SPECIES OF CONCERN OF THE

Tillamook Rainforest

& North Coast, Oregon

A CENTER FOR BIOLOGICAL DIVERSITY REPORT

Species of Concern of the Tillamook Rainforest and North Coast, Oregon

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Nurse stumps, Tillamook Forest
Photo courtesy Oregon Department of Forestry

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Executive Summary

Situated in northwest Oregon, the Tillamook Rainforest and North Coast contain a diversity of habitats, including extensive rainforests, marine environments, estuaries, coastal headlands, and rivers and streams. Mostly under state and private ownership, the Tillamook Rainforest has long been dominated by industrial forest practices based primarily on clearcutting, which in combination with the "Tillamook Burns" of the 1930s have resulted in the near-total loss of once-extensive mature and old-growth forests. Many species associated with older forests have declined or even disappeared from the Tillamook. The Pacific fisher, for example, is closely associated with closed-canopy forests comprised of large trees, and has not been seen in northwest Oregon for more than 50 years. Although at reduced numbers, many fish and wildlife species still survive in the Tillamook Rainforest and North Coast and with greater protection could once again thrive.

To assess the full range of species at risk from logging, urbanization, pollution and other threats in the Tillamook Rainforest and North Coast, we comprehensively reviewed available published and gray literature concerning the status of, and threats to, species in these areas. Based on this review, we identified a total of 215 species of concern, including nine that are already extinct. Of these species of concern, we determined that 71 (34 percent) are critically imperiled, 77 (37 percent) are imperiled, and 58 (29 percent) are vulnerable.

Critically imperiled species include 46 plants, 10 fungi, nine invertebrates, four fish, one bird and one mammal. These species are found in all habitats of northwest Oregon and represent a wide diversity of taxa. In old-growth forests, for example, the marbled murrelet, dusky tree vole and two lichens are threatened primarily by historic and present logging. Tillamook Rainforest rivers and streams support at least seven critically imperiled aquatic species, including chum, chinook and coho salmon, steelhead, two mussels and two snails. In coastal areas, the Oregon silverspot butterfly, three plants, two fungi and a lichen are all critically imperiled, threatened by a combination of coastal development and, for the forest-dependent species, logging.

Smith Homestead Trail, Tillamook Rainforest
photo courtesy Oregon Department of Forestry

Imperiled species include 30 plants, 10 birds, 10 fish, 10 fungi, nine invertebrates, three mammals, two reptiles, and one salamander. Highlighting the diversity of the Tillamook and North Coast, these species run the gamut of habitats from Cassin's auklets and Steller sea lions in marine areas to western snowy plovers on beaches, harlequin ducks and coastal cutthroat trout in rivers and estuaries, northern spotted owls in the last remaining

western gray squirrel
photo by Terry Spivey, USDA Forest Service

late-successional forests, and northwestern pond turtles in wetlands and lakes. Habitat loss caused by logging, roads, urban and agricultural development, and other activities threatens the greatest number of these species, but many are also threatened by pollution, exotic species, direct human disturbance, and environmental factors such as climate change.

Vulnerable species include 17 plants, 10 fish, eight mammals, eight fungi, six birds, six amphibians, and four invertebrates. Although some of these species have relatively large populations compared to the imperiled species discussed above, many are believed to have declined, such as the Pacific lamprey and American marten, and others are known to be sensitive to habitat destruction, such as the clouded salamander and olive-sided flycatcher. Because in some cases these vulnerable species have wider distributions, they make excellent indicator species for avoiding the impacts of logging or other projects on imperiled species' habitat, and with improved habitat management, these species could avoid further imperilment.

We identified eight species that have been extirpated from the Tillamook Rainforest and North Coast, including the grizzly bear, California condor, Columbian white-tailed deer, gray wolf, Pacific fisher, sea otter, sandbar darkling beetle, and small spikebrush. Species such as the fisher and Columbian white-tailed deer still can be found in Oregon, albeit at reduced numbers, but have been lost from northwest Oregon. The grizzly bear, California condor, and gray wolf have disappeared from northwest Oregon as well as from most of their historical range in the continental United States.

Based on our literature search, we identified threats to 27 critically imperiled, 43 imperiled, and 36 vulnerable species, which comprise 49 percent of all species of concern. The number one source of species imperilment is habitat destruction, with logging and development being important contributors. Other significant threats are pollution, direct exploitation, exotic species, and global climate change. Loss of mature and old-growth forests is of particular concern in the Tillamook Rainforest, as is the siltation of rivers and streams associated with logging and logging roads. Urbanization is

an increasing threat in the North Coast. To remedy all of these threats, we recommend the following:

- Protect critically imperiled species as threatened or endangered species under the Endangered Species Act, including the dusky tree vole, Pacific Coast chum, Pacific fisher and others.

- On state lands, develop a system of reserves similar to late-successional and riparian reserves designated under the Northwest Forest Plan. Implement greater protections outside reserves by increasing rotation age to more than 120 years, creating streamside buffers of 150 feet, and requiring substantially greater retention of both live and dead trees in cutting areas.

- On private lands, strengthen the Forest Practice Act to require retention of substantially greater numbers of live and dead trees, increase rotation age to more than 100 years, increase stream buffers to 150 feet on all second-order and greater streams, and to 50 feet on all non-fish bearing and headwater streams.

- Support the Governor's Advisory Group on Global Warming goals and strategies to reduce global warming in Oregon.

- Work towards zero discharge of all persistent organic pollutants (POPs) and heavy metals.

- Continue to strictly regulate and enforce fishing restrictions for coastal spring chinook, chum salmon and coastal cutthroat trout.

- Require the use of the latest technology to avoid bycatch of marine mammals, seabirds, non-target fishes, and other marine life.

tufted puffin
photo © Don Getty

- Manage exotic and nonnative plants and animals by identifying problematic species and designing plans to remove or control these species.

- Design and implement short- and long-term research activities for all imperiled species, especially plants and invertebrates, collecting information on population status and trends, threats, habitat requirements, and other important factors necessary for species recovery.

- Identify and designate critical habitat areas for imperiled species.

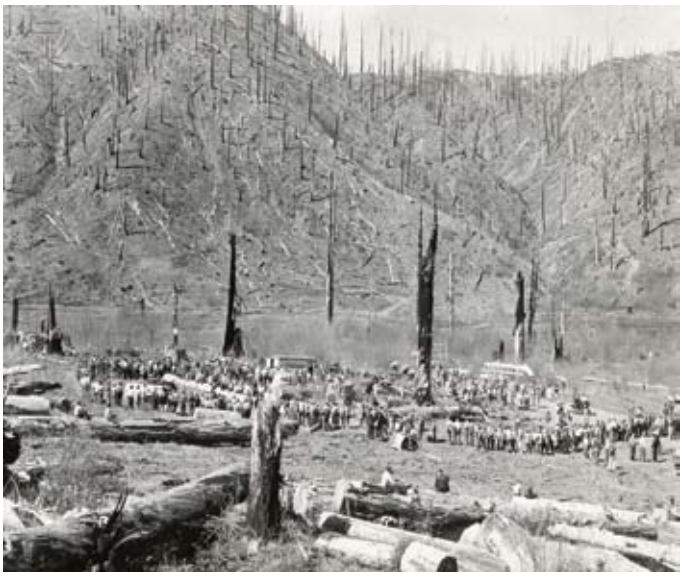
Introduction

The Tillamook Rainforest is a lush area of coastal temperate rainforest in northwestern Oregon that provides rich habitat for numerous wildlife species, from the federally listed northern spotted owl and coho salmon to the clouded salamander. More than 300 animal and plant species depend on the Tillamook Rainforest, and half of the remaining healthy salmon runs in Oregon are found in its rivers and streams. A number of these species, such as the dusky tree vole and Saddle Mountain bittercress, are found nowhere else. Likewise, Oregon's North Coast contains rich habitats that support a diversity of wildlife species: from rockfish found in marine habitats, to seabirds like tufted puffins and Cassin's auklets nesting on coastal islands, to the Oregon silverspot butterfly in coastal grasslands. Many North Coast species have declined in the face of rapid urban development, invasive species, and overfishing.

Unlike areas to the north and south, the Tillamook Rainforest has few federally managed lands or protected areas. This, combined with its close proximity to the region's major transportation centers and relatively mild topography, has long since rendered the Tillamook Rainforest a sacrifice zone to industrial forestry. After several decades of logging, the first of a series of fires, later to become known as the Tillamook Burn, was started by a logging operation in 1933. Fires followed in 1939, 1945 and 1951, eventually burning hundreds of thousands of acres. Following massive salvage logging operations that damaged sensitive soils, harmed streams, and decimated fish and wildlife populations, the timber companies abandoned the Tillamook to tax foreclosure by the counties. The counties then turned management of the land over to the state, which in turn formed the Tillamook and Clatsop State Forests.

Elk Creek, Tillamook Forest
photo courtesy Oregon Department of Forestry

The Tillamook Rainforest is at an historic crossroads. Stands established following the Tillamook Burn, many of which are nearly 70 years old, are beginning to develop old-growth characteristics. Such stands have the potential to be a haven for recovering old-forest species, or they may be logged again, further damaging fish and wildlife, sensitive watersheds, and the scenic value of the forest. The Oregon Department of Forestry, who is charged with managing the Clatsop and Tillamook State Forests, is encouraging the latter. Recent plans released by the agency would leave as much as 85 percent of the forest open to logging and call for annual clearcutting in the Tillamook and Clatsop State Forests of a possible 4,035 acres, with up to an additional 11,350 acres to be partially cut each year between 2002 and 2011. This means that more than 40,000 acres could be clearcut, and more than 113,000 additional acres partially cut in the next 10 years. Over 50 years, this would mean that more than 200,000 acres – or more than one-third of these forests – could be clearcut, and close to 85 percent of the entire area partially cut.



Top photo: From the ashes of the Tillamook Burn, forests are beginning to provide high quality fish and wildlife habitat.
Bottom photo: Massive replanting efforts followed the Tillamook Burn.

photos courtesy Oregon Department of Forestry

To understand the combined impacts of logging, fire, urban and agricultural development, invasive species, and commercial exploitation on wildlife of the Tillamook Rainforest and North Coast, we have conducted a biodiversity assessment that identifies all species of concern in northwest Oregon, characterizes their status, identifies the primary threats to their continued existence, and recommends measures to ensure more wildlife species are not lost from the Tillamook Rainforest and North Coast.

The Tillamook Rainforest and North Coast

Our assessment focuses on the Tillamook Rainforest and North Coast, including an area bordered to the north by the Columbia River, to the east by the Willamette Valley, and to the south by Highway 20. The Clatsop and Tillamook State Forests make up a substantial portion of the Tillamook Rainforest, totaling roughly 518,000 acres in three districts: Tillamook, Astoria and Forest Grove. Other forest lands in the Tillamook Rainforest are owned largely by private timber companies and, to a lesser extent, small landowners and other entities. Coastal areas are primarily privately owned. Beaches below the high-tide line, as well as nearshore areas, are publicly owned and primarily managed by the state.

Tillamook Rock, Oregon's North Coast
photo courtesy NOAA

Encompassing the northern Coast Range, the Tillamook Rainforest and North Coast are composed of both sedimentary and volcanic rocks with elevations ranging from sea level to 3,500 feet. The climate is maritime with cool, wet winters and mild, dry summers. Annual rainfall is high, between 45 and 100 inches. This heavy precipitation, combined with a relatively mild climate and frequent fog along the coast, nurtures a long and robust growing period, allowing trees to grow throughout the whole year. It also has a naturally low fire frequency, which ranges from 100 years on dry sites to more than 700 years in Sitka spruce stands near the coast (Agee 1993).

There are myriad streams and rivers throughout the Tillamook Rainforest and North Coast that empty both into the Pacific Ocean and Columbia River. The hundreds of miles of streams and rivers are home to both resident and anadromous fish species such as the state sensitive coastal cutthroat trout and lower Columbia steelhead, and the federally threatened coho and chum salmon.

Methods

To identify all species of concern in the Tillamook Rainforest and North Coast, we searched data from the Oregon Natural Heritage Information Center (ONHIC), NatureServe, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and other sources for information on species in Clatsop, Tillamook, Columbia, Washington and Yamhill Counties. Species were considered to be of concern if they were identified as such by one of the above sources or were identified as rare, having low population levels or having substantially declined by any source. For bird species, we included only birds that were of concern and that breed in one of the included counties.

Data on distribution, population status, trends, threats and habitat preferences were collected from various sources. We searched the Biosis database to find peer-reviewed literature on any of the above categories and then reviewed the bibliographies to obtain any new papers of both peer-reviewed and gray literature. We also used the Google search engine to obtain gray literature and government documents with pertinent information on distribution, life history, and population status and trend information. We used the NatureServe database for distribution, population status, threats and habitat information and the United States Geological Survey's (USGS) Breeding Bird Survey database for population and trend information. Additionally, we used the Oregon Department of Fish and Wildlife's (ODFW) Oregon Native Fish Status Report for data on distribution, status, population trend, and threats.

We classified species as vulnerable, imperiled and critically imperiled based on their classification by one or more of the above sources (Table 1). In cases where status information was conflicting, we used our best judgment based on the available information. Trend estimates from the USGS Breeding Bird Survey were not used because the estimates for northwest Oregon were self-identified as unreliable. For candidates for protection under the federal Endangered Species Act, we considered all species with a listing priority less than or equal to five to be critically imperiled and species with a priority greater than or equal to six to be imperiled.

Table 1. Classification of Tillamook Rainforest Imperiled Species

Source	critically imperiled	imperiled	vulnerable
Oregon Natural Heritage	critically imperiled (S1) in Oregon	imperiled (S2) in Oregon	vulnerable (S3)
NatureServe	critically imperiled (G1) globally	imperiled (G2) globally	vulnerable (G3)
Federal Endangered Species Act	endangered, candidate priority <=5	threatened, candidate priority >=6	species of concern
Oregon Endangered Species Act	endangered	threatened, SC (critical)	SV (vulnerable)
Oregon Department of Fish and Wildlife	at risk	potentially at risk	
Audubon Society	red	yellow	
American Fisheries Society	endangered	threatened	vulnerable
World Conservation Union (IUCN)	critically endangered	endangered	vulnerable

Species of Concern in the Tillamook Rainforest and North Coast

We identified 206 species of concern in the Tillamook Rainforest and North Coast, including 71 critically imperiled, 77 imperiled, and 58 vulnerable species. These species of concern include 92 plants, 28 fungi, 24 fish, 21 invertebrates, 17 birds, 14 mammals, seven amphibians, and two reptiles. At least eight species – the sea otter, grizzly bear, California condor, Columbian white-tailed deer, gray wolf, Pacific fisher, sandbar darkling beetle, and small spikebrush —have been extirpated from northwest Oregon.

Tillamook Rainforest and North Coast species of concern are found in a variety of habitat types, including forests, streams, lakes, rivers, estuaries, coastlines and marine areas, all of which have been severely degraded by expansive logging, historical forest fires, and development. Many of the species associated with these habitats are undergoing subsequent large-scale declines. We found habitat information on 27 critically imperiled, 43 imperiled, and 36 vulnerable species, or 106 (52 percent) of the 206 species of concern.

Forest Habitat

The rich forest habitats of the Tillamook support a variety of wildlife species, from the familiar northern spotted owl to lesser-known bats, birds, arboreal mammals, lichens and many others. At least 58 of the 206 species of concern of the Tillamook and North Coast strictly depend on forest habitat (13 critically imperiled, 20 imperiled and 25 vulnerable). Imperiled species like the Townsend's big-eared bat, for example, forage for insects in the forest canopy, and the purple martin nests in tree cavities. Poorly known yet biologically important mycorrhizal fungi species, such as *Thaxterogaster pavelekii*, are involved in symbiotic relationships with Tillamook forest trees, where they grow on the trees' roots and help them obtain nutrients. Other forest-dependent imperiled species include the Cope's giant salamander, Pacific fisher, northern goshawk and several species of fungi and lichen. The largest factors threatening forest-dependent species are logging, development and fire.

Before the extensive logging and the Tillamook Burn, old-growth stands were common in the Tillamook Rainforest. The high moisture, mild temperatures, and low fire frequency of the area supports a long, rapid growing season that enables plants and animals to flourish year-round and encourages development of old-growth conditions. These climatic conditions favor long-lived species like western hemlock, Douglas-fir, and Sitka spruce, the trees that compose the Tillamook Rainforest. Because the large trees that are found in old-growth stands are economically valuable, they have been vigorously logged throughout the Tillamook Rainforest. In combination with historic forest fires and development, logging has nearly eliminated these important and unique ecosystems in northwest Oregon, where only roughly 1 percent of old-growth stands remains (ODF 2002).

northern goshawk
photo by Don Baccus

Many species depend on the dense canopy cover, large-diameter trees, spacious area between trees, curved branches, whorls of trees, high density of decaying logs and snags, and rich soils found in mature and old-growth stands (Spies and Franklin 1988). Northern spotted owls, for example, depend on the forked and broken treetops and other tree deformities characteristic of old-growth stands for nesting structures. Likewise, woodpeckers and other cavity-nesting birds depend on the plentiful cavities found in the large snags and partially live trees common in old-growth forests. The imperiled lichen *Usnea longissima* capitalizes on the high moisture and large trees of old-growth forests for nutrients and growth.

northern spotted owls
photo courtesy USFWS

Usnea longissima
photo by Karen Dillman, USFS

Of the 58 species of concern that were found to occur in forest habitats, a total of at least 18 (five critically imperiled, four imperiled, and nine vulnerable) are specifically associated with late-successional forests of the Tillamook. Given that more than 1,000 species have been documented to be closely associated with old-growth forests in the Pacific Northwest (FEMAT 1993), this likely represents only a fraction of the species that are imperiled or that have been lost in the Tillamook because of loss of late-successional forest, reflecting the lack of available historic or current information for species in the Tillamook.

Old-forest associated species of concern in the Tillamook range from the small, arboreal dusky tree vole and well-known marbled murrelet and northern spotted owl to a variety of biologically important lichen and fungi including *Teloschistes flavicans* and *Phaeocollybia californica*. The northern spotted owl and marbled murrelet are both listed as threatened under the federal Endangered Species Act. In the Tillamook, the northern spotted owl has been reduced to a few populations, totaling roughly 25 individuals on state lands (USFWS 2004, ODF 2003, ODF 2003a, ODF 2003b, ODF 2004c). Likewise, the marbled murrelet, where once abundant in the North Coast Range, is

northwestern pond turtle
photo by William Leonard

now rarely seen (Nelson et al. 1992, Marshall et al. 2003, USFWS 2004a). Loss of old-growth forest, as well as historic fur trapping, resulted in the extirpation of the Pacific fisher from the Tillamook. Remnant old-growth forests of the Tillamook Rainforest found in Cape Lookout State Park serve as the last bastion in the Pacific Northwest for the lichen *Teloschistes flavicans* (Glavich et al. 2005, McCunne 1997, in ONHIC 2004a). These and many other species need stronger forest protection to once again thrive in the Tillamook Rainforest.

Rivers and Streams

The Tillamook Rainforest and North Coast are bisected by a wealth of rivers and streams flowing into both the Columbia River and Pacific Ocean. These rivers and streams are an important source of drinking water and provide habitat to numerous plants and wildlife. The Tillamook District alone, for example, contains more than 300 miles of fish-bearing streams (ODF 2003a). Aquatic species such as chum salmon, California and Willamette floater mussels, Cope's giant salamander, the northwestern pond turtle, and numerous others depend upon cool temperatures and clean, free-flowing water to survive. For chum salmon, the Tillamook forms a last refuge in the southern portion of its range, with populations in both the lower Columbia River and further south in Oregon and northern California now extinct (ODFW 2005).

Urban and recreational development, logging, and agricultural activities have severely degraded stream habitat across much of northwest Oregon, impacting many aquatic species. The abundance of large, deep pools that provide important habitat conditions for salmonids, for example, have decreased by as much as 80 percent on private coastal lands due to habitat destruction (Trout Unlimited 2006). Moreover, a status assessment by the Oregon Department of Forestry (ODF) on the conditions of riparian habitats throughout the forests of northwest Oregon determined that "instream habitat conditions indicate that current freshwater productivity may be at a low point" (ODF 2001).

We identified nine critically imperiled, 11 imperiled, and nine vulnerable species of concern that rely on healthy streams and rivers in the Tillamook Rainforest. Of the 29 species, 15 are anadromous and resident fish, including six federally threatened salmonids: Columbia River chum salmon, lower Columbia River and Southwest Washington coho salmon, lower Columbia River steelhead (summer and winter runs), and lower Columbia River chinook salmon (spring and fall runs). Other riparian-associate species of concern include the silver-haired bat, Yuma myotis, harlequin duck, northwestern pond turtle, painted turtle, coastal-tailed frog, northern red-legged frog and others. Two aquatic mollusks, the rotund physa and nerite ramshorn, are possibly extinct (Frest and Johannes 1995).

Steller sea lion haulout
photo by Kevin Bell, USFWS

Wetlands and Freshwater Lakes

The wetlands and lakes of the Tillamook Rainforest and North Coast have experienced large-scale declines and degradation as a result of various land-use activities. Wetlands in Oregon and Washington have been estimated to have diminished by one-third (Trout Unlimited 2006). A total of seven (26 percent) critically imperiled, six (14 percent) imperiled, and three (eight percent) vulnerable species are found near or in wetland and freshwater habitats. These species include the silver-haired bat, Yuma myotis, olive-sided flycatcher, western snowy plover, white-tailed kite, peregrine falcon, northwestern pond turtle, painted turtle, California floater, Willamette floater, evening fieldslug, many flowered sedge, two lichens (*Usnea longissima* and *Ramalina pollinaria)*, and one moss (*Pohlia sphagnicola)*. Threats to these species and their habitats include logging, agriculture, dams and urbanization.

Coastal, Shoreline, Estuary and Coastal Grassland Habitat

Shoreline and marine habitats of the North Coast include the marine coast, brackish waters of bays and estuaries, nearshore islands, sand dunes, salt-spray meadows, tidal mudflats, and coastal grasslands. All these habitats are ecologically unique and support a wide diversity of species. Pelagic birds and shorebirds, for example, forage along the coastal shores of the Tillamook and breed in coastal grasslands. Other important fish species, such as sharks, use the shallow coastal waters for foraging, while some, such as rockfish, use them for breeding. Some salmon species migrate to the brackish waters of estuaries and bays to breed. There are a variety of coastal plants, insects and lichen found here as well.

Many coastal habitats have been degraded by development and pollution. There are 44 species of concern that utilize coastal areas in the Tillamook region (nine critically imperiled, 22 imperiled, and 13 vulnerable). The birds include sea dwellers like the tufted puffin and rhinoceros and Cassin's auklet, along with species such as the western snowy plover and peregrine falcon. Fish species of concern include salmonids such as Columbia River chum, Oregon Coast coho and steelhead, as well as the white shark, basking shark, and five rockfish. Other species include the Steller sea lion, California myotis, Siuslaw sand tiger beetle, Oregon silverspot butterfly, and seven plants. These coastal species have experienced substantial declines in response to alteration and degradation of their habitat on the North Coast.

Threats to Tillamook Rainforest Biodiversity

The number of species of concern identified above highlights the severity of impacts from logging, roads, agricultural and residential development and other factors on wildlife habitat in the Tillamook Rainforest and North Coast. We found threat information for 128 (62 percent) of the 206 species of concern. Habitat degradation presented the greatest threat to species of concern, affecting 94 (73 percent) of the species for which we have threat information. Other threats include ecological factors such as predation and low productivity (72 species), pollution (25 species), human disturbance (25 species), commercial fisheries — either through overfishing, competition or bycatch (23 species) — invasion of exotic species (17 species), and commercial exploitation (11 species). We found information to suggest that anthropogenic climate change is a threat to 16 species, but likely many more will be threatened should model projections prove accurate and if sufficient actions to reduce greenhouse gases are not taken.

Habitat Destruction

Habitat destruction caused by logging, fire, and urban and agricultural development is the greatest threat to Tillamook and North Coast species. Logging and fire have reduced old-growth forests in northwest Oregon to approximately 1 percent of historical levels (ODF 2002). Many old-forest species have experienced severe declines and are unlikely to recover without the protection and recovery of old-growth conditions in the Tillamook. We determined that the indirect and direct impacts of logging, including destruction of mature and old-growth forests, road construction, erosion and other factors, are threats to at least 60 (47 percent) of the species of concern for which we found threat information.

Although the Northwest Forest Plan has improved forest practices and provided a modicum of protection to old forests in Oregon, this for the most part does not apply to the Tillamook because there are few federal lands. In Clatsop, Tillamook, and Lincoln counties, 41 percent of forest land is owned by industrial timber companies that manage their lands as short rotation plantations (with tree rotation ages of 50 to 70 years) with little consideration for fish and wildlife habitat, particularly habitat utilized by old-forest dependent species.

clearcut in Tillamook Forest
photo courtesy Sierra Club

Management on private lands in Oregon is guided by rules of the Forest Practices Act. These rules do little to protect old-forest conditions in the Tillamook Rainforest, allowing clearcuts of up to 120 acres, failing to specify a minimum rotation age or to require retention of large trees or snags, and restricting cutting within only 20 feet of rivers and streams, rather than 150 feet as on federal lands in Oregon. Using these methods, clearcutting — the most harmful logging practice to plants and wildlife — predominates on private lands in northwest Oregon. In 2001 alone, 88,912 acres were clearcut on private forest industry lands in western Oregon, compared to zero total partial-cut acres (ODF 2001a, Johnson 2005). Moreover, rotation ages, which have

ranged between 40 to 60 years in the past, are dropping further to 35 to 40 years in order to produce higher yields (Johnson 2005).

Poor management on private lands places an additional burden on state lands, which cover roughly 27 percent of the North Coast, to ensure that forest management does not drive species such as the dusky tree vole, northern spotted owl, and many others to extinction. Unfortunately, implementation plans for the three state forest districts call for clearcutting up to 53,000 acres and partial-cutting up to 74,000 acres between 2002 and 2011 (ODF 2003abc). Under these plans, as much as a quarter of all state forest lands in the Tillamook Rainforest would be intensively logged in just one nine-year period.

Of particular concern, state forest management plans fail to create substantial reserves where late-successional forests can develop and species that are sensitive to disturbance can thrive. This is devastating for the many old-forest dependent species that have already experienced dramatic declines in the Tillamook, including the Pacific fisher, dusky tree vole, northern goshawk and others. Excluding the federally protected northern spotted owl and marbled murrelet, the Oregon Department of Forestry does not require surveys or mitigation for any wildlife species.

Urban sprawl is another source of habitat degradation in the Tillamook Rainforest. Urban and agricultural development has resulted in the loss and fragmentation of forest and coastal habitats. Urban sprawl has been on the increase in the Tillamook Rainforest and surrounding areas and is expected to continue (ODF 2001). Clatsop County grew 7 percent between 1990 and 2000, and 2 percent between 2000 and 2004 (U.S. Census Bureau 2006). Tillamook County's population has also been on the rise, growing 12.5 percent between 1990 and 2000 and 2.7 percent between 2000 and 2004 (U.S. Census Bureau 2006). Moreover, the population in the Willamette Valley west of the

Pacific fisher
photo courtesy WDFW

Cascades is expected to grow by 1.3 million people in the next 40 years. This growth will likely fuel coastal area development to support recreation demand and potentially put additional pressure on state forests to produce additional timber revenue to support state infrastructure (references in Kline et al. 2002). This development is a severe threat to the many species of concern dependent on coastal habitats.

Pollution

There are a number of sources of pollution in northwest Oregon, including industrial waste from pulp and wood mills and agricultural industries, sediments and chemical sprays from industrial logging and dairy farms, and oil spills along the coast and Columbia River. Logging, for example, has led to increased sediments in freshwater ecosystems throughout the north Oregon Coast Range, affecting fish and other aquatic species by suffocating eggs and aquatic insect larvae,

obstructing fish gills, and reducing overall water clarity (Scorecard 2006).

Some of the largest sources of water, sediment, and air pollution in Clatsop and Tillamook Counties are the many wood and pulp mills in the region (Scorecard 2006). In a study of the known pollutants released in Clatsop and Tillamook Counties, many of the toxic chemicals that were at the highest levels — such as ammonia, chlorine, and chlorine dioxide — were associated with pulp and wood production (Scorecard 2006). These chemicals are known neurological and reproductive toxins in humans and likely affect wildlife as well.

Agriculture, particularly dairy farming, is another source of pollution in Tillamook and Clatsop Counties. Dairy farms in the region introduce large quantities of pesticides and nutrients from waste and fertilizers into the environment. Not surprisingly, in Tillamook County and Clatsop County, ammonia—primarily from agriculture—was the number one toxic chemical detected (Scorecard 2006). Likewise, the remaining top five toxic chemicals discovered in these counties were also products of fertilizer, agricultural waste, and pesticides such as methane, chlorine, hydrochloric acid, and sulfuric acid (Scorecard 2006).

Another potential threat to wildlife is oil spills from tanker transportation along the Pacific Coast and in the Columbia River. In 2002, for example, the *Seattle Post Intelligencer* catalogued 19 oil spills and "near-misses" along the coast of Washington and Oregon, including in the Columbia River. Oil spills affect flora and fauna by physically smothering wildlife and releasing toxins like polyaromatic hydrocarbons (PAHs) into sediment, water, and directly onto wildlife (Dicks 1998).

Despite being banned since 1979, polychlorinated biphenyls (PCBs) and other organochlorines have been detected in rivers and streams in Clatsop County (Tanner and Lee 2005). PCBs, used in electrical transformers in the 1960s and 1970s, are nearly insoluble in water and incredibly persistent in the environment (Tanner and Lee 2005, Bonn 1999). The fact that PCBs that have been shown to be dangerous to both humans and wildlife are still detected in aquatic ecosystems in Clatsop County — despite their ban nearly 30 years ago — demonstrates that they still have the potential to harm plants and wildlife.

As a result of the many sources of industrial and agricultural pollution described above, Clatsop County was placed in the top 10 percent for release of carcinogens into water bodies in the United States in 2002 (Scorecard 2006). Moreover, Tillamook County has seven impaired estuaries and bays and 25 impaired rivers, streams and creeks, based on only partial sampling of the area's waterways and related primarily to sediment and nutrient pollution from logging and agricultural

pulp mill air pollution
photo courtesy Native Forest Network

activities (Scorecard 2006). Pollution is a threat to at least 25 of the species of concern in the Tillamook and needs to be curbed to ensure the viability of these species and the health of all of the North Coast's ecosystems.

Exotic Species Invasion

Exotic species, by outcompeting or preying on native populations, are a threat to the resident biota of the Tillamook. For example, the Oregon silverspot butterfly has been reduced to just two populations and is in danger of extinction because its primary food source, the western blue violet, is being displaced by nonnative plants (USFWS 2001, references in Natureserve 2006). The northern spotted owl, native to the Pacific Northwest,

Oregon silverspot butterfly
photo by Dave Imper,USFWS

is being pushed out of its habitat in many locations by the barred owl. The barred owl is indigenous to the eastern United States but has been expanding its range into Canada and the Pacific Northwest since the early 1900s. The invasion of the barred owl is a concern for the survival of the northern spotted owl, especially in combination with other serious threats such as the vast loss of the latter's habitat throughout its range (e.g. Forsman 1998). Other species affected by the presence of nonresident populations are the western toad, northwestern pond turtle, Point Reyes bird's-beak, and several lichen species.

The release of hatchery fish that comprise approximately 70 to 80 percent of coastal salmon and steelhead fisheries in the Pacific Northwest is also a serious concern for many native salmon in the Tillamook (NFSC 2007). Hatchery-bred fish pose a number of problems for native species by displacing or preying on populations, reducing genetic variability, and encouraging the spread of disease (NFSC 2007). We found that the presence of hatcheries affects more than half (six of 11) of the imperiled fish populations in the Tillamook and is partially responsible for the Oregon Department of Fish and Wildlife (2005) placing many of them in the "at risk" category. Hatchery coho salmon in the lower Columbia River Basin are a listed threat to wild populations. Likewise, hatchery steelhead are displacing native steelhead in the lower Columbia River and are thus listed as a critical threat to natural populations (NMFS 1996, 1998).

The spread of exotic species is a concern for many of the Tillamook flora and fauna and should be monitored and managed in order to sustain the unique biota of the north Oregon Coast Range.

Exploitation

Several species have gone extinct in the Tillamook Rainforest partially as a result of hunting and predator control, including the gray wolf, California condor, and Pacific fisher. History has shown that unregulated exploitation of wildlife can lead to severe population declines for wildlife, and can still contribute to population loss for some Tillamook species if left unchecked. Although exploitation of wildlife is for the most part effectively regulated, it remains a potential threat to a number of Tillamook species in combination with habitat degradation and other factors. Both the northwestern pond turtle and the lichen *Usnea longissima* are

currently collected, which although limited, is a potential threat because of these species' already depressed populations.

Commercial fishing is another form of exploitation that affects a number of Tillamook species and can be a concern for species that are already depressed because of habitat degradation related to dams, logging, agriculture and development. Although tightly regulated, commercial fishing — both direct harvest and incidental take — affects 18 of the 24 fish found in Tillamook waters. Commercial fisheries likely have contributed to substantial population declines in coastal spring chinook and Pacific coast chum, and could still pose a threat to coastal spring chinook populations (NMFS 1998, Nehlsen et al. 1991). Columbia River chum have been lost from the lower Columbia River primarily due to habitat degradation, but also to some degree due to incidental take from the coho and fall chinook fisheries (Nehlsen et al. 1991). Finally, a number of non-fish species are impacted indirectly by commercial fishing, such as the marbled murrelet and tufted puffin, primarily as bycatch in fisheries nets (references in Marshall et al. 2003).

Global Climate Change

Global climate change, which is caused by anthropogenic release of heat-trapping chemicals such as carbon dioxide into the atmosphere, has caused dramatic shifts in weather conditions, warming temperatures and waters, and sea-ice melt. Scientists studying the impacts of global climate change on the Pacific Northwest state that they are "very certain that the Pacific Northwest is warming and that since 1975 the warming is best explained by human-caused changes in greenhouse gases" (State of Oregon 2004, App. C). Scientists also state that precipitation in the Pacific Northwest over the past 100 years has increased by 10 percent and sea levels have risen at a rate of 0.06-0.08 inches (1.5- 2mm) annually, submerging land on the central and northern Oregon coast. Temperatures in the Pacific Northwest are expected to increase by 2.7° F by 2030 and 5.4° F by 2050, along with other climatic changes (State of Oregon 2004, App. C). Several Tillamook species are threatened by climate change, and because it is difficult to study the direct impacts that result from climatic shifts and very few studies have been attempted, likely many more species will be affected.

Disease

Swiss needle cast, a native fungal disease affecting Douglas-fir forests along the coast and western Cascades, is another threat to the biota of the Tillamook. The spread of this disease has reached unparalleled proportions in northwest Oregon in part because complex stands comprised of several tree species were replaced with monocultures of Douglas-fir. Swiss needle cast sickens trees, and in some areas of the coast range has affected more than 50 percent of growth (ODF 2001). Concern over the large number of acres infected in Northwest Oregon has led the Oregon Department of Forestry to state that "the future of many stands is uncertain" (ODF 2001). While Swiss needle cast does threaten forest conditions in the Tillamook, management of the disease by means of clearcutting additionally contributes to the overall loss and fragmentation of stands and increases the impact on forest-dependent species.

Swiss needle cast on a Douglas fir
photo courtesy USDA Forest Service

Recommendations

As documented in this report, a variety of threats, ranging from logging and nonnative species invasions to the pollution of aquatic and marine environments, have led to and are leading to declines in many Tillamook Rainforest species. To increase protection and recovery of the species of concern in the Tillamook, we recommend the following:

List Species Under the Endangered Species Act

We identified a total of 71 critically imperiled and 77 imperiled species in the Tillamook Rainforest. To avoid further declines and extinction of these species, many of these species should be considered for protection as threatened or endangered species under the Endangered Species Act. In particular, we recommend that the species identified below be immediately considered for protection as threatened or endangered species based on serious population declines, restricted home ranges, severity of threats, biological vulnerability, or overall loss of habitat.

Two mammals, the dusky tree vole and fisher, have suffered severe population and range loss and are in need of protection under the Endangered Species Act. The dusky tree vole, formerly present throughout the Tillamook Rainforest, has been found in extremely low numbers in many recent studies, and populations are isolated with much of the species' preferred habitat — late-successional forest — lost and fragmented (USDA, USDI 2004, ONHIC 2004, NatureServe 2006). Similarly, the fisher has been reduced to small, disjunct populations in its former range and has been completely lost from the Tillamook Rainforest. The fisher is designated as a candidate for listing as a threatened species by the U.S. Fish and Wildlife Service.

There are already a number of salmonids protected as threatened or endangered species in the lower Columbia River. With complete loss of populations in northern California and southern Oregon and decades of low returns, the Pacific Coast evolutionary significant unit of chum salmon is another species that should be listed as endangered or threatened under the Endangered Species Act.

California floater mussels
photo by William Leonard

We determined that six invertebrates from the Tillamook Rainforest require the urgent protection of the Endangered Species Act. The evening field slug, California floater mussel, and Willamette floater mussel are rated as critically imperiled by NatureServe (2004), and the California floater is a federal species of concern. All have experienced dramatic declines in northwest Oregon. The Willamette floater, for example, may already be extinct in the lower Columbia River (Frest and Johannes 1995, Branson and Branson 1984). The rotund physa and nerite ramshorn, other freshwater mollusks, may also be extinct in the Tillamook (Frest and Johannes 1995). Lastly, Roth's blind ground beetle needs the protection of the Endangered Species Act based on its status as a federal species of concern and NatureServe

critically imperiled species. Listing is important for these invertebrates because of their extremely low population numbers and the severity of threats they face.

Finally, based on serious population declines, restricted ranges, severity of threats, biological vulnerability or overall loss of habitat, we recommend listing 16 critically imperiled plants and fungi: Coast Range fawn lily, Henderon's sidalcea, Munz pink sand verbena, Point Reyes bird beak, Saddle Mountain saxifrage, western marsh rosemary, three fungi (*Chrysomphalina grossula*, *Ramaria rubella* and *Thaxterogaster pavelekii*), three lichens (*Bryoria bicolor*, *Teloschistes flavican*, and *Usnea hesperin*), and two liverworts (*Herbertus aduncus* and *Tritomaria quinquedentata*).

Coast Range fawn lily
photo by Emily Roberson

The Coast Range fawn lily, for example, is reduced to only five "fairly isolated sites, in north coastal Oregon where logging remains a threat" (NatureServe 2007). A recent study failed to find Henderson's sidalcea at nine of 10 historical coastal tidelands locations where development is an ongoing threat (Love 2004, in Natureserve 2006). The fungus *Ramaria rubella* is known from only one location in the Tillamook and has very low reproductive capabilities, placing it at immediate risk of extirpation. All of these species require immediate attention and protection under the Endangered Species Act.

Limit Habitat Destruction

Habitat destruction caused by logging, fire and development is by far the greatest threat to species of concern in the Tillamook. Logging throughout the Tillamook Rainforest has resulted in loss of the majority of late-successional habitat, isolation of forest-dependent species, and alteration of aquatic habitats through siltation and increased water temperatures, among other changes. Likewise, rampant development is threatening many coastal habitats. Regulations guiding logging and development activities on state and private lands in the north Oregon Coast Range are inadequate to protect forest or other habitats and ensure protection for the vast number of declining species. Due to this lack of adequate regulations, we recommend the following:

- On state lands, develop a system of reserves similar to late-successional and riparian reserves designated under the Northwest Forest Plan and implement greater protections outside of reserves that increase rotation age more than 120 years, significantly increase streamside buffers, and require substantially greater retention of both live and dead trees in cutting areas.

Tillamook westernslug
photo by William Leonard

- On private lands, strengthen the Forest Practice Act to require retention of substantially greater numbers of live and dead trees, increase rotation age to more than 100 years, increase stream buffer size to 150 feet on all second-order and greater streams, and require stream buffers on all streams, including non-fish bearing and headwater streams.

- Reduce road densities well below one mile per square mile by eliminating roads at highest risk of failure or with excessive numbers of stream crossings. As part of this process, remove all barriers to fish passage.

- Strengthen county and community growth management plans to ensure protection of critical habitats for species of concern in coastal and other areas.

These rules will not only protect species of concern; they will also benefit the tourist industry and ensure a high quality of life for coastal communities.

Reduce Pollution

Pollution in the North Coast comes from multiple and in many cases diffuse sources, ranging from pulp and paper mills to logging, agriculture and urban and industrial development. Based on the complexity of the problem, the following are preliminary recommendations for beginning to to address this serious threat:

- Design protocols and begin monitoring primary toxins that are released into water bodies in northwest Oregon.

- Ratify and enforce the Stockholm Convention, an international treaty that calls for eliminating sources of persistent organic pollutants (POPs). The United States is a signatory to the convention, but has not ratified it to become a party to the convention – a critical step for addressing problems related to POPs in the North Coast and the nation.

- Reduce pollution from pulp and paper mills through pollution-abatement

programs and by switching to non-chlorine bleaching technologies.

- Require stream buffers on state and private lands, where logging, grazing and agriculture are prohibited, to reduce direct input of sediments, nutrients and other pollutants.

- Close and repair unstable roads to reduce road related debris slides and sedimentation.

- Identify other sources of pollution and work towards zero discharge.

Stop Introduction and Spread of Exotic Species

Threats from nonnative species can be severe. Whether it is an aggressive plant or animal that outcompetes the native flora and fauna, the end result is the same—the potential loss of a great number of native species. We suggest the following to curtail the threat of nonnative species invasions:

- Manage exotic and nonnative plants and animals by identifying problematic species and designing plans to remove these species.

- Prohibit release of unscreened ballast water into the Columbia River or other areas.

Limit Exploitation of Wildlife

The direct harvest of species, along with the indirect loss of individuals from exploitation activities for other species, is a concern to many plants and wildlife in the Tillamook Rainforest. We suggest the following to protect against overexploitation and accidental capture of the species of concern:

coho salmon
photo courtesy NOAA

- Continue to strictly regulate and enforce fishing restrictions for coastal spring chinook and chum salmon.

- Require the use of the latest technology to avoid bycatch of marine mammals, seabirds, non-target fishes, and other marine life.

- Enforce restrictions on collection of species such as the northwestern pond turtle.

Curb Global Warming

To address the serious threat of global warming to both the Tillamook and the planet, we support the goals and strategies developed by Oregon's Governor's Advisory Group on Global Warming, including:

- By 2010, arrest the growth of Oregon's greenhouse gas emissions (including, but not limited to carbon dioxide) and begin to reduce them, making measurable progress toward meeting the existing benchmark for carbon dioxide of not exceeding 1990 levels.

- By 2020, achieve a 10 percent reduction below 1990 greenhouse gas levels.

- By 2050, achieve a "climate stabilization" emissions level at least 75 percent below 1990 levels (State of Oregon 2004).

Additional and more detailed information on the strategies to achieve these goals can be found in the "Oregon Strategy for Greenhouse Gas Reductions, Governor's Advisory Group on Global Warming," online: http://www.oregon.gov/ENERGY/GBLWRM/index.shtml.

More Research

We found little information on several groups of species, particular many invertebrates, plants, and fungi, indicating that more research is necessary to guarantee adequate protection and recovery of the full range of species in the Tillamook. There was no available trend information for 63 percent (96/153) of the critically imperiled and imperiled species, nor for 74 percent (40/54) of the vulnerable species. Percentages of species for which we lacked trend information were even higher for plants, fungi and invertebrates.

Invertebrates, plants, and fungi often play important roles in ecosystems, helping recycle nutrients in the forest and providing an important food source to higher forms of aquatic and terrestrial species. Based on the paucity of available information, it is likely that there are many more imperiled invertebrates, plants, fungi and lichen than we identified. To alleviate this critical lack of data, we recommended the following:

- Design and implement short- and long-term research activities for all imperiled species, especially plants and invertebrates, collecting information on population status and trends, threats, habitat requirements, and other important factors necessary for species recovery.

- Identify critical habitat areas for imperiled species and initiate protective reserves.

bog anemone
photo by Thayne Tuason, CWNP.org

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Pseudocyphellaria perpetua
photo by Karen Dillman, USFS

Appendix I: Critically Imperiled and Imperiled Species of the Tillamook Rainforest and North Coast

Mammals. In the Tillamook Rainforest, there are nine critically imperiled and imperiled mammals: four bats, one small arboreal rodent, three carnivores, and one ungulate. All of the mammals are dependent upon forest habitat. The dusky tree vole is associated to a large degree with old-growth and late-successional stands. Townsend's western big-eared bat, Townsend's big-eared bat, and the fringed myotis utilize forest habitats of both conifer and deciduous trees, grassland and desert shrubland. Likewise, other mammals such as the grizzly bear, gray wolf, and Columbian white-tailed deer are forest species, but also can be found in prairie and meadows.

The greatest threat to the critically imperiled and imperiled mammals of the Tillamook region is habitat loss and destruction. In addition, the Pacific fisher was reduced from much of its historical range in the lower 48 and Oregon by trapping, and the gray wolf from large-scale eradication efforts. The gray wolf, fisher, and grizzly bear are all extinct from the Tillamook region. There are three federally listed and candidate listed mammals including the fisher, gray wolf and grizzly bear. The gray wolf is listed as endangered by the State of Oregon.

Table 1. Imperiled Mammals of the Tillamook Rainforest

Common	Status	Common	Status
gray wolf	extinct	fringed myotis	imperiled
pacific fisher	extinct	Townsend's western big-eared bat	imperiled
Columbian white-tailed deer	extinct	Townsend's big-eared bat (*spp. pallescens*)	imperiled
grizzly bear	extinct	Pacific fringed-tailed bat	imperiled
dusky tree vole	critically imperiled		

Reptiles and Amphibians. We discovered three imperiled amphibians and reptiles in the Tillamook Rainforest: the northwestern pond turtle, painted turtle, and Cope's giant salamander. All three species are denizens of streams, rivers, lakes and ponds throughout the Tillamook Forest. Logging, construction of dams and water drainage for agriculture that alters microhabitat conditions are threats to these species. Other concerns are the infestation of nonnative predators such as bullfrogs, the overall loss and degradation of available habitat, and population isolation. The northwestern pond turtle is also threatened by collection.

Table 2. Imperiled Reptiles and Amphibians of the Tillamook Rainforest

Common	Status	Common	Status
northwestern pond turtle	imperiled	Cope's giant salamander	imperiled
painted turtle	imperiled		

Birds. Twelve critically imperiled and imperiled birds breed in or along the coastline of the Tillamook Rainforest, including the federally endangered and threatened marbled murrelet, northern spotted owl, California condor, and the western snowy plover. Oregon state threatened and endangered species include the aforementioned federally listed species as well as the peregrine falcon. The California condor has been extirpated from the entire state of Oregon and most of the United States. The habitats used for breeding by the imperiled birds of the Tillamook include offshore islands, the sand and grassland of the coastline, as well as coastal and inland forest habitats. The marbled murrelet and northern spotted owl are largely dependent on old-growth habitat. Development of both coastal and forest areas are serious threats to imperiled birds of the Tillamook. Additional threats include urban sprawl, disturbance of nesting areas, predation and competition with native and nonnative species, climate change, and pollution from oil, environmental toxins, and the ingestion of plastics.

Table 3. Imperiled Birds of the Tillamook Rainforest

Common	Status	Common	Status
California condor	extinct	peregrine falcon	imperiled
marbled murrelet	critically imperiled	tufted puffin	imperiled
Cassin's auklet	imperiled	harlequin duck	imperiled
rhinoceros auklet	imperiled	fork-tailed storm petrel	imperiled
western snowy plover	imperiled	purple martin	imperiled
white-tailed kite	imperiled	northern spotted owl	imperiled

Fish. We identified 12 critically imperiled and imperiled fish in the Tillamook Rainforest that are either freshwater, marine, or anadromous (fish that breed in freshwater but live their adult lives in the ocean). Freshwater and anadromous fish are threatened by logging, water withdrawals, dam development, and the release of hatchery fish. There also are numerous impacts on marine fish such as pollution and overharvesting. Half (six of 12) of the critically imperiled and imperiled fish in the Tillamook are threatened under the Endangered Species Act including Columbia River chum, lower Columbia River coho, summer and winter lower Columbia River steelhead runs, and spring and fall lower Columbia River chinook runs. The lower Columbia River chum is extinct.

Table 3. Imperiled Fish of the Tillamook Rainforest

Common	Status	Common	Status
chum salmon (Columbia River ESU*)	critically imperiled	coastal cutthroat trout (lower Columbia River/ southwest Washington coast ESU)	imperiled
chum salmon (Pacific coast ESU)	critically imperiled	steelhead (Oregon coast ESU, winter run)	imperiled
coho salmon (lower Columbia River/southwest Washington coast ESU)	critically imperiled	steelhead (Oregon coast ESU, summer run)	imperiled
steelhead (lower Columbia River ESU, winter run)	critically imperiled	chinook salmon (lower Columbia River, ESU, spring run)	imperiled
chinook salmon (lower Columbia River ESU, fall run)	critically imperiled	coho salmon (Oregon Coast ESU)	imperiled
steelhead (lower Columbia River ESU, summer run)	imperiled	coastal spring chinook	imperiled

*ESU = evolutionary significant unit, used for listing salmon under the Endangered Species Act. An ESU is a set of populations that is substantially reproductively isolated from other such populations with a potentially distinct evolutionary history.

Invertebrates. There are 18 critically imperiled and imperiled invertebrates in the Tillamook Rainforest, including 10 mollusks and eight insects. Both freshwater and terrestrial mollusks inhabit the Tillamook Rainforest and are threatened by logging, the construction of dams, water conversion for agriculture, and pollution. There is one species, the spotted taildropper, for which we were not able to find habitat or threat information. The insects include three beetles, two butterflies, and three bugs. The paucity of habitat and threat information makes it difficult to assess the exact threats to these species. However, the destruction or degradation of their habitat from logging, development, and exotic plant invasions are obvious threats. The Oregon silverspot butterfly, the only insect with habitat information, is found in stabilized dunes and salt spray meadows and is threatened by exotic species and development. The Oregon silverspot butterfly is protected under the Endangered Species Act.

Table 4. Imperiled Invertebrates of the Tillamook Rainforest

Common	Classification	Status	Common	Classification	Status
sandbar darkling beetle	insect	extinct	Tillamook westernslug	mollusk	imperiled

Common	Classification	Status	Common	Classification	Status
Roth's blind ground beetle	insect	critically imperiled	broadwhorl tightcoil	mollusk	imperiled
hoary elfin butterfly	insect	critically imperiled	spotted tail-dropper	mollusk	imperiled
California floater	mollusk	critically imperiled	western ridge mussel	mollusk	imperiled
Willamette floater	mollusk	critically imperiled	Oregon plant bug	insect	imperiled
rotund physa	mollusk	critically imperiled (possibly extinct)	Johnson's waterfall carabid beetle	insect	imperiled
nerite ramshorn	mollusk	critically imperiled (possibly extinct)	Oregon silverspot butterfly	insect	imperiled
evening field slug	mollusk	critically imperiled	Mulsant's water treader	insect	imperiled
warty jumping slug	mollusk	imperiled	marsh damsel bug	insect	imperiled

Plants. There is a wide range of critically imperiled and imperiled plants in the Tillamook Rainforest, from mosses and liverworts to rare lilies and bluegrass. We identified 56 imperiled plants that occupy a variety of habitats from coastal shorelines and sand dunes to forest, mountain, and riparian areas. The plants associated with forest habitat, wetlands, rivers, streams and lakes are threatened by logging, development, water drainage, exotic species and pollution. Along the coast, development, exotic species, and pollution threaten plants and their associated habitat. We were unable to find threat and habitat information for many of the critically imperiled and imperiled plants, indicating the need for more detailed studies. One plant, Nelson's sidalcea, is listed as threatened under the Endangered Species Act, and five are threatened or endangered under the Oregon State Endangered Species Act. These include the Cascade Head catchfly, Nelson's sidalcea, Coast Range fawn-lily, Point Reyes bird's-beak, and Munz pink sand verbena.

Table 5. Imperiled Plants of the Tillamook Rainforest

Common	Status	Common	Status
Munz pink sand verbena	critically imperiled	western red avens	critically imperiled

Common	Status	Common	Status
bog anemone	critically imperiled	seaside gilia (dark-eyed gilia)	critically imperiled
Saddle Mountain bittercress	imperiled	western marsh-rosemary	critically imperiled
many-flowered sedge	critically imperiled	northern bog clubmoss	imperiled
Chambers' paintbrush	critically imperiled	coast microseris	imperiled
Point Reyes bird's-beak	critically imperiled	North Pacific plantain	critically imperiled
Willamette Valley larkspur	critically imperiled	creeping starwort	critically imperiled
frigid shootingstar	imperiled	*Calypogeia sphagnicola* (liverwort)	imperiled
small spikebrush	extinct	*Diplophyllum plicatum* (liverwort)	imperiled
wandering daisy	imperiled	*Plagiochila semidecurrens* (liverwort)	critically imperiled
Coast Range fawn-lily	critically imperiled	*Barbilophozia barbarta* (liverwort)	critically imperiled
queen-of-the-forest	imperiled	*Herbertus aduncus* (liverwort)	critically imperiled
rosy lewisia	imperiled	*Herbertus sakuraii* (liverwort)	critically imperiled
San Francisco bluegrass	critically imperiled	*Lophozia laxa* (liverwort)	imperiled
Saddle Mountain saxifrage	critically imperiled	*Metzgeria temperata* (liverwort)	critically imperiled
Flett's groundsel	imperiled	*Radula brunnea* (liverwort)	critically imperiled
Henderson's sidalcea	critically imperiled	*Tritomaria quinquedentata* (liverwort)	critically imperiled
bristly-stemmed sidalcea	imperiled	*Cynodontium jenneri* (moss)	critically imperiled

Common	Status	Common	Status
Nelson's sidalcea	imperiled	*Encalypta brevipes* (moss)	critically imperiled
Cascade Head catchfly	critically imperiled	*Hedwigia stellata* (moss)	imperiled
short-stemmed sedge	imperiled	*Iwatsukiella leucotricha* (moss)	critically imperiled
pale sedge	imperiled	*Oxystegus tenuirostris* (moss)	critically imperiled
Alaska long-awned sedge	imperiled	*Platyhypnidium riparioides* (moss)	imperiled
retrorse sedge	critically imperiled	*Pohlia sphagnicola* (moss)	critically imperiled
russett cottongrass	critically imperiled	*Racomitrium aquaticum* (moss)	imperiled
Indian rice	critically imperiled	*Rhytidium rugosum* (moss)	critically imperiled
sweet gale	critically imperiled	*Tetraphis geniculata* (moss)	critically imperiled
Russian water-milfoil	critically imperiled	*Tetraplodon mniodes* (moss)	critically imperiled

Lichen and Fungi. As with the plants, there is very little habitat and threat information on the critically imperiled and imperiled lichen and fungi of the Tillamook Rainforest. Fungi and lichen are largely found in forest ecosystems. Other areas where fungi and lichen are found are on rocky outcrops, talus slopes, dunes, and riparian areas. There are two lichens and four fungi that are associated with late-successional and old-growth stands. Lichens are highly sensitive to air pollution and climate change. Other threats to lichen and fungi are logging, development, herbicide use and other habitat-disturbing activities, as well as overcollection. There are no federally or state-listed fungi or lichen.

Table 6. Imperiled Lichen and Fungi of the Tillamook Rainforest

Scientific	Status	Scientific	Status
Noleana edulis	critically imperiled	*Bryoria bicolor*	critically imperiled
Radiigera bushnellii	critically imperiled	*Bryoria subcana*	imperiled
Catathelasma ventricosa	imperiled	*Bryoria pseudocapillaris*	critically imperiled

Scientific	Status	Scientific	Status
Chamonixia caespitosa	critically imperiled	*Cetrelia cetrarioides*	imperiled
Choiromyces alveolatus	imperiled	*Cladonia norvegia*	imperiled
Chrysomphalina grossula	critically imperiled	*Erioderma sorediatum*	imperiled
Clavulina castaneopes	imperiled	*Heterodermia sitchensis*	critically imperiled
Cortinarius depauperatus	critically imperiled	*Hypogymnia duplicata*	imperiled
Endogone oregonensis	imperiled	*Hypogymnia pulverata*	critically imperiled
Helvella maculata	imperiled	*Hypotrachyna revoluta*	critically imperiled
Mycena tenax	critically imperiled	*Ochrolechia subplicans*	imperiled
Pannaria rubiginosa	imperiled	*Pilophorus nigricaulis*	imperiled
Phaeocollybia dissiliens	imperiled	*Pseudocyphellaria perpetua*	imperiled
Phaeocollybia californica	imperiled	*Pyrrhospora quernea*	imperiled
Phaeocollybia gregaria	critically imperiled	*Ramalina pollinaria*	critically imperiled
Phaeocollybia lilacifolia	critically imperiled	*Sticta arcticta*	critically imperiled
Phaeocollybia olivacea	imperiled	*Teloschistes flavicans*	critically imperiled
Ramaria rubella	critically imperiled	*Usnea hesperina*	critically imperiled
Thaxterogaster pavelekii	critically imperiled	*Usnea longissima*	imperiled
Tuber asa	critically imperiled	*Usnea rubicunda*	imperiled

Photos, clockwise: Point Reyes bird's beak (California Native Plant Society), Cope's giant salamander (WDFW), chinook salmon (Ernest Keeley), harlequin duck (Glen Tepke)

Appendix II: Vulnerable Species of theTillamook Rainforest and North Coast

Table 1. Vulnerable Mammals of the Tillamook Rainforest

Common	Natureserve state	Natureserve national	Federal	Oregon State
white-footed vole	S3S4	G3G4	SOC	SU
silver-haired bat	S3S4	G5	SOC	SU
hoary bat	S3	G5		
American marten	S3S4	G5		SV
long-eared myotis	S4	G5	SOC	SU
long-legged myotis	S3	G5	SOC	SU
Yuma myotis	S3	G5	SOC	
western gray squirrel	S4	G5		SU
California myotis	S3	G5		

Table 2. Vulnerable Reptiles and Amphibians of the Tillamook Rainforest

Common	Natureserve state	Natureserve national	Federal	Oregon State
clouded salamander	S3	G3		SU
coastal-tailed frog	S3	G4	SOC	SV
western toad	S3	G4		SV
northern red-legged frog	S3S4	G4T4	SOC	SV (Willamette Valley)/SU (elsewhere)

Common	Natureserve state	Natureserve national	Federal	Oregon State
Columbia torrent salamander	S3	G3		SC
southern torrent salamander	S3	G3G4	SOC	SV

Table 3. Vulnerable Birds of the Tillamook Rainforest

Common	Natureserve state	Natureserve national	Federal	Oregon State	Audubon
northern goshawk	S3B	G5	SOC	SC	
acorn woodpecker	S3	G5	SOC	SV	
olive-sided flycatcher	S3B	G4	SOC	SV	yellow
black oystercatcher	S3	G5			yellow
band-tailed pigeon	S3B	G4	SOC		
slender-billed nuthatch	S3	G5T4			

Table 4. Vulnerable Fish of the Tillamook Rainforest

Common	Natureserve state	Natureserve national	Federal	Oregon State	Oregon Dept. of Fish and Wildlife status report
green sturgeon	S3	G3	SOC		not at risk
river lamprey	S3?	G4	SOC		

Common	Natureserve state	Natureserve national	Federal	Oregon State	Oregon Dept. of Fish and Wildlife status report
Pacific lamprey	S3	G5	SOC	SV	at risk
coastal cutthroat trout (Oregon Coast ESU)	S4	G3T3Q	SOC	SV	not at risk

Table 5. Vulnerable Invertebrates of the Tillamook Rainforest

Common	Classification	Natureserve state	Natureserve national	Federal	Oregon State
Oregon floater	Mollusk	S3	G5		
Oregon megomphix	Mollusk	S3	G3		
Siuslaw sand tiger beetle	Insect	S3?	G5T3		
Lepania cascada (caddisfly)	Insect	S3	G3	SOC	

Table 6. Vulnerable Plants of the Tillamook Rainforest

Common	Natureserve state	Natureserve national	Federal	Oregon State
Howell's montia	S3	G3G4		C
loose-flowered bluegrass	S3	G3		
yellow sandverbena	S3	G5		
flaccid sedge	S3	G5T5		

bighead sedge	S3	G5		
tall bugbane	S3	G3		C
California pitcher plant	S3S4	G3G4		
male fern	S3	G5		
dwarf isopyrum	S3	G4?		
western wahoo	S3	G5		
flowering quillwort	S3?	G5?		
common water-milfoil	S3	G5		
San Francisco bluegrass	S1?	G3	SOC	

Table 7. Vulnerable Lichen and Fungi of the Tillamook Rainforest

Scientific	Natureserve state	Natureserve national	Federal	Oregon State
Clitocybe senilis	S3?	G3G4Q		
Gymnopilus punctifolius	S3	G3G4		
Macowanites chlorinosmus	S3	G3?		
Phaeocollybia piceae	S3?	G3?		
Phaeocollybia pseudofestiva	S3?	G3		
Phaeocollybia sipei	S3?	G3?		
Phaeocollybia spadicea	S3?	G3G4		

Scientific	Natureserve state	Natureserve national	Federal	Oregon State
Phaeocollybia scatesiae	S3?	G3?		
Calicium abietinum	S3	G4G5		
Chaenotheca furfuracea	S3	G4G5		
Platismatia lacunosa	S3	G3G4		
Pseudocyphellaria rainierensis	S3	G3G4		

Photos this page: acorn woodpecker (Glen Tepke), *Pseudocyphellaria rainierensis* (Karen Dillman, USFS)
Photos facing page, clockwise: silver-haired bat (© Merlin D. Tuttle, Bat Conservation International), western wahoo (Charles Webber © California Academy of Sciences), western toad (Joyce Gross), Oregon megomphix (William Leonard), American marten (Gerald and Buff Corsi © California Academy of Sciences), California pitcher plant (Jo-Ann Ordano © California Academy of Sciences)