planning approaches generally emphasize a watershed perspective in planning and management, but it is important to consider how management of federal lands affects downstream aquatic systems and beneficial uses. There are also important cross-boundary issues involved in terrestrial systems, especially due to tribal treaty rights to gather, hunt, and fish on lands outside present-day reservations. There are also complex land management situations such as the Quinault Special Management Area, which is managed by the Forest Service with specific benefits provided directly to the Quinault Indian Nation (Vinyeta and Lynn 2015). Tribes that have been displaced from their ancestral homelands often have strong interest in lands that are distant from their current residences (Cronin and Ostergren 2007). In particular, some reservations are governed by confederated tribes whose members originated from broad territories and held a wide range of traditions and cultural practices. For example, descendants from the Rogue River tribe are now members of the Confederated Tribes of the Siletz Indians and currently reside in Northwestern Oregon, but they retain interest in forest management activities in their ancestral territory on the Rogue-Siskiyou National Forest in southwestern Oregon. For all these reasons, it is important for forest planning efforts to recognize that the relatively small areas identified as tribal lands in contemporary maps, such as in fig. 2, do not adequately depict the depth and breadth of tribal concerns across larger landscapes.
What are Resources and Ecosystems of Special Value to Tribes in the NWFP Area?

Several groups of organisms represent prominent tribal resources across the NWFP area, including anadromous fish, ungulates, geophytes, fungi, nut-bearing trees, berry-bearing shrubs, and many other understory plants, all of which are discussed in this chapter. Many of the plants and animals discussed below are likely to qualify as cultural keystone species (Garibaldi and Turner 2004) because of their important roles in maintaining tribal cultures and because they were widely used and traded by tribes in the NWFP area (Turner and Loewen 1998). They may also be ecological keystones due to their importance in maintaining important ecological processes. Consequently, many of these species are important to consider as keystones in an integrated ecocultural context.

Mammals, including ungulates and fur-bearers—

Columbian black-tailed deer (*Odocoileus hemionus columbianus*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*) and elk (*Cervus elaphus*) are big game animals of traditional importance to tribes in the NWFP area. These species depend in particular on forest openings, many of which were maintained with former tribal burning practices (Turner et al. 2011). Managers of private forest lands have argued that populations of elk and black-tailed deer have declined without regeneration harvests (Burns et al. 2011). Fuels reduction can enhance the quantity and quality of elk forage (Long et al. 2008). Deer browse the new shoots or branch-tip growth of many of the berry-producing shrubs that are also important to tribes, including salal (Stockton et al. 2005). In some areas within the NWFP, such as the Gulf and San Juan Islands, black-tailed deer have increased, leading to declines in many understory plants as well as birds (Martin et al. 2011). However, in other areas, a decline in elk and deer populations associated with fire exclusion and suppression and forest succession has diminished tribal food security (MacDougall 2008). These large ungulates also have high value from the non-tribal public for subsistence and sport hunting (Lehmkuhl et al. 2001). Collaborative landscape efforts designed to restore habitats (e.g. winter range associated with lower elevation oak woodlands, or higher elevation forests) can help address tribal interests in increasing these wild ungulate populations.

Many mammals such as river otter (*Lontra canadensis*), American beaver (*Castor canadensis*), mountain beaver (*Aplodontia rufa*), Pacific marten (*Martes caurina*), fisher (*Pekania pennanti*), mink (*Neovison vison*), and porcupine (*Erethizon dorsatus*) are used in making regalia and other cultural items...
Birds important for food, regalia, and ceremonies—

Various birds are important as sources of food and materials for tribal regalia, and many species have special cultural significance in ceremonies, stories, and songs. Jordan (2015) provides a detailed examination of how the Hupa people have woven the pileated woodpecker (*Dryocopus pileatus*) into their material and spiritual culture by using the feathered scalps to make dance regalia (figs. 4 and 5, and 6) and maintaining a reciprocal relationship with the bird. For example, the Hoopa Valley Tribe has engaged in research to study how forest disturbances influence the species (see Tribal ecosystem services from dead trees and forest gaps). Other birds that are prominently featured in American Indian featherwork include mallard duck (*Anas platyrhynchos*), bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), mountain quail (*Oreortyx pictus*), California quail (*Callipepla californica*), band-tailed pigeon (*Patagioenas fasciata*), acorn woodpecker (*Melanerpes formicivorus*), and northern flicker (*Colaptes auratus*) (Gleeson et al. 2012). Among some tribes, owls may have complex cultural associations that limit direct interactions (Gleeson et al. 2012). California condor (*Gymnogyps californianus*) was historically significant, with feathers used in regalia items, and it remains a species of interest for some tribes in the NWFP area (Gleeson et al. 2012).

Forest management and fires affect bird habitat in complex ways, but in general increasing forest heterogeneity to include a variety of successional stages can increase avian diversity (Burger et al. 2013). Tribes often emphasize the importance of food webs and habitat to support the range of species on which they depend, calling attention to the importance of tree cavities and production of nuts, berries, and other foods not only for their own use, but also for wildlife (Long et al. 2016). Riparian areas may be particularly important for many bird species held with special importance to tribes, and treatments that reduce the likelihood of high-severity fire may better protect those areas and their associated fauna (Stephens and Alexander 2011).

Sidebar: Tribal ecosystem services from dead trees and forest gaps

The Hoopa Valley Tribe recently partnered with Humboldt State University researchers to examine the effects of tree damage caused by black bears (*Ursus americanus*) (Mendia 2016). They found that bear damage in 40- to 60-year-old stands of Douglas-fir (*Pseudotsuga menziesii*) was significantly correlated with dead and decaying trees larger than 10 in. (25.4 cm) diameter at breast height. While the damage to
trees negatively affected the lumber value of the stand, it created dead wood that would normally be
found in older stands and was associated with increased observations of pileated woodpecker (Dryocopus
pileatus), a culturally important species used for regalia, as well as red-breasted sapsucker (Sphyrapicus
ruber) and other cavity-nesting birds. The researcher also observed deer browse on new growth of
western swordfern (Polystichum munitum) in the canopy gaps resulting from killed trees (fig. 7).
Consequently, this study found that the small-scale disturbance caused by bears may have promoted
provisioning and cultural ecosystem services associated with biodiversity and tribal spiritual values.

Figure 4—Pileated woodpecker head mounted on a handle made of madrone “curly” wood (with
disfigured growth from a honeysuckle [Lonicera sp.] vine) and adorned with woodpecker tail feathers and
shells from dentalium (Dentalium sp.) and abalone (Haliotis sp.). This regalia item, photographed June
2007, was made and used by Frank Lake in contemporary tribal (Karuk and Yurok) brush dance and war
dance ceremonies. Photo credit: Frank K. Lake.
Figure 5— Lake family regalia photographed August 2016, including a quiver made from fisher adorned with red abalone shells surrounded by men’s ceremonial headbands composed of acorn woodpecker scalps sown on tanned deer hide. Photo credit: Frank K. Lake.
Figure 6—Hupa men dressed in Brush Dance regalia in 2015, adorned with pileated woodpecker scalps along with a variety of other products derived from forest and ocean wildlife. Photo credit and copyright: Dawn Blake, who granted permission for one-time use of this photo in this report.
Figure 7—Canopy gap resulting from black bear damage to trees in a second-growth redwood stand, Hupa Valley Reservation. Photo by Shannon Mendia.

**Anadromous fish—**

Many tribes in the NWFP area value anadromous fish such as salmon and trout (*Oncorhynchus* spp.) and sturgeon (*Acipenser* spp.) as cultural keystones (Benson et al. 2007, Crozier and Zabel 2006, Richter and Kolmes 2005). Lamprey (*Lampetra tridentata*) is another anadromous fish of special value to tribes (fig. 8) (Close et al. 2002, Larson and Belchik 1998, Petersen Lewis 2009, Sheoships 2014). Eulachon, “candlefish” smelt (*Thaleicthys pacificus*) (fig. 9) is an important traditional food that was also a valuable trade good (Larson and Belchik 1998, Mitchell and Donald 2001) and has been listed as threatened in the NWFP area (Chapter 7). These anadromous species, and their safety for human consumption, have been impacted by increasing freshwater temperatures, drought, parasites, and toxins (Benson et al. 2007, Crozier and Zabel 2006, Richter and Kolmes 2005). Norgaard et al. (2013) studied trace metals in three species used by the Karuk Tribe in the Klamath River (salmon, steelhead trout, and freshwater mussels) and found that the foods were deemed safe even at the comparatively higher levels of consumption in
traditional tribal diets. This study demonstrated the importance in tailoring risk assessments to particular tribal contexts, as well as to consider the potential impacts of releases of toxic substances in sediments stored behind dams.

Figure 8—Alme Allen (left) with Eugene Coleman hold lampreys caught with a basket trap along the Klamath River, near Orleans, California, May 2005. Photo credit: Frank K. Lake.

Figure 9—Lamprey, candlefish, and night smelt (*Spirinchus starksi*) harvested by Yurok Tribal members on a basket tray made from sandbar willow (*Salix exigua*), March 2014. Photo credit: Frank K. Lake.
Mollusks—

Freshwater mussels (e.g., *Margaritifera falcata*, *Gonidea angulata*, and *Anodonta californiensis*) are important tribal sources of food that have a very patchy and reduced abundance in the region particularly resulting from declines in host fish species associated with degraded habitats, non-indigenous fishes, and reduced connectivity, including dams on the Klamath, Columbia, and other large rivers (Box et al. 2006, Davis et al. 2013, Howard 2010). Other mollusks, including terrestrial snails (see Chapter 6), have special values to tribes.

Nut-bearing trees—

Tree species that were traditionally valued for nut production include hardwood species such as tanoak (*Notholithocarpus densiflorus*) (fig. 10) (Bowcutt 2013), California black oak (*Quercus kelloggii*) (Long et al. 2016), Oregon white oak (*Quercus garryana*) (Hosten et al. 2012), and California hazel (*Corylus cornuta*) as well as conifer species such as sugar pine (*Pinus lambertiana*). Many of the hardwood species are capable of resprouting following fires, but the loss of mature crowns may retard/reduce production of nuts for long periods in several species. There is greater potential for lost nut production in many of these species because fire exclusion, conifer encroachment, and increased fuel loading have increased the potential for high-severity fire (Cocking et al. 2012, Devine and Harrington 2006). However, Sadler’s oak (*Q. sadleriana*) is a shrubby oak also valued for nut production, but which can respond to fire with vigorous acorn production. Sudden oak death is a fungal disease that threatens many of the hardwood species (Cobb et al. 2012, Ortiz 2008), while white pine blister rust threatens sugar pine and other white pines (Samman et al. 2003). Strategies to promote forests that are more resilient to mortality agents include reducing fuel loads, restoration of fire regimes, reducing tree density, and shifting composition away from fire-sensitive species to more fire-adapted plants, especially in more frequent-fire forest types.
Conifer trees used for material, medicine, and ceremonies—

Conifer trees of special value to tribes include various pines (*Pinus* spp.); spruces (*Picea* spp.) (fig. 11); Pacific yew (*Taxus brevifolia*), Port Orford cedar (*Chamaecyparis lawsoniana*), coast redwood (fig. 12), and many other species (Turner and Loewen 1998). Populations of many of these species are threatened by diseases (e.g., Port Orford cedar root disease) as well as a warming climate and associated disturbances. In particular, populations at higher elevations and lower latitudes (i.e., northern California) generally appear more vulnerable to projected climate change, but vulnerabilities appear variable from one species to the next (Coops and Waring 2011). For example, Alaska yellow-cedar (*Callitropsis nootkatensis*), which is an important source of weaving materials, appears highly vulnerable within its range (Coops and Waring 2011). In contrast, western redcedar (*Thuja plicata*) appear highly adapted and may experience range expansions (Coops and Waring 2011). Western redcedar is an important cultural keystone due to its importance for construction materials, including the carving of sea-faring canoes and totem poles (Barbeau 1930, Garibaldi and Turner 2004) (fig. 13). For harvest of those special wood products and nuts, American Indians often need access to large trees with particular characteristics. Consequently, predictions of range expansion for species under future climate may not sufficiently gauge the sustainability of important tribal ecocultural resources that depend upon the availability of such special trees.
Figure 11—Deanna Marshall, right, with her mother Laverne Glaze, gathering Sitka spruce (*Picea sitchensis*) roots for basketry material, July 2006. Photo credit: Frank K. Lake.

Figure 12—Frank Lake with son Jason (middle) and Bryan Colegrove use a traditional redwood canoe on the Klamath River near Orleans, California, August 2005. Photo credit: Lisa Latimer.
Understory plants for basketry, floral greens, medicines, berries, and other foods—

A wide variety of understory plants are important for maintaining the health, diet, lifeways, and cultural traditions of tribal communities (Lynn et al. 2013, Rogers-Martinez 1992). These plants include many shrubs that produce berries such as huckleberries (fig. 14), cane fruits and brambles (*Rubus* spp.), elderberries (*Sambucus* spp.), and serviceberry/saskatoon berry (*Amelanchier* spp.) (Kellogg et al. 2009, Turner and Turner 2007). Several species of huckleberries are particularly important resources from a socioecological perspective, with gathering for traditional tribal use coming into conflict with commercial harvest by non-American Indians (Carroll et al. 2003, Richards and Alexander 2006). Indeed, the market value of huckleberries picked from a good site was reported to be as much as $760/ac ($1780/ha) in 1976 (Minore and Dubrasich 1978).
Figure 14—LaVerne Glaze with evergreen huckleberries picked from pruned branch tips, October 2003.

Photo credit: Frank K. Lake.

A variety of understory plants are important for basketry materials, including willows (*Salix* spp.), basket sedge (*Carex barbara*), dogbane (*Apocynum cannabinum*), and many others. Salal (*Gaultheria shallon*) is an important shrub gathered by American Indians for food and medicine, as well as by non-American Indian harvesters for floral industry uses (Ballard et al. 2008). Many geophytes, including camas (*Camassia* spp.), cluster-lilies (*Brodiaea* spp.) (fig. 15), biscuit roots (*Lomatium* spp.), and lilies (*Lilium* spp.), are important traditional foods. Beargrass (*Xerophyllum tenax*) is an important geophyte with leaves used for weaving baskets and used in tribal regalia items (Hummel et al. 2012, Shebitz et al. 2009).

Many understory plants are associated with disturbances that create or maintain canopy gaps and/or open understory environments, such as fire. Canopy gaps allow light to reach the understory, and burning often promotes characteristics desired by gatherers, such as long, supple stems, larger roots, and increased fruit production, as well as ease of access for harvesting. For example, research indicates that tribal gatherers prefer beargrass from stands with fewer, larger trees and less down wood, which are conditions that can be promoted through thinning and frequent fire (Hummel and Lake 2015). However, such relationships can vary greatly among closely related species; for example, Kerns et al. (2004) found that red huckleberry (*Vaccinium parvifolium*) would likely benefit from thinning young conifer stands, while the more shade-tolerant evergreen huckleberry (*Vaccinium ovatum*) appeared more abundant in closed canopy forests along the Oregon coast and might decline with thinning in such stands. Similarly, Keyes and Teraoka (2014) found red huckleberry to be more dominant in second-growth rather than old-growth redwood stands in Northern California. Kerns et al. (2004) noted that harvesters expressed concern about conifer encroachment in stands with big huckleberry (*Vaccinium membranaceum*) which is the favored species for many American Indians. They concluded that more site-specific investigations informed by tribal harvesters would help to better understand favorable management practices. In
adoption, forestry and botanical research typically evaluates percent cover or abundance of vegetative
cover, not the metric of berry abundance used by tribal gatherers. Tribal harvesters may judge various
characteristics including cover, abundance, branching, and fruit production in the forest and in openings
when suggesting management strategies for particular stands.

Figure 15—Lilian Rentz (left) harvesting cluster-lily corms with LaVerne Glaze near Somes Bar,
California, July 2006. Photo credit: Frank K. Lake.

Tribes have valued and tended several plants found in wetland habitats. For example, tribes in
Oregon and on the Olympic Peninsula in Washington have long gathered small cranberry (*Vaccinium
oxycoccos*) from bogs and used fires to deter encroaching trees and shrubs and to stimulate the plants to
produce more fruit (Anderson 2009) (fig. 16). Bog Labrador tea (*Ledum groenlandicum*) (fig. 17) is
another species used for medicine that has a similar history of tribal burning; the plant resprouts from
stems following low-intensity fires, and from deep rhizomes following more severe fires (Anderson
2009). Another example is the western lily (*Lilium occidentale*), a threatened species. As described in a 5-
year status report (U.S. Fish and Wildlife Service 2009), this plant is endemic to the coast of northern
California and southern Oregon, where it occupies early-successional habitats including freshwater
wetlands, coastal prairie and scrub, and the edges of Sitka spruce forests. Declines in habitat quality for
the species have been linked to reductions in American Indian burning and ungulate grazing, which
historically was provided by elk but for which cattle may be a useful surrogate (U.S. Fish and Wildlife
Service 2009).
Figure 16—Gary Ray picking bog cranberries at a prairie on the Makah Reservation in late September 2009. Photo credit: M. Kat Anderson.

Figure 17—Pat Boachup collecting bog Labrador tea at a prairie on the Makah Reservation, late September 2009. Photo credit: M. Kat Anderson.
**Fungi—**

Many species of fungi are important sources of food and medicine for tribes including matsutake (*Tricholoma magnivelare*), morels (*Morchella* spp.), chanterelles (*Cantharellus* spp.); hedgehogs (*Hydnum* spp.), boletes (*Boletus* spp.), *Hericium* spp., and oyster mushrooms (*Pleurotus* spp.) (Anderson and Lake 2013). Many of these species produce fruiting bodies following fire and other disturbances to trees and soils, although disturbance of mycelial mats could also impact these fungi (Anderson and Lake 2013).

**Diversity and similarities among tribes regarding ecocultural resources—**

Tribal cultures across the NWFP area constitute a great diversity of languages, knowledge systems, practices, and traditions that reflect the ecological diversity of their ancestral territorial homelands (Kroeber 1920, Suttles 1990). Many parts of the region, such as the Klamath Mountains, have distinctive ecological mixes of the Coast Range, Cascade Range, and California provinces. Tribal knowledges reflect similar mixes, as tribes of northern California have cultural knowledge and practices of species that extend from the Great Basin, Pacific Northwest, and California floristic biomes (Kroeber 1920). Meanwhile, tribes along the lower Columbia River depend upon and have knowledge of plants and animals found in both the Pacific Northwest and Columbia Plateau. Tribal knowledge systems have evolved with an understanding of conditions across bioregions and habitats. Maintenance of those same knowledge systems requires managing resource conditions and accessibility across those larger geographic areas (Dobkins et al. 2016, Trosper 2003, Turner et al. 2003).

Even though tribes living in similar environments may represent different language groups, they tend to exhibit similarities in cultural practices, including subsistence strategies. For example, tribes along the coast from British Columbia to northern California used and still depend upon many similar resources (Suttles 1990). Although many tribes use the same species for similar purposes, their harvesting, gathering, processing and stewardship methods may vary based on culturally-specific knowledge and customs, as illustrated in the case of Pacific lamprey (Close et al. 2004, Petersen Lewis 2009). Similarly, all the tribes have rich basket weaving traditions, and many use primarily the same few species, such as hazel and beargrass (fig. 18) as central components. However, tribes have distinctive weaving techniques and designs, as well as distinctive cultivation and harvesting practices (Hummel et al. 2012, Hummel and Lake 2015).
Figure 18—LaVerne Glaze holding harvested beargrass, July 2005. Photo credit: Frank K. Lake.

The distinctions in how tribes use and manage forest resources are important for planning, prioritizing, and implementing restoration strategies (Stumpff 2006). Such implications are especially great when planning restoration for large landscapes, as each interested tribe may have specific values attributed to particular places. Tribal knowledge can guide and inform resource management for a suite of similar habitats and species, but specific prescriptions and treatments may be needed to promote desired conditions for specific sites. For example, many tribes may want to use fire within a landscape, but they may have different approaches regarding the timing of burning in particular habitats. As a consequence, consultation, coordination and communication by federal agencies with individual tribes is important to address landscapes, habitats, and species of interest, rather than expecting that generalized prescriptions will serve the needs of all tribes in an area (Raish et al. 2007).
What Factors are influencing the Quality and Availability of Tribal Ecocultural Resources?

Changes in tribal socioeconomic conditions—

Many tribes experienced socioeconomic transformation as they shifted from subsistence to market-based economies by the start of the 20th century. Many tribal members sought employment opportunities in regional fisheries, agricultural, and timber-based industries (Mondou 1997). Employment within such sectors can provide economic security while facilitating continuance of tribal traditions and cultural practices. However, during much of the 20th century, local tribes had little influence over forest management on federally-managed lands, in part because many were not federally recognized. Many tribes perceive that legacy of past management as having degraded the quality and quantity of important tribal ecocultural resources, as well as having engendered considerable distrust of land management agencies (Norgaard 2014c). Removal of tribes, fire exclusion, commercial timber harvest and protections for threatened species have all reportedly contributed to separating tribes from the benefits they derived from ancestral lands, which in turn has negatively affecting tribal community wellness and reduced tribal engagement in forest management (Norgaard 2014c). Tribes and community members have long faced challenges in attempting to maintain both economic security and traditional cultural practices. Many tribal economies remain strongly linked to forest industries and management through activities such harvesting kinds of forest products and firefighting. Many tribes now direct their own natural resource programs and industries, and tribes have had increased opportunities to influence management on national forests through agreements, compacts, and stewardship contracts under the Tribal Forest Protection Act and related authorities (McAvoy et al. 2005, Murphy et al. 2007).

Limited access and competition for gathering forest products—

Gathering of nontimber forest products (also known as special forest products) represents a very large economic activity in the region (see Chapter 10). For federally recognized tribes in Washington and Oregon, reserved treaty rights reaffirm access and use of forest products, fish and game, and other natural resources for “usual and accustomed” purposes. For the tribes of northwestern California as well as other tribes in the Pacific Northwest region with unratified treaties, gathering “forest products for traditional and cultural purposes” is allowed under the Cultural and Heritage Cooperation Authority, chapter 32A in the Farm Bill of 2008. In recognition of tribal reserved rights and the importance of forest products to the daily lives of American Indians, the Forest Service adopted rules that authorize the collection and
harvesting of nontimber forest products for traditional and cultural purposes free of charge (Middleton 2011). However, the supply of those products may also be an important practical constraint on tribal use (Findley et al. 2001). There has been competition for many of these resources among American Indians and non-native groups (Hansis 1998). In some cases, nontimber forest products have had commercial importance, yet local residents and American Indians have not benefitted because harvesters and buyers have come from outside areas (Charnley et al. 2008a). Forest Service policy (FSH 2409.18.80) restricts issuance of commercial permits when there are shortages to ensure that tribal use can be accommodated. Access to suitable logs to construct river- and ocean-going canoes (fig. 12) is a limiting factor for larger contemporary tribal traditions and celebrations (Johansen 2012). Tribes have faced obstacles in gathering these rare logs from national forests across the NWFP area due to limited availability, disputes over fees, and other complications (Catton 2016). Notably, the Farm Bill of 2008 (25 USC 3055) addressed such uses by authorizing the Secretary of Agriculture to provide any trees, portions of trees, or forest products to Indian tribes free of charge for noncommercial traditional and cultural purposes.

Illega marijuana cultivation—

Marijuana cultivation on national forests and other public lands poses concerns for public safety, access, and resources, especially in northwestern California, where that activity has proliferated since the 1990s (Bauer et al. 2015). The impacts of illegal marijuana cultivation can harm wildlife. For example, illness and deaths in fisher populations in southern Oregon and northern California, including on and around the Hoopa Valley Reservation, have recently been linked to the use of rodenticides in marijuana cultivation (Gabriel et al. 2012). Other researchers found that the rodenticides cause direct or indirect mortality to wildlife species such as fisher, bobcat (Serieys et al. 2015), owls, and other predators that consume rodents laced with the toxic compounds (Hosea 2000, Stone et al. 1999). Additionally, Bauer et al. (2015) found that water diversion associated with illegal marijuana cultivation in several California watersheds negatively affected the health of salmonids and amphibians. Finally, these operations pose safety concerns for forest users, including tribal gatherers, and land managers responsible for treating, monitoring and protecting forests. Some tribes have expressed safety concerns for traditional gatherers who encounter illegal marijuana grow sites on federal and tribal lands.

Climate change—

Climate change is likely to affect ecosystems that sustain tribal ecocultural resources through droughts, extreme storms and floods, wildfires, and outbreaks of pests and pathogens. In addition, it is inducing sea-
level rise and associated flood hazards that are impacting tribes in low-lying and coastal areas (Papiez 2009), which may further increase the importance of federal lands for sustaining tribal communities. Long-term climate projections are important for understanding potential effects on resources of concern (McClure et al. 2013). Observed and projected trends in climate, such as reduced water availability in soils and streams, are expected to threaten the availability of traditional foods to tribes (Bennett et al. 2014). Many of these impacts are compounded by other stressors, including insect pests and pathogens, hydrologic alterations caused by human development, and changes in fire regimes (Spies et al. 2010). As discussed in Chapter 2, there is considerable uncertainty regarding how climate, fire, invasive species, and other influences may alter future habitats and species composition at fine scales. Attempts to cope with this uncertainty commonly rely on downscaling regional climate projections to smaller areas, modeling future interactions, and synthesizing expert judgment in vulnerability assessments and adaptation strategies. When assessing vulnerability to climate change and other stressors, focusing attention on tribally important values is important for identifying important threats and opportunities for adaptation. Western scientific knowledge of climate-habitat-species relationships can be cross-linked with tribal ethnobotanical knowledge to better forecast and anticipate changes to, or impacts on, tribal uses (Turner et al. 2011). Integration can help to identify areas of the landscape that may be critical refugia for at-risk or vulnerable species (Carroll et al. 2010, Olson et al. 2012), which may have special cultural significance to tribes. If cultural keystone species are reduced or eliminated from a tribe’s ancestral territory, then the associated cultural traditions, knowledge systems, and material well-being of tribal communities may in turn suffer (Colombi 2012).

Research has projected that mixed evergreen forest in California may expand under future climate, which could benefit species such as ponderosa pine, California black oak, and tanoak (see Chapter 2). Deciduous hardwoods are often at a disadvantage when competing with conifers such as Douglas-fir (Pseudotsuga menziesii var. menziesii) and true firs (Abies spp.) in the absence of disturbance, but resprouting gives many of these hardwood trees an advantage after stand-replacing fire (Long et al. 2016, Waring and Franklin 1979). Although these species are expected to fare well under warmer and fire-prone conditions, the benefits they provide to tribes, such as nut production (see Nut-bearing trees section above) may nevertheless be vulnerable.

**Terrestrial ecosystems**—

Invasive pests, diseases, and pathogens are affecting tribally valued habitats and species, and those impacts may grow worse under periods of heightened climatic stress (Pfeiffer and Voeks 2008) or in fire-suppressed forests with extremely high tree densities and fuel loads. Turner and Clifton (2009) identified
many examples of recent environmental declines to ecosystem services of high tribal value in British Columbia; they attributed those declines at least partially to changes in climate associated with intensifying droughts, leading to declines in amphibians and fishes and outbreaks of pests (e.g., mountain pine beetles and spruce budworms) and diseases leading to declines in forests. Many of these effects may also be pertinent to conditions in the NWFP area, which is expected to also experience declines in amphibians (Lawler et al. 2009) and some forest tree species (Fettig et al. 2013).

The spread of the sudden oak death pathogen \( (Phytophthora ramorum) \) is having profound implications for ecological processes and tribal ecocultural resources in the northern California and western Oregon coastal region. The disease has killed many large tanoak and black oak trees and it infects many other species of special value to tribes, including California bay laurel \( (Umbellularia californica) \), California hazel \( (Corylus cornuta) \), huckleberry \( (Vaccinium spp.) \) and salmonberry \( (Ribes spectabilis) \) (Cobb et al. 2012, Ortiz 2008). Although infection may not necessarily kill those understory plants, it may reduce their suitability for gathering due to lesions and prompt land managers to remove those plants, especially California bay laurel, to protect tanoak stands (Swiecki and Bernhardt 2013).

**Alterations of hydrologic regimes**—

Changes in hydrologic regimes that have occurred due to past land use practices include decreases in low flow, increases in peak flow, and increases in temperature (Beechie et al. 2013). These impacts are likely to be intensified under future climates, and they are expected to have negative consequences for cold-water fisheries such as salmon and trout (Abdul-Aziz et al. 2011). Habitat fragmentation and elevated water temperatures have had a wide impact on salmon fisheries (Coates 2012). Tribes are concerned about the threats such impacts pose to anadromous fishes that are critically important to many tribes’ traditions and livelihoods (Dittmer 2013). Because dams are a leading cause of altered hydrology throughout the NWFP area, dam removal has become an important restoration strategy and subject of research (see Dam Removal section below).

**Alterations of fire regimes**—

Wildland fire affects the physical, biological and socio-cultural components of landscapes in ways that can both benefit and damage tribal ecocultural resources. Fire has cascading effects, beginning with direct combustion and heating that can damage sites or resources, and extending to second-order physical effects such as erosion following fires, as well as third-order impacts to cultural values, which can result from tangible and intangible resource change, loss or damage (Ryan et al. 2012). Fire management activities themselves, such as fire line construction (mechanically and manually) that results in physical
removal or modification of vegetation and soil, can also degrade tribally valued resources (Timmons et al. 2012, Welch 2012); tribal members have also cited instances when use of fire retardant has affected gathering areas (Norgaard 2014c).

Fire regimes in many regions, especially dry forests but also in some wetter coastal environments, have been altered by frequent suppression of lightning fires and reductions in aboriginal burning (Kimmerer and Lake 2001, Skinner et al. 2009) (see also Chapter 3). These alterations, along with climate change, may be leading to increased likelihood of very large fires (Stavros et al. 2014), which in turn threaten tribal ecocultural resources associated with mature trees, such as acorn production in various oaks and tanoaks. Tribal members also have stated that their ability to gather forest products such as acorns, berries, beargrass and hazel has declined due to reduced resource quality, quantity, and accessibility, which they often attribute to lack of fire and tribal stewardship as well as other changes in forest management, such as use of tree plantations (Charnley et al. 2008a, Dobkins et al. 2016, Long et al. 2016).

Lack of fire-associated forest products has reduced the quality of life for American Indians who depend on those resources (Norgaard 2014c). The widespread accumulations of fuels due to fire exclusion has complicated efforts to reintroduce fire without risking loss of tribal ecocultural resources such as mature black oaks and archaeological sites (such as rock art and obsidian) that may be particularly sensitive to high-intensity fire. Consequently, restoration strategies often may entail phased treatments that first reduce hazardous fuels prior to reintroducing fire with the higher likelihood of desired fire effects (Lake and Long 2014, Long et al. 2016).

Changes in tribal/indigenous tending/management regimes—

In addition to the displacement of cultural fire regimes, other historical tribal stewardship practices, such as gathering, weeding, pruning, burning, and removing fuels, have been altered. Application of these practices varied in scale from patches to landscapes, and they evolved into a complex agroforestry system that tribes have used to promote many favored resources (Rossier and Lake 2014). Such practices have been important in maintaining resource quality, such as reduced incidence of pests and higher production (Lake 2013). The disruption of such practices has led to reductions in quality, which can perpetuate a vicious cycle in which community members derive less benefit from maintaining these practices and knowledge of these practices eventually declines (Richards and Alexander 2006). Collaborative research in the Sierra Nevada has shown that many areas on public lands are not suitable for gathering black oak acorns due to low productivity and quality (Codding et al. In review). Similar concerns have been documented for a host of resources, including huckleberries, which supports the belief that some areas, such as parts of the Klamath region, have high levels of food insecurity (Norgaard 2014b). Tribal
members have described how diminishment of traditional tending practices has also disrupted the intergenerational transmission of knowledge and allowed the land to become feral and inhospitable “wilderness” (Anderson 2005).

How has the Diminishment of American Indian Influence Affected Resources and Ecosystems?

Understanding historical tribal uses and reliance upon ecosystems is important for restoring both those ecological values and the resulting biophysical and cultural ecological services to American Indians today. Restoring ecosystems and promotion of resilience will depend upon reestablishing or emulating historical disturbance regimes (see Chapter 3) that have shaped ecosystems, including American Indian management practices such as harvesting and burning (Anderson and Barbour 2003, Wray and Anderson 2003). These practices likely had a myriad of influences, many of which may not be well studied or understood due to complex, coupled human-ecological system dynamics. However, research suggests the following were likely to be common effects on forests:

- Increasing habitat and abundance for species of high cultural-use value. Many of these species are associated with early-successional and wetland habitats, including meadows, riparian areas, and forest gaps. Examples of those highly desired species include numerous tree and shrubs species that produce edible nuts, geophytes that produce edible roots, fungi that produce edible mushrooms, and grasses that produce nutritious seeds (Shebitz et al. 2009, Turner and Cocksedge 2001, Turner et al. 2011).

- Increasing the frequency and extent of low-intensity fire (Hessburg et al. 2015, Perry et al. 2011), particularly in locations close to settlements, along trade and travel routes, and important gathering and hunting areas, which were often along edges between forests and grasslands or wetlands. The maintenance of trails and forest gaps would likely have promoted heterogeneity at multiple scales (Lake 2013, Storm and Shebitz 2006, Turner et al. 2011).

American Indian influences likely had cascading effects on ecosystem dynamics that may have benefited their communities yet be difficult to quantify. Hypothesized outcomes of such influences include:

- Increasing the longevity of trees, such as black oaks, that were tended with fire and other practices to maintain acorn production (Long et al. 2016).

- Lowering summer stream temperatures as a result of shading by smoke from cultural burning (Lake and Long 2014).
Below we highlight a few of the vegetation communities where American Indian influences appear to have been especially pronounced and important for sustaining tribal ecocultural resources.

**Gaps in the forest—**

American Indians burned areas within forests of the NWFP area to maintain early-successional, graminoid and/or shrub-dominated habitats that Lewis and Ferguson (1988) described as linear “corridors”, especially along streams, trails, and ridges, and areal “yards”. Such fire-maintained yards and corridors were particularly important for promoting growth of berries, camas, and brackenfern (*Pteridium aquilinum*), as well as forage for deer and elk (Huntsinger and McCaffrey 1995, Lepofsky and Lertzman 2008, Lewis and Ferguson 1988, Norton 1979). A description of practices by the Tolowa, Yurok, Karuk, Tututni, and Wiyot within redwood-dominated forests in Northern California and Southern Oregon indicated that forest clearings were small, with the largest only 0.25 miles (0.4 km) wide, and located in resource-poor parts of the landscape (Lewis and Ferguson 1988). Similarly, the abstract for Wills and Stuart (1994) summarized pre-EuroAmerican settlement conditions Douglas-fir dominated stands in the Klamath National Forest as “exceptionally patchy containing complex mosaics of different age and size.” This patch configuration was actively maintained through frequent fire, with one forest surveyor describing the entire Klamath River reservation, which belonged to the Yurok Tribe, as “over-run by fire” in 1912, when the federal government authorized rewards for stopping “incendiariists” responsible for setting those fires (Huntsinger and McCaffrey 1995). The ensuing era of fire suppression has shifted frequent low severity regimes toward infrequent high severity regimes that may include larger patches of high-severity fire, and resulting forest gaps, than occurred historically in some areas (see Chapter 3).

**Grasslands, meadows and wetlands—**

A variety of non-forest communities that are dependent on fire to persist are important to sustaining tribal ecocultural resources. Even regions dominated by wet forests with an infrequent, high-severity fire regime had areas that were burned by American Indians more frequently than what occurs today, such as bog, prairies, and balds on the Olympic Peninsula, western Oregon coast range, and Northwestern California (Anderson 2009, Underwood et al. 2003, Wray and Anderson 2003). Several plants that occur in wetlands in the area have long been valued by tribes and maintained with fire (Anderson 2009). Grasslands and meadows have been declining across the northwest forest region due to reduction of aboriginal burning, changing climate, and other factors (Zald 2009). Evidence such as a lack of biological legacies (i.e., large woody debris, stumps, snags, and remnant trees), dominance by graminoids rather than shrubs, and presence of disjunct and endemic plant species suggests that many of these communities were persistent rather than more ephemeral, early-successional stages (Zald 2009). Their biological
diversity includes unique flora and fauna, including a variety of butterflies. They also support large ungulates of special importance to tribes for hunting, including elk (*Cervus elaphus*) and deer (*Odocoileus* spp.) (Wray and Anderson 2003). Similarly, mountain meadows among conifer-dominated forests are distinctive habitats that offer a range of tribally valued resources (Turner et al. 2011, Zald 2009). Many meadows, and the associated plant species, are dependent on fire to reduce tree and shrub encroachment, to facilitate reproduction and vegetative persistence, and to maintain hydrologic and nutrient cycling. Tribes regularly burned meadows to deter conifer encroachment and maintain the abundance and desired qualities of culturally important species including various berries (*Vaccinium* spp.) and beargrass for traditional food and basketry uses (Turner et al. 2011). The steep reduction in burning has encouraged tree encroachment and accelerated declines in grassland habitats (Zald 2009). Such impacts have converged with development of many accessible prairie habitats with great impact on the availability of valued resources and the socioecological integrity of those places (Breslow 2014).

**Oak woodlands**

A variety of oak communities also likely reflect long-term caretaking by American Indians to cultivate important resources, including California black oak (Long et al. 2016), Oregon white oak (Lepofsky and Lertzman 2008), and tanoak (Bowcutt 2013). Traditional activities include frequent use of low-intensity fire to maintain production of nuts and desired understory species (Huntsinger and McCaffrey 1995, Long et al. 2016). Many of these oak woodland areas, which have long been close to human settlements, have been reduced and degraded in the Pacific Northwest by land development and conifer encroachment (Hosten et al. 2012), in addition to a lack of tending and burning by American Indians.

**Conflicting science**

While research has demonstrated many influences of Native peoples on ecosystems through both ecological and anthropological approaches, there remain debates over the extent of those influences. In particular, there are questions regarding how much human influence altered systems and how far beyond village sites and major trails those influences were expressed (Lake 2013). Lepofsky and Lertzman (2008) discuss the extensive evidence for effects of burning and other practices to modify vegetation within small patches. They note that teasing out signs of human influence within larger landscapes is difficult and depends upon multiple lines of evidence. Synthesizing available science regarding tribal uses and influences is especially challenging because much of the past research relied upon single-disciplinary approaches in ecology or ethnography. Some studies have focused on ecological aspects of disturbance.
Peer Review Draft 10/19/16 “THIS INFORMATION IS DISTRIBUTED SOLELY FOR THE PURPOSE OF PRE-DISSEMINATION PEER REVIEW UNDER APPLICABLE INFORMATION QUALITY GUIDELINES. IT HAS NOT BEEN FORMALLY DISSEMINATED BY [THE AGENCY]. IT DOES NOT REPRESENT AND SHOULD NOT BE CONSTRUED TO REPRESENT ANY AGENCY DETERMINATION OR POLICY.”

regimes without considering the long-standing influences of American Indians on ecosystems, habitats, and species or subsumed such influences as part of the natural regime. For example, Halofsky et al. (2011) described mixed severity fire regimes without discussing American Indian influence. Meanwhile, Perry et al. (2011) noted that American Indian burning likely shifted mixed-severity fire regimes to more frequent, low-severity fire regimes in, “areas with high densities of American Indians,” citing specific studies from northern California and the Umpqua National Forest. Different methods employed by various disciplines, which may or may not include tribal perspectives or information, may lead to findings that appear inconsistent or conflicting.

Many sampling methodologies lack the resolution to recognize or distinguish human influence on fire regimes (Conedera et al. 2009). However, more interdisciplinary and collaborative approaches may lead to greater consilience, or at least agreement about where indigenous influences were most profound and where current conditions have deviated most sharply from conditions prior to EuroAmerican settlement (Crawford et al. 2015, Lightfoot et al. 2013). Through such efforts, there has been significant progress in understanding historical ecology in areas such as the Willamette Valley. There researchers have found that American Indian influence on fire was key in specific areas associated with American Indian habitation and availability of key resources such as oaks, berries, and camas (Walsh et al. 2010). In general, such areas are likely to be those where American Indian occupation and use were greatest, including former tribal villages, camps at lake or meadow sites, and trails, all of which may be indicated by archaeological evidence (Lake 2007, Lake 2013). Engaging tribes in these research efforts is important for helping to understand historical cultural influences on ecosystems (Lepofsky and Lertzman 2008).

What Strategies Can Promote Tribal Ecocultural Resources and Effectively Engage Tribes in Forest Planning and Management?

Tribal-federal relationships

During the initial development of the Northwest Forest Plan, many tribes did not contribute directly to the preparation of the alternatives, and the Bureau of Indian Affairs (BIA) represented tribal interests to the USDA Forest Service. Since passage of the Tribal Self-Governance Act of 1994, tribal governments have been able to assume control over many of the responsibilities previously overseen by the BIA, including many forestry, wildlife, and other natural resource programs. Consequently, now tribes are actively engaged in influencing and improving U.S. Forest Service and tribal government relations (Vinyeta and
Lynn 2015). Self-governing tribes are actively participating in research and management to support collaborative landscape restoration efforts. Significant progress has been made in developing institutional platforms to address sensitive issues regarding resource and management on federal lands (Jurney and Hoagland 2015). Donoghue et al. (2010) characterized different types of tribal-federal collaborative agreements, ranging from less formal working agreements to mutually dependent co-management in which tribes can participate in management decisions.

Consultation—

Federal-tribal consultation, coordination, and collaboration on land and resource management has evolved considerably as the political, economic, and sociocultural capacity of tribes has increased in recent decades (Breslow 2014). This evolution reflects increased emphasis on tribal engagement in federal policies (Vinyeta and Lynn 2015). Despite such changes, in some cases tribes have criticized federal attempts at consultation as little more than notification of a planned federal action (Harris 2011, Vinyeta and Lynn 2015). Both the 15- and 20-year Northwest Forest Plan federal-tribal monitoring reports illustrate the importance of mechanisms such as memorandums of understanding (MOUs) and memorandums of agreement (MOAs) to formalize consultation protocols and strengthen government-to-government relationships. For example, the National Park Service via Olympic National Park and eight Olympic Peninsula tribes signed a memorandum of understanding in July 2008 to help build a collaborative relationship (Harris 2011). The 20-year report (Vinyeta and Lynn 2015) describes successes and examples of MOUs and MOAs in fostering improved federal-tribal collaboration and government-to-government interactions. They found that such agreements clarify expectations and result in greater accountability in consultations by specifying how often federal-tribal meetings would occur, and who is to be involved in the meetings. They also found that such agreements provide opportunities for greater tribal participation in agency planning and decisions. Drawing on interviews with 27 tribal natural resources staff from within the NWFP boundary, they found that consultation is more effective when it includes formal protocols that are individualized to each tribe’s unique needs, laws, practices, policies and responsibilities to membership. That report provides additional recommendations for strengthening consultation, addressing tribal rights and access to cultural resources, and improving the compatibility of federal and tribal approaches to forest management, including the development of protocols for projects that involve traditional knowledge.
Collaborative partnerships—

National Forest planning has increasingly emphasized collaborative approaches, and scientists have emphasized the value of participatory approaches throughout the life of projects, including research, monitoring, planning, implementation, maintenance, and review (Charnley et al. 2014). These trends generally complement tribal interests, while recognizing that tribes have a unique relationship with federal land management agencies because of their sovereign legal status and historical relationships. Intentions to promote collaborative relationships between federal agencies and communities that have been historically marginalized, such as many tribes, need to consider legacies of mistrust and inequity (Cronin and Ostergren 2007). Encouraging tribal participation in the full life cycle of projects may facilitate cooperation, trust, knowledge reciprocity, and accountability. Facilitating development and retention of staff with good understandings of tribal relations may be important, because staff turnover is commonly cited as an obstacle for encouraging vibrant partnerships (Bussey et al. 2016, Vinyeta and Lynn 2015).

Tribes have not only expanded efforts to influence ecosystem conditions within their ancestral territories, but also beyond their immediate jurisdiction, through a variety of formal partnerships to address climate change, to include watershed and fisheries restoration, hazardous fuels reduction/forest thinning, and landscape forest restoration (Senos et al. 2006). Federal policies, authorities and directives, including the National Fire Plan (2000), Tribal Forest Protection Act (2004), Healthy Forest Restoration Act (2005), and Federal Land Assistance, Management and Enhancement (FLAME) Act (2010), have encouraged tribal participation in USDA Forest Service land management activities. Concurrently, several notable community-based efforts, such as watershed and fire safe councils in northern California and southern Oregon (Senos et al. 2006), and nongovernmental organizational programs (e.g., The Natural Conservancy’s Fire Learning Network), have supported tribal participation in restoration- and conservation-based efforts in the Pacific Northwest. Many of these efforts started as habitat or species-specific projects but grew into larger collaborative restoration partnerships with tribes as co-leaders (Cronin and Ostergren 2007). Some collaborative efforts have guided management and policy based upon tribal traditional knowledge and Western science (see “Coquille Indian Tribe” on page XX). Another example is the Tapash Sustainable Forest Collaborative, in which the Yakama Nation has collaborated with the Okanogan-Wenatchee National Forest, Washington Department of Natural Resources, Washington Department of Fish and Wildlife and the Nature Conservancy. The collaborative has undertaken a variety of restoration projects across 1.6 million acres (647 000 ha) of forest lands under fragmented ownership (including tribal lands) in central Washington (Schultz et al. 2012).
Sidebar: Coquille Indian Tribe

The Coquille Indian Tribe has reacquired forest lands that were originally reserved for them and other tribes in an 1855 treaty that was never ratified. Following termination in 1954 and re-recognition in 1989, the tribe sought the return of its ancestral lands. They received 5,400 acres (2,185 ha) of forest from 14 parcels of Bureau of Land Management (BLM) lands, which were placed into trust status in 1989, with the requirement that the lands meet the standards and guidelines of adjacent federal forests under the Northwest Forest Plan. The tribe (fig. 19) has adopted a forest management plan that reflects traditional-ecological-knowledge values including the protection of large trees, snags, and nesting sites of culturally important birds, and management practices that regenerate habitat for culturally significant wildlife following timber harvest (Vinyeta and Lynn 2013). The tribe proposed to extend approaches applied on its tribal lands through its Coos Bay Wagon Road Lands proposal, a collaborative effort with the BLM that involved incorporating silvicultural principles recommended by professors Jerry Franklin at the University of Washington and Norm Johnson at Oregon State University (Franklin and Johnson 2012). For this coastal wet-forest environment, the proposed plan included provisions for new riparian management approaches; harvesting biofuels; retention of biological legacies such as large trees, coarse woody debris, and snags; variable-density thinning; long rotations; and regeneration harvest to maintain early-successional conditions (USDOI BLM).

Figure 19—Coquille tribal members at Euphoria Ridge near North Bend, Oregon, spring 2003. Chief Don Ivy (left, with hat) addresses the group on a field trip to discuss tribal forest management and restoration strategies. Photo credit: Frank K. Lake.
Traditional ecological knowledge in collaborations—

Collaboration on projects involving traditional ecological knowledge or native knowledge provide unique opportunities to enhance research and management, while also posing unique challenges for tribes and tribal-knowledge holders. There are many examples where tribes and their members have seen benefits from working with researchers and land managers to inform restoration with traditional ecological knowledge, including burning to promote beargrass (Shebitz 2005). However, it is important to recognize that tribes may also have strong interests and capacities in conventional Western science, which has been critical in protecting vital resources such as salmon (Breslow 2014). Federal agencies can ensure that collaboration with tribes provides reciprocal benefits to all parties, minimizes risks to tribes, and recognizes the inherent rights and responsibilities of tribes towards their lands and peoples by adopting “cause-no-harm” and “free-prior-and-informed-consent” frameworks (Norgaard 2014b, Vinyeta and Lynn 2013). In particular, tribes have suggested that agencies pursue collaborations that facilitate tribal application of traditional ecological knowledge to off-reservation lands within the respective tribes’ ancestral territories without seeking to transfer or relinquish such knowledge (Norgaard 2014b). Many tribes have concerns that sharing details regarding cultural knowledge might be coopted or misused if shared with non-tribal entities. One safeguard is to protect sacred, sensitive or confidential information such as the locations of particular sacred sites, or specialized uses of fungi, plant, and animal species. Another approach is to establish stewardship agreements or compacts in which tribes can apply traditional ecological knowledge and applicable cultural practices on federal lands.

Collaborative management and co-management—

One pathway for ensuring that tribal sovereignty and culture are respected in agency policies and management is through collaborative management of off-reservation lands and resources. “Co-management” is a term applied to varying degrees of tribal and federal influence on land management in an area (Nie 2008), but a recent definition adopted by the U.S. Fish and Wildlife Service (see Glossary) requires each entity to have legally established management responsibilities. Some laws, including the Indian Self-Determination and Education Assistance Act (1975), allow for certain federal agencies to delegate management responsibilities to a tribe. Treaties that reserve the right to manage or control access to natural resources also constitute a legal authority for co-management (Goodman 2000). That strong legal basis and a focus on key resources such as salmon have been important factors in making some co-management initiatives successful in the Pacific Northwest (Kellert et al. 2000).
Collaborative efforts have posed a challenge for Forest Service personnel in reconciling the tension between creating expectations that collaborators will have say in management decisions while retaining responsibility for those decisions, as well as in negotiating procedural requirements associated with advisory groups (Butler 2013). In Canada, and especially in British Columbia, there have been examples of devolving some management authority over public lands to local communities under the umbrella of “community forestry”, and many of those involved co-management with indigenous communities (Charnley and Poe 2007, McCarthy 2006). In the United States, some environmental groups have resisted community forestry initiatives over concerns that such efforts would favor local timber industries and undermine environmental protections and limit public input (McCarthy 2006).

Proposals for co-management between the Forest Service and tribes have had to address legal requirements for federal agencies to have final decision-making power over federal lands (Nie 2008). However, the government-to-government relationship, as well as numerous policies in the U.S, provides a distinctive legal basis for consultation and collaboration with tribes that recognizes the long-standing relationships between tribes and their ancestral lands. In accordance with those policies, the Forest Service has entered into landmark agreements that embody important principles of collaborative management and have recognized the unique stewardship role of tribes on their ancestral lands. In the late 1990s, the Lake Tahoe Basin Management Unit established various agreements with and issued special use permits to the Washoe Tribe to address tribal interests in managing ancestral lands at Lake Tahoe (Adelzadeh 2006). Another example was the Maidu Stewardship Pilot Project, in which the Plumas National Forest awarded a 10-year stewardship contract to the Maidu Culture and Development Group, a native nonprofit dedicated to strengthening Maidu culture and people, to apply traditional land management practices to 2,100 acres (850 ha) of national forest land (Donoghue et al. 2010). The Santa Rosa and San Jacinto Mountains National Monument Act of 2000 stipulated that the U.S. Secretaries of Interior and Agriculture, "shall make a special effort to consult with representatives of the Agua Caliente Band of Cahuilla Indians regarding the management plan during the preparation and implementation of the plan" and authorized the use of “cooperative agreements and shared management arrangements with any person, including the Agua Caliente Band of Cahuilla Indians, for the purposes of management, interpretation, and research and education regarding the resources of the National Monument" (114 Stat. 1362 Public law 106-351). The Tribal Forest Protection Act of 2004 advanced such distinctive efforts by authorizing the U.S. Secretaries of Agriculture and the Interior to give special consideration to tribally proposed stewardship contracts, agreements, compacts or other arrangements on Forest Service or BLM land bordering or adjacent to Indian trust land to protect the Indian trust resources from fire, disease, or other threats.
Promoting multi-scale temporal and spatial diversity in terrestrial habitats

From stand to landscape scales, maintaining a diversity of plant communities that support tribal ecocultural resources is important for increasing resilience to wildfire, drought, pathogens, and insect pests (Churchill et al. 2013, Kauffman and Jules 2006). Efforts to promote heterogeneity within stands and across larger landscapes are likely to promote ecological diversity (see Chapters 3 and 12). Multi-scale diversity is also important for maintaining the diversity and quality of resources needed to maintain traditional tribal livelihoods and lifeways in a modern context (Lake 2013, Turner and Cocksedge 2001, Turner et al. 2011, Underwood et al. 2003). Traditional tribal burning practices that maintained non-forested habitats in both areal and linear arrangements were important for promoting diversity at different scales (Lewis 1982, Underwood et al. 2003). Thomas et al. (2006) recognized the importance of maintaining all structural stages across the landscapes of the NWFP area.

Promoting tribal adaptive capacity—

Forest planning presents opportunities to support the continuity of traditional ecological knowledge (also referred to as “native knowledge”, see Glossary) among generations by maintaining culturally valued resources. In turn, tribal knowledge of historical and current ecological processes (Colombi and Smith 2012), and the seasonality of natural patterns can help predict and prepare for future changes in habitats and species’ distributions. The edges between different ecological communities, at both broad and fine scales, have long been important to tribes because they afforded opportunities to harvest diverse resources. Tribal management often accentuated transitional habitats, such as the edges between forest and non-forest habitats (Turner et al. 2003). For example, tribal burning practices purposefully increased the frequency and seasonality of fire to maintain early seral and more open forest environments (Anderson and Barbour 2003). Because reducing the accumulation of forest fuels can moderate the effects of stand-replacing disturbances (Stevens et al. 2014), such practices can enhance the resilience of social and ecological systems.

Maintaining cultural keystone species such as salmon is another critical strategy for maintaining adaptive capacity (Colombi 2012). Safeguarding cultural keystone places is another important strategy for maintaining cultural memory and practices and allowing for renewal of cultural, ecological, and socioeconomic processes (Cuerrier et al. 2015). Tribes also have relied on intertribal networks that facilitate exchange of resources, cultural practices, and knowledge systems as a source of adaptive capacity (Papiez 2009). Historical socioeconomic networks among tribes remain relevant to understanding how to sustain resilience among tribal communities today (Trosper 2003, Turner and...
Cocksedge 2001). Many tribes across the region come together in summits, ceremonies, conferences, and workshops as ecocultural revitalization and support networks (Tveskov 2007).

Restoring fire—

A key principle for restoring landscapes in the NWFP area is the reestablishment of fire regimes in fire-adapted forest types through prescribed burning and management of lightning-ignited fires for beneficial resource objectives (Odion and Sarr 2007, Ryan et al. 2013) (see Chapter 3. This approach reflects the strategy of managing or emulating “natural” disturbance regimes (North and Keeton 2008, Odion and Sarr 2007). These efforts may encompass a diversity of outcomes, but frequent, low-severity burns are particularly important in many areas for maintaining understory diversity without damaging large and old trees (Perry et al. 2011). Maintaining old-growth forest is important for sustaining tribal ecocultural resources (Yazzie 2007). Understanding the spatial and temporal responses of vegetation following fires of different severities can help to predict which tribally valued resources will occur at specific places on the landscape over time (Lake 2013).

Intensive management practices, such as tending of stands with large oaks or tanoaks, or maintaining gaps for beargrass and huckleberries, are important for perpetuating resources at levels that facilitate tribal use (Hummel et al. 2015, Long et al. 2016, Minore and Dubrasich 1978). Such treatments often require more frequent applications of fire than would be expected through lightning-ignitions alone; consequently, they may depend on intentional burning (Turner et al. 2011) (see Sidebar below).

Burning to promote early-successional patches and non-forest communities—

The reapplication of fire is consequently an important practice to sustain tribal ecocultural resources but has sometimes faced resistance due to concerns for sensitive species. An example is the Makah copper butterfly (Lycaena mariposa charlottensis), which feeds on native cranberries that grow in bogs during its larval stage. However, a report by the Washington Department of Fish and Wildlife (Larsen et al. 1995) on various butterflies suggests that burning for the Makah copper may be appropriate to reduce conifer encroachment. That report also suggests burning to promote habitat for the Puget blue butterfly, which depends on lupines (Lupinus spp.) in forest gaps and lowland prairies and whose range has constricted considerably due to loss of those habitats.

A well-distributed arrangement of early successional plant communities may promote tribal ecocultural resources (Rogers-Martinez 1992), especially if they are often adjacent to mature or old-growth patches (Swanson et al. 2011). Although large high-severity burns can create such habitats, application of managed fire for resource benefit may increase the likelihood of achieving high diversity with proximity to late-successional conditions. While large stand-replacing disturbances can have
beneficial effects on some components of biodiversity (fig. 20), they can also reduce the flows of
important ecosystem services associated with mature forests, such as nuts, and they can also threaten
downstream aquatic resources in addition to life and property. Efforts to maintain and restore tribal
ecocultural resources will depend upon understanding what frequencies, seasonality, and severity of fire
is desired within particular vegetation or habitat types to produce an optimal range of resources and
ecosystem services (Storm and Shebitz 2006). In general, strategies that help restore low-severity fire
regimes are likely to promote valued resources and opportunities for ecocultural revitalization.

Figure 20—Ron Reed harvesting gooseberries (Ribes sp.) in 2011, 3 years after the 2008 Siskiyou
Wildfire on the Klamath National Forest. Photo credit: Frank K. Lake.
Sidebar: Examples of Cooperative Burning

Where tribes traditionally used fires to manage landscapes in the NWFP area, implementing fuels reduction treatments in concert with reinstatement of traditional burning will depend upon consultation, planning, and coordination with tribes. The Olympic National Forest began working with the Skokomish Indian Tribe and others to restore beargrass and other native species using thinning and burning at 3 to 5 year internals (Shebitz et al. 2009). In 2006, the Quinault Indian Nation performed its own burn modeled after this project (Charnley et al. 2008b). Many tribes desire a more active role in the implementation of cultural prescribed burns, rather than delegating this stewardship responsibility to the federal agencies and non-tribal organizations (Eriksen and Hankins 2014). A memorandum of understanding between U.S. Forest Service Region 5 and The Nature Conservancy was established to facilitate burning across public and private boundaries to achieve goals of the National Cohesive Wildland Fire Management Strategy (Harling 2015). In support of that effort, a Klamath River Training Exchange burn was organized in 2014, in which Karuk and Yurok tribal members and employees ignited traditional burns to reduce hazardous fuels along an important road in the wildland urban interface, increase tribal access to traditional food resources (e.g., acorns), and support research treatments; however, the project was limited to private and tribal lands rather than including Forest Service lands due to a ban on burning (Harling 2015). Other projects have continued in the area (fig. 21), representing applications of traditional burning in a contemporary context to achieve multiple resource objectives.
Figure 21—Klamath River Training Exchange prescribed burn on a privately owned area for experimental research and tribal gathering near Orleans, California, October 2015. Yurok and Karuk Tribal members ignite an area under tanoak trees that had previously been treated (manually thinned in 2011, pile burned in 2012, and prescribed burned in Spring 2013) to reduce hazardous fuels and improve acorn accessibility and quality (by reducing pests). Photo credit: Frank K. Lake.

Cross-jurisdiction fire management—

As individual national forest plans are revised, concurrent with plans by communities (e.g., community wildlife protection plans) and tribes (e.g., integrated land resource management plans), provide new opportunities for cross-jurisdiction collaborations among federal agencies, communities, and tribes, including landscape-level strategic planning and implementation of restoration treatments that adapt traditional fire use in a modern context to achieve multiple objectives. Fire management policy is allowing land managers to pursue more flexible approaches to use fire for resource benefit through
managed natural ignitions and prescribed fire including cultural burns. Across the NWFP area, fire safe
councils have been developing community wildfire protection plans and participating in national
programs such as the Fire Wise and Fire Adapted Communities programs. Many tribes have used this fire
response and management development among community-based or nongovernmental organizations to
increase their partnership opportunities with fire stewardship (see sidebar on Western Klamath
Restoration Partnership).

Sidebar: Western Klamath Restoration Partnership

Within portions of the Six Rivers and Klamath National Forests in northern California, the
Orleans-Somes Bar Fire Safe Council, the Karuk Indigenous Basketweavers Association, and the Karuk Tribe initially partnered to integrate tribal knowledge with hazardous fuels reduction and prescribed fire
treatments on private and tribal lands. Building upon this effort, the Western Klamath Restoration Partnership seeks to align and implement landscape restoration strategies (Hessburg et al. 2015) that address climate change vulnerabilities to the environment and human communities, while integrating key components of the National Cohesive Wildland Fire Management Strategy (NCWFMS). The goal is to confront the impacts of climate change, increase the pace and scale of landscape restoration while effectively implementing the NCWFMS within a coupled human-natural systems framework. This framework includes an interdisciplinary approach for identifying, classifying, planning, analyzing, and implementing restoration strategies that address the economic, socio-cultural and ecological components of sustainable resource management supporting tribal ecocultural revitalization efforts.

The Western Klamath Restoration Partnership is working to reduce fuel loading around homes and along critical emergency road routes, as well as enhance access to tribal basketry and food resources (Harling 2015, Senos et al. 2006). Recently, these organizations have collaborated prescribed fire projects that include tribal workforce training and promotion of tribal fire related landscape values. They have organized partnerships between tribes (Yurok and Karuk), tribal community groups (i.e., Indigenous Peoples Burning Network), The Nature Conservancy (Fire Learning Network and TREX), and federal and state agencies with the local fire safe/watershed councils to conduct hazardous fuels treatments and prescribed burns in and around several communities.
Many tribes harvest trees on their own lands and recognize the need for harvest as a means of promoting desired resources, as a complement to fire to create canopy gaps and shift fuel conditions that facilitate the return of a more natural fire regime (Healey et al. 2008). Naturally formed canopy gaps from tree mortality may create distinctive heterogeneity by forming pit and mound topography, broken tops and branches, and downed logs, all of which in turn may stimulate understory diversity (Pollock and Beechie 2014). Thinning and mowing treatments may be useful tools for restoring and maintaining habitats encroached by trees as a means of facilitating use of fire or as a surrogate where burning is not feasible. For more discussion of restoration silviculture, see Chapter 3. Many tribal silvicultural and related forest management approaches address socio-cultural, economic, and ecological values with integrated management plans (Gordon et al. 2013).

Use of herbicides—

Across the NWFP area, some national forests authorize and use herbicides for forest and resource management objectives. Many American Indians and tribes have registered concern over the use of herbicides to accelerate growth of planted conifers or to control invasive species because tribal gatherers are profoundly concerned about potential for exposure to environmental toxins (Huntsinger and McCaffrey 1995, Norgaard 2007, Segawa et al. 1997). These concerns are particularly strong for terrestrial and aquatic food resources and non-forest products such as basketry materials that are placed in people’s mouths. Herbicide use is just one example of current exposure- or risk-assessment methods that often do not fully address the vulnerabilities of tribes (Burger et al. 2008).

Replanting/reforestation—

Concerns over herbicides as well as alteration of successional pathways following fires are two reasons that tribes may have concern over extensive replanting efforts. In particular, tribes with interest in using early-successional shrub patches and oak stands may be concerned over conifer-centric planting proposals. Across many national forests of the study area, historical logging has replaced mature forests with plantations (Healey et al. 2008). Strategies for managing plantations have often focused on growth of commercial tree species, but strategies are increasingly directed toward promoting resilience to climate change, fire and pests, while concurrently providing valued ecosystem services, including wildlife habitat,
forest products, and tribal subsistence (Carey 2003, Charnley et al. 2007, Franklin and Johnson 2012). Chapter 3 discusses these strategies in more detail.

### Riparian management—

Promotion of tribal ecocultural resources within riparian areas may depend on periodic disturbance to maintain gaps and understory production. Especially in drier areas with more frequent fire regimes, disturbances such as managed fire and removal of trees may be important for restoring desired reference conditions. Streams in mid-successional forests often can be more productive than those in old-growth forests under certain circumstances (Reeves et al. 2006); therefore, active management may be important to sustain productivity of tribal ecocultural resources such as fish. On the other hand, researchers have suggested that removing trees from riparian areas might reduce suitability of associated streams for cold-water fishes (McClure et al. 2013). Reconciliation of these potential tradeoffs may ultimately depend on regional and even site-specific contexts, such as current temperature regimes, as discussed further in Chapter 7.

Some tribes have expressed concern that restrictions in riparian reserves, which were intended to protect those sensitive areas adjacent to streams (Naiman et al. 2000), might impede the ability of tribes to maintain traditional practices such as harvesting and burning. For example, members of the Karuk Tribe expressed concerns that the Aquatic Conservation Strategy of the NWFP might impose restrictions on cutting willows in riparian reserves (Charnley et al. 2008a). However, several projects have included cutting and burning willows in riparian zones along the Klamath River (Lake 2007). Nevertheless, management decisions that leave riparian areas untreated may create tensions with tribal interests in promoting canopy gaps to favor plant communities desired for gathering. For example, the Aquatic Conservation Strategy provides for “releasing young conifers from overtopping hardwoods,” yet in some contexts, restoration of desired conditions might depend upon release of hardwoods from overtopping conifers. For example, large oaks and pines growing on river terraces adjacent to historic village sites (Hosten et al. 2012) may be at risk of being overtopped by more shade-tolerant conifers.

### Aquatic systems management—

One of the most important management strategies to promote aquatic ecocultural resources is to restore hydrologic regime and formative processes through removal of dams, roads, and other barriers (see Chapter 7), as well as restoration of floodplain connectivity, degraded meadows and other riparian wetlands. Aquatic ecocultural resources of particular importance to tribes include anadromous fish
species such salmon, lamprey, and sturgeon with complex life stages that depend on diverse and interconnected habitats (Close et al. 2002, Miller 2012, Wang and Schaller 2015). Free-flowing stream networks from forested headwaters are also important for supplying driftwood to tribal riverine and coastal communities (Lepofsky et al. 2003). Recovery of tribally valued fish and wildlife species likely depends upon restoration of hydrologic regimes and physical habitats through removal of dams, restoration of degraded meadows, removal or relocation of roads and levees, and other actions to restore the eco-hydrological system through more natural flows of water, sediment, wood, and organisms (Beechie et al. 2013, Nehlsen et al. 1991). Studies have suggested that such active measures will be needed to ameliorate the predicted effects of climate change (Wade et al. 2013). In particular, enhancing connectivity is important for increasing the potential for wildfire to benefit rather than negatively impact fish populations (Falke et al. 2014, Flitcroft et al. 2016), as discussed in Chapter 7.

Dam removal—

Dam removal is increasingly recognized as a method for habitat restoration, especially as many aging dams require expensive modifications. In the last decade, several major dams have been intentionally breached within the NWFP area, notably the Elwha and Glines Canyon Dams in the ancestral lands of the Lower Elwha Klallam Tribe on the Olympic Peninsula (Pess et al. 2008), and the Condit Dam on the White Salmon River. More removals are anticipated, with the 2016 Klamath Power and Facilities Agreement (KPFA) set to remove four dams on the Klamath River. Such efforts may affect national forest lands and tribal ecocultural resources, and they may increase the importance of upstream watershed conditions as more stream habitats are reopened to migratory fish (Pess et al. 2008). Due to the diverse range of watersheds and recent nature of dam removal, scientists have been actively researching how to predict the benefits and possible impacts of dam removal in particular contexts (Poff and Hart 2002). Because existing studies of dam removal have been largely short term, the long-term benefits and impacts of dam removal are not well understood (Hart et al. 2002).

Existing research points to a variety of anticipated benefits for migratory fish and associated mollusks; however, dam removals can also release accumulated sediments, nutrients, toxics, and other pollutants (Pess et al. 2008, Poff and Hart 2002, Stanley and Doyle 2003), which can temporarily disrupt downstream habitats of sensitive organisms such as mussels. An additional concern is the potential spread of invasive species upstream (Hart et al. 2002). Therefore, while dam removal is expected to be critically important in restoring aquatic organisms of special significance, it is important to consider its potential for both beneficial and harmful effects. Nevertheless, dam removal may provide critical opportunities for integrated restoration of tribally valued riparian plants such as willows, berry plants (e.g., Rubus...
parviflorus) (Michel et al. 2011), and birds (Gelarden and McLaughlin 2013). As one example of a potential strategy to accompany dam removal, McLaughlin (2013) recommended maintaining or increasing large woody debris to encourage seed distribution by birds.

**Road management—**

Roads can impair aquatic resources by increasing erosion and creating barriers to movement as discussed in Chapter 7. Tribes have successfully sued the State of Washington to demand remediation of culvert impacts on fish passage to support their treaty rights to fish (Breslow 2014). This lawsuit demonstrates the importance of road management on tribal ecocultural resources. Tribes have partnered with U.S. Forest Service national forests and Bureau of Land Management districts and researchers to implement road decommissioning to restore habitat for native salmonids (Burnson and Chapman 2000). One study that involved the Nez Perce Tribe found that road re-contouring, rather than passive recovery following road abandonment, accelerated recovery of ecological and hydrological properties, including carbon storage (Lloyd et al. 2013).

While roads can exact a toll on aquatic resources, aesthetics, and other values, they also provide access for tending forests, managing fire, hunting, fishing, gathering, and other activities that are important to tribes. Tribes have emphasized their interests in both access and watershed management (Vinyeta and Lynn 2015), so consultation is particularly important when making plans regarding roads. In particular, tribal members have noted that a lack of road maintenance and road closures can limit access to desired resources; in addition, many elders rely upon vehicles for traditional activities so contemporary intergenerational transmission of knowledge also depends on roads (Dobkins et al. 2016).

**Access to forest products—**

Conflicts with nontimber forest product gatherers from non-tribal communities is another important concern. In an important precedent, the Gifford Pinchot National Forest designated a long-standing berry-harvesting area for exclusive use by American Indians under its forest management plan (see Sidebar on Handshake Agreement). Efforts to not only increase supplies of valued resources, but also to regulate access through seasonal area closures that do not restrict access and harvest to tribes, may both be important to consider in managing limited supplies of desired forest resources. The U.S. Forest Service’s National Tribal Relations Program Task Force recommend a variety of measures to improve tribal management of lands under federal care, including providing the Forest Service with the authority to close federal lands to the public for tribal traditional uses (Nie 2008). Numerous examples suggest that
successful resolution of conflicts over access depends upon a strong and proactive working relationship between land managers and tribes that recognizes their unique status (Catton 2016).

Sidebar: Forest Service-Yakama Nation Handshake Agreement to Access Huckleberries

An important historical instance of federal-tribal collaboration is the 1932 Handshake Agreement between the Yakama Nation and the U.S. Forest Service. In response to growing pressure on huckleberries from the unemployed migrant workers during the Great Depression, J.R Burkhardt, then Gifford Pinchot National Forest Supervisor, met with tribal representatives and agreed to reserve 2,800 acres (1,130 ha) of off-reservation huckleberry patches for exclusive use by the Yakama Nation during huckleberry season (Richards and Alexander 2006) (fig. 22). This agreement has been honored since, although it was only put into writing as recently as 1990, prior to the adoption of the NWFP (Fisher 1997, Richards and Alexander 2006). This case set an important precedent for upholding the federal trust responsibility and the rights of the Yakama Nation to gather in their “usual and accustomed” areas.

Figure 22—Handshake Agreement sign in Indian Heaven Wilderness, Gifford Pinchot National Forest, Washington, August 2012. Photo credit: Leslie Seaton.
Sustaining timber harvest and mill capacity—

Tribes with interest in harvesting timber from their lands, such as the Quinault Indian Nation, have expressed concern that cutbacks in harvest on federal lands have caused declines in mill capacity and other resources needed to allow them to manage and receive income from their working forestlands, as well as to protect their homelands from hazardous buildup of fuels (Vinyeta and Lynn 2015). In some areas, such as the mid-Klamath region, some of the void associated with declines in the timber industry have been partially filled by tribal leadership promoting economic development (Charnley et al. 2008a). These issues demonstrate how federal forest management can influence tribal economies, as well as opportunities for federal-tribal partnerships to promote mutual interests (Alvarado et al. 2011). For example, the Yakama Nation’s milling facility has processed logs resulting from the Tapash Sustainable Forest Collaborative forest restoration project.

Adaptive management—

Researchers have recommended greater use of adaptive management frameworks as a way to better understand the complex responses of socioecological systems to management strategies (Franklin and Johnson 2012, Gray 2000). The NWFP called for using Adaptive Management Areas (AMAs) to allow land managers the flexibility to try new and innovative management strategies and treatment practices as experiments to reduce uncertainty of subsequent management actions (Bormann et al. 2007, McClure et al. 2013). Many tribal practitioners believed that such approaches shared a common perspective with traditional tribal practices (Catton 2016). Some of the AMAs explicitly involved tribes. For example, land managers of the Northern Coast Range Adaptive Management Area established agreements with the Confederated Tribes of the Grande Ronde to facilitate cohesive management of a watershed that included 10,900 acres (4 400 ha) of federal land (Gray 2000). However, many of the bureaucratic challenges that appear to have limited implementation of adaptive management, including limited staff and funds, cumbersome environmental reviews, and institutional momentum (Gray 2000), have frustrated tribal partnerships as well (Catton 2016). The challenges in making formal adaptive management projects successful have encouraged less formal approaches that emphasize observation, communication, and formal review of ecological changes and adaptation actions (Peterson et al. 2011).
Special designations—

Federal lands may receive a variety of special designations, such as experimental forests, research natural areas, wild and scenic rivers, and wilderness areas. Sites that are likely to be recommended for special designations based upon distinctive qualities and limited degradation are also likely to be significant to tribes. In particular, areas that are a high priority for biological conservation (Staus et al. 2010) are likely to be highly productive and overlap sacred areas (Turner et al. 2011). Consequently, proposals for special land management designations, including reserves, have potential to affect tribal access to important resources and culturally important places. Past efforts to impose designations such a wilderness areas without tribal support have been a source of much consternation in the past (Catton 2016), and concerns persist among tribal communities that special designations for conservation purposes may limit their access and use (Baldy 2013, Nie 2008, Papiez 2009). Other special designations, including adaptive management areas, may provide opportunities for tribes to implement a variety of treatments that promote desired conditions (Stein et al. 2013) and advance larger landscape restoration strategies (Berkes 2009).

An alternative designation of “community forests”, managed for the benefit of particular communities, has been common in Canada and other countries, and there are many recent examples of community forests established by tribes through acquisition of private lands; however, that designation has generally not been adopted for federal forests in the United States (Charnley and Poe 2007, McCarthy 2006).

Another alternative includes designation of contemporary tribal use areas and tribal stewardship areas. Several national forests have designated landscape areas as tribal heritage districts, zones or areas. These areas have a documented history of tribal uses and are conceptually similar to traditional cultural properties designated under the authority of the National Historic Preservation Act of 1966. Such tribal landscape area designations are linked to federal policies that facilitate consultation and coordination for heritage management (Wang et al. 2002). Agreements can provide guidance for permissible management actions; protection of heritage or cultural resources; and access to, and foster contemporary tribal use of, areas or resources for traditional and cultural purposes (Lake and Long 2014). A unique example is the Quinault Special Management Area, a 5,460 acre (2,210 ha) area of forestland managed by the U.S. Forest Service. The tribe has a right to 45 percent of the revenue generated in this special area (Vinyeta and Lynn 2015). Another example is the Katimiin Cultural Management Area established on the Klamath and Six Rivers National Forests to allow the Karuk Tribe to apply cultural practices, including reintroduction of fire (Lake and Long 2014). The Sherar Burn on the Mount Hood National Forest showcased opportunities for setting aside huckleberry tracts for exclusive use by American Indians, and then cooperatively managing the areas with tribes using prescribed fire and thinning on competing vegetation (Wang et al. 2002).
Research Needs

Because many of the ecocultural resources discussed previously have had limited study, there is considerable need for research in ways that consider their quality and availability for tribal use. In addition to direct input from tribes, considering the criteria used to identify cultural keystones could be helpful in identifying priorities for monitoring and research. A few efforts have identified research needs based upon tribal perspectives. For example, after surveying tribal forest resource managers and decision makers, Beatty and Leighton (2012) identified three major themes:

1) Research related to water, fisheries and other “nontimber” values.
2) Collaboration and cooperation, especially concerning the integration of traditional knowledge with Western science.
3) Adaptation of research projects to local tribal contexts.

The report produced for the Karuk Tribe by Norgaard (2014a) prioritized the need for socioeconomic research, as well as research on effects of climate change on tribal sovereignty, identification of effective contracting and compacting mechanisms, and study of carbon implications of tribal burning.

A particularly important need is for collaborative, integrative research that evaluates the benefits to tribes from active management practices, both in terms of the ecological responses to treatments and the socioeconomic benefits that result from those responses (Hummel and Lake 2015). Chapter 3 discusses the need to better understand effects of applying ecological forestry strategies designed to reestablish or emulate natural disturbance regimes. It is particularly important to consider potential impacts to tribal resources that may result from a lack of active management given current trajectories, including forest densification, dieback, and wildfire. Impacts to large trees are a particular concern (Thomas et al. 2006). Considering vulnerability and developing adaptation strategies in cooperation with tribal entities is important to understand the effects of ecological change on tribal communities (Dittmer 2013, Norgaard 2014b, Petersen et al. 2014)

There are valuable examples of collaborative research regarding tribal ecocultural resources in the NWFP area (e.g., beargrass, pileated woodpecker, and black oaks discussed previously), but more studies and expanded monitoring are needed to address the many interests of diverse tribal communities. Research designed by ecologists may often not target the conditions used by gatherers, as explained by Kerns et al. (2004) in a study of huckleberries. In many cases, information to quantify reference conditions, such as the abundance of particular resources and forest structure in pre-settlement times, may be lacking, particularly at fine scales; however, collaborative partnerships provide opportunities to qualitatively describe those objectives and to develop research and monitoring to better quantify them.
(Hummel et al. 2015, Long et al. 2016). Through such efforts, tribal knowledge and practices, such as cultural burning, can be studied, implemented, and evaluated at different scales for valued species, habitats, and the creation of landscape heterogeneity that fosters socioecological resilience.

Conclusions and Management Considerations

Below we highlight key findings in response to questions posed by managers who requested this report. In general, strategies to promote tribal ecocultural resources are consistent with emerging directions in forest management, including the seven core principles for restoring fire-prone inland Pacific landscapes recommended by Hessburg et al. (2015).

1) Active management and restoration to promote a diversity of ecocultural resources at multiple scales—

- Ecosystems of the NWFP area support a wide array of tribal ecocultural resources, including various “first” foods, and active management is important to restore the supply of many of those resources.
- In particular, changes in fire regimes, forest encroachment and densification in many habitats, and alterations of hydrologic systems have degraded the amount, accessibility, and quality of important tribal resources.
- Remediation of forest road systems and culverts constitutes a priority for restoring aquatic systems due to their impacts on fish passage and flows of wood, water, and sediment.
- In terrestrial systems, active forest management, including understory and overstory thinning, may be important to facilitate use of wildland fire and maintain the quantity and quality of many species to perpetuate tribal uses.
- Use of wildland fire for resource benefit, in partnership with tribes and including prescriptions that emulate traditional cultural burning, will be a greater need in drier ecosystem types that evolved with more frequent fire, but fire is also important at fine scales within wetter ecosystem types. This finding is consistent with the recommendation by Hessburg et al. (2015) to emulate disturbance regimes, especially wildland fires.
- Addressing large landscape areas in restoration efforts can help to ensure long-term sustainability and availability of resources. Ideally, these areas would span traditional areas still used by tribes.
- Active management to promote heterogeneity of habitat conditions, including a variety of seral stages, at multiple scales is important to sustaining tribal ecocultural resources. For example,
some species of special tribal value, including marten and pileated woodpecker, are associated
with older forests, large decadent or dead trees, and dense tree canopies (Aubry and Raley 2002)
(see Chapter 6). Some are associated with young forests and more open forests that support
vibrant understory plant communities and associated animals (e.g., porcupine and many Neo-
tropical birds) (Carey 1996). Many other species highlighted in this chapter are associated with
forest gaps dominated by shrubs or graminoids, some of which constitute short phases of
succession, and others which can be persistent. A strategy designed to promote heterogeneity can
encompass tribal ecocultural resources in particular by incorporating cultural burning practices
and promoting fire effects desired by tribes (Lake and Long 2014, Long et al. 2016). Modeling
may help to evaluate the effects of forest management on these diverse values (Nalle et al. 2004)

2) Engaging tribes in partnerships—

• Given the pervasive interests of tribal communities in forest ecosystems of the NWFP area,
partnerships with tribes are likely to generate more successful strategies to promote
socioecological resilience.

• Consideration of native knowledge can help understand the effects and tradeoffs associated with
management actions and lack of active management on important ecological and socio-cultural
processes.

• Collaborative partnerships and tribal participation in planning, research, and monitoring
treatments within an adaptive ecosystem management framework also foster tribal adaptive
capacity.

• Plans for collaborative management can build upon the legal foundations in the Tribal Forest
Protection Act and other legislation that provides for agreements, compacts, and contracts to
facilitate tribal engagement.

• Designation of special tribal stewardship areas may be a useful strategy to formalize collaborative
management over particular areas of special importance to tribes.

• The concepts and principles of adaptive management and restoration forestry are consistent with
efforts to promote tribal interests. However, particular attention to tribal engagement, including
formal consultation as well as broader partnerships, will be important to ensure that development
and implementation of strategies will uphold tribal rights, federal responsibilities, and the critical
importance of these ancestral lands to tribes.
Literature Cited


Mondou, D.J. 1997. Our land is what makes us who we are: Timber harvesting on tribal reservations after the NIFRMA. American Indian Law Review. 21(2): 259-296.


Nie, M. 2008. The use of co-management and protected land-use designations to protect tribal cultural resources and reserved treaty rights on federal lands. Natural Resources Journal. 48: 585-647.


Norgaard, K.M. 2014a. Retaining knowledge sovereignty: Expanding the application of tribal traditional knowledge on forest lands in the face of climate change. Orleans, CA: Karuk Tribe Department of Natural Resources. 80 p.


U.S. Fish and Wildlife Service. 2009. 5-year review: Lilium occidentale (Western lily). Arcata, California: Arcata Field Office. 48.


USDI-BIA 2016. Tribal leaders directory. [Updated].

USDOI BLM 2012. Coos Bay Wagon Road pilot. [Updated 2012].


