

Chapter 10 Ecosystems and Endangered Species Act Issues

1 What are the major ecosystems in the central Puget Sound region?

The central Puget Sound region includes three major ecosystems—upland or terrestrial, freshwater, and marine/nearshore. Within these ecosystems, a number of different habitat types can be defined. Examples of Puget Sound habitats include high-elevation glaciers; alpine meadows; mid-elevation mixed forests of fir, hemlock, alder, and maple; prairie and oak woodlands; river floodplains; freshwater wetlands; riparian forests; estuarine and tidal marshes; mudflats; kelp beds and eelgrass meadows; rocky shores; bluffs; sand and gravel beaches; and the deeper marine waters of Puget Sound. Ecosystems and habitats are formed and maintained by the interaction of physical, chemical, and biological processes occurring throughout their watersheds.

While each of these habitat types play some role in overall ecosystem health, some have been defined as regionally significant by state and nonprofit stakeholders. These high-quality ecosystems are considered to be more vulnerable to land use changes and their associated infrastructure systems. These habitats, which are shown in Exhibit 10-1, have been identified as high priorities for conservation based on systems-level approaches, rather than reflecting individual species of concern or individual resources.

Central Puget Sound includes parts of three ecoregions (Exhibit 10-2):

- West Cascades
- Puget Trough to the foothills of the Olympic Mountains
- North Cascades

Which elements of Washington Administrative Code (WAC) 197-11-444 are addressed in this chapter?

This chapter addresses:

- Section (1)(d)(i) Habitat for and numbers or diversity of species of plants, fish, or other wildlife
- Section (1)(d)(ii) Unique species
- Section (1)(d)(iii) Fish or wildlife migration routes

What is the Endangered Species Act?

The Endangered Species Act of 1973 is an environmental law designed to protect critically imperiled species from extinction as well as the ecosystems upon which they depend.

What is an ecosystem and ecoregion?

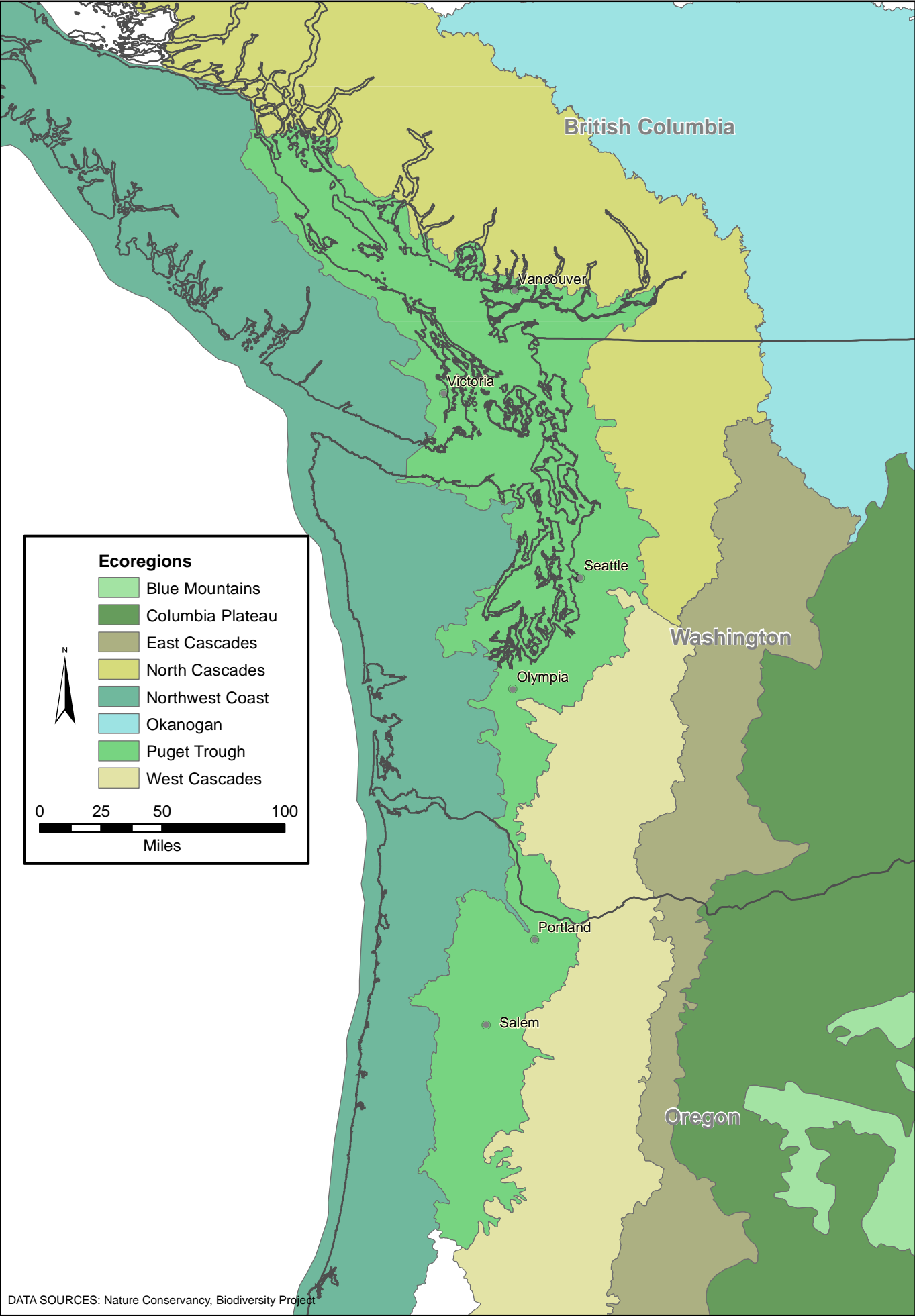
An ecosystem includes all living organisms (biological factors) in an area, as well as the physical environment, and the interactions between the two, functioning together as a unit. For example, Puget Sound, including all the interacting physical and biological components, is an ecosystem.

Ecoregions are larger geographic areas that are defined by similarity of climate, landforms, and biological communities.

Exhibit 10-1. Areas Identified as Regionally Significant Habitat Areas



Exhibit 10-2. The Puget Trough Ecoregion and Surrounding Ecoregions



West and North Cascades Ecoregions

The West and North Cascades ecoregions include the mountain slopes, alpine ridges, and glaciers of the Cascade Mountain Range in Washington. The central Puget Sound region includes the western slope of the Cascades from Mt. Rainier north to the Skagit County border. The western, windward slopes of the Cascade Range are areas of high rainfall and winter snow, and are covered by temperate rainforests. Conifers such as fir, hemlock, and spruce predominate and can grow to enormous size, especially on the moister, western slopes. The extreme variability of soils and geology, combined with extensive effects of glaciation and topography, have led to large localized differences in climate, species, natural communities, and ecological systems.

Numerous wildlife species characterize the Cascades region, including large mammals such as the mountain lion (*Felix concolor*) and black bear (*Ursus americanus*), which still persist as apparently stable, self-sustaining populations. When the region was extensively logged, the more open habitats of cleared areas and very young forest supported large populations of black-tailed deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*). Populations of these mammals have declined because most logged areas that provided abundant forage have reforested. Mountain streams and wetlands support a relatively high number of amphibian species. In addition to the conifer forests, plants in the region include a number of species that are not found elsewhere—most of these are concentrated in alpine habitats on Mt. Rainier and the higher elevations in the North Cascades.

Puget Trough Ecoregion

The Puget Trough ecoregion includes the wide lowlands and large river valleys adjacent to Puget Sound, forested foothills of the Cascades and Olympic Mountain ranges, and the marine waters of Puget Sound. The Puget Trough contains a number of large freshwater lakes, including Lake Washington and Lake Sammamish. Large rivers include the White, Carbon, Puyallup, Green/Duwamish, Cedar, Snohomish, and Stillaguamish.



The Cascade Mountain Range is home to many plant and animal species.

Source: Wikipedia, 2005a



Puget Sound is part of the Puget Trough ecoregion.

Source: Wikipedia, 2006

Historically, coniferous forest dominated the vegetation in the Puget Trough ecoregion, with many of the largest trees in North America occurring in this region. Also present were a mix of riparian habitats, oak woodlands, and prairies. The native forest is primarily of Douglas fir, western red cedar, and western hemlock. Red alder, black cottonwood, and big leaf maple grow in riparian areas. Red alder also colonizes areas disturbed by fire or logging. Common understory plants in these forests include sword fern and shrubs such as snowberry, Oregon grape, Indian plum, and salmonberry. On dry bluffs, Pacific madrone trees are frequently found. Garry oak is the only native oak in Washington and occurs in oak woodlands and oak savannas mixed with native prairies. Oregon ash occurs in wetlands within oak woodlands and along wetland or stream riparian areas.

Many of the same wildlife species that occur in the Cascades also occur in the Puget lowlands. The varied habitats support populations of migratory songbirds, raptors, waterfowl, and shorebirds. Puget Sound lowland rivers are home to all five species of Pacific salmon, including Chinook, coho, sockeye, pink, and chum salmon. Puget Sound rivers also support bull trout, sea-run cutthroat, steelhead, Pacific lamprey, and a number of native sculpins.

Urban and Agricultural Environments

The vegetation in most of the central Puget Sound region has been altered and replaced with agriculture, residential landscaping, or urban and industrial development. This development has fragmented the remaining undeveloped habitat. Much of the forest cover in the region has been replaced by impervious surface. Between 1991 and 2001, 2.3 percent of the forest cover was lost, and impervious surface increased by 4 percent (Ruckelshaus and McClure, 2007). Invasive plant species have become common or dominant in many areas and include purple loosestrife and reed canarygrass in wetlands, Eurasian milfoil in lakes, and English ivy in forested areas.

What is a riparian zone?

A riparian zone is the strip of vegetation that grows along the edge of rivers, lakes, and marine shorelines and creates a buffer between terrestrial and aquatic habitats. The word “riparian” is derived from Latin *ripa*, meaning river bank.

Riparian zones are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. Local and state environmental regulations establish protected buffers adjacent to critical areas to protect the functioning of critical areas, such as salmon-bearing streams.

Some animal species are adaptable to cities and suburbs, and their populations have increased in the region. Typical urban wildlife include raccoons, crows, and coyotes, and introduced species such as opossum, European starlings, and rock pigeons.

Puget Sound Marine Environments

Puget Sound's marine environment is rich and complex, with a wide variety of deepwater and nearshore habitats. These include coastal lagoons, kelp and seagrass beds, rocky shores, sandy beaches and spits, large estuaries, and salt marsh wetlands.

The steep underwater slopes in many parts of Puget Sound create limited shallow water area near the shore. Sunlight in this area allows eelgrass, seaweeds, and plankton to grow—providing food and shelter for many invertebrates, young salmon, herring and other fish, and wading and diving birds. The Puget Sound's waters support numerous residential and migratory marine species, including over 150 species of marine birds, 230 species of fish, 20 mammal species, over a thousand species of plants and algae, and numerous invertebrates and microbes. Marine mammals include harbor seals, orcas, porpoises, and California sea lions. Marine invertebrates include sea urchins, as well as native and introduced species of shellfish. Some of the largest octopus and barnacle species in the world live here.

2 Which species are listed under the ESA?

Loss, fragmentation, and degradation of aquatic and riparian habitats and old-growth forests have contributed to the decline of many species within the ecoregion. The populations of a number of native species have declined to the extent that they are listed as threatened or endangered under the federal Endangered Species Act (ESA) (refer to sidebar).

Chinook salmon (*Oncorhynchus tshawytscha*), Coho salmon (*Oncorhynchus kisutch*), bull trout (*Salvelinus confluentus*), and steelhead (*Oncorhynchus mykiss*) are among the well-known aquatic species at risk within the ecoregion. Substantial efforts have been undertaken to protect these species.

Species in the region listed under the federal Endangered Species Act of 1973:

Listed species

Bull trout (*Salvelinus confluentus*)
 Canada lynx (*Lynx canadensis*)
 Grizzly bear (*Ursus arctos* = *U. a. horribilis*)
 Gray wolf (*Canis lupus*)
 Marbled murrelet (*Brachyramphus marmoratus*)
 Northern spotted owl (*Strix occidentalis caurina*)
 Marsh sandwort (*Arenaria paludicola*)
 Golden paintbrush (*Castilleja levisecta*)
 Water howellia (*Howellia aquatilis*)
 Puget Sound Chinook (*Oncorhynchus tshawytscha*)
 Puget Sound steelhead (*Oncorhynchus mykiss*)
 Southern Resident Orca (*Orcinus orca*)

Candidate Species

Oregon spotted frog (*Rana pretiosa*)
 Yellow-billed cuckoo (*Coccyzus americanus*)
 Mardon skipper (*Polites mardon*)
 Mazama pocket gopher (*Thomomys mazama* ssp. *glacialis* and *tacomensis*)
 Streaked horned lark (*Eremophila alpestris strigata*)
 Taylor's checkerspot (*Euphydryas editha taylori*)

3 Which species are currently under state and local agency protection?

Washington state also has several programs and laws designed to protect and conserve natural species and their habitats. These include the Washington State Department of Fish and Wildlife priority habitats and species program, which identifies endangered, threatened, and sensitive wildlife species and their habitats (Washington Administrative Code [WAC] 232-12-297). The Department of Natural Resources manages the Washington Natural Heritage Program (WNHP) and maintains lists of rare plants and natural communities in the state, under the authority of the Natural Area Preserves Act (Ch. 79.70 Revised Code of Washington [RCW]).

Many of the listed species are provided some level of protection at the local level by critical areas ordinances adopted under the Growth Management Act. County and city critical areas ordinances are intended to provide protection in these designated areas, which include: (a) wetlands, (b) areas with a critical recharging effect on aquifers used for potable water, (c) fish and wildlife habitat conservation areas, (d) frequently flooded areas, and (e) geologically hazardous areas. Because these areas coincide with state-listed species, the ordinances provide some level of protection that can help avoid, minimize, and, where practicable, mitigate unavoidable impacts that result from permitted activities. State agencies have also prepared management plans for a number of listed species and habitats that provide guidance for avoiding, minimizing, and mitigating impacts to these species and habitats.

4 What are the current issues affecting ecosystems and species in the central Puget Sound region?

Major factors affecting ecosystems and species include climate change, alteration of ecosystem processes, loss of forest habitat, loss or alteration of habitat, habitat fragmentation, invasive species, overharvesting, impervious surface and water pollution, and changes in natural flow regimes. Transportation systems, which are a component of the overall urban

Washington State Department of Fish and Wildlife priority habitats and species

To see the list of endangered, threatened, and sensitive wildlife species and their habitats, please refer to Appendix G.

Washington Natural Heritage Program

To see the list of rare plants, please refer to Appendix H.

development pattern within the central Puget Sound region, have historically played a key part in these ecosystem changes.

Climate Change

Sea level rise associated with climate change is expected to increase erosion and landslides and decrease some shoreline and estuarine habitats. Changes in oceanographic processes such as circulation, mixing, and stratification, as well as water temperatures and chemistry, are expected to influence salmonids and other marine life. Increases in marine water temperatures may affect plankton diversity, distribution, and abundance, thereby driving changes in other species' composition and abundance in the marine food webs. Climate change and higher temperatures may already be limiting populations of Pacific cod. Changes in early spring temperatures are expected to lead to mismatches in insect development and host plant flowering. These changes would affect the reproductive success of the populations and possibly lead to extinctions. Warmer air temperatures apparently have led to a lengthening of the period of summer stratification in Lake Washington, which in turn affects the timing of phytoplankton and zooplankton blooms. These changes disrupt the interaction between predator and prey at the base of the food chain.

While there are uncertainties related to the amounts of future emissions that will affect climate change and the climate system's sensitivity to changes in emissions, scientists project that climate change will have significant effects on the species, food webs, and biodiversity of the Puget Sound basin. (Also refer to Chapter 9: Water Quality and Hydrology for more discussion on climate change and water resources.)

Alteration of Ecosystem Processes

Critical ecosystem processes that maintain habitat and support biological communities have been altered in terrestrial, freshwater, and marine ecosystems. Important processes include the movement of water, sediment, large woody debris, and organisms. The movement of water and sediment creates complex habitats in river channels, floodplains, and estuaries

What are the actions affecting marine and nearshore ecosystems?

Development and actions that affect the marine and nearshore ecosystems include:

- Overwater structures
 - Dredging and channel straightening
 - Marinas
 - Oil spills
 - Jetties, breakwaters, log booms, and rafts
 - Culverts/tide gates
 - Armoring – seawalls, bulkheads, and revetments
 - Aquaculture
 - Fill/dikes
 - Removal of native vegetation
 - Invasive species
 - Habitat conversion
 - Impervious surfaces/stormwater runoff
 - Excess nutrients (septic, stormwater, wastewater)
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that are critical spawning, rearing, and refuge areas for salmonids. Coastal bluffs provide sources of sediment to the nearshore and currents carry sediment along the shore to be deposited on beaches, spits, and lagoons. These processes are important to the formation of pocket estuaries, salt marshes, forage fish spawning beaches, and eelgrass meadows.

The armoring of river banks and marine shorelines, draining and filling of wetlands and floodplains, channelizing and diking of rivers, and blocking tidal flows with roadways and tide gates are examples of the types of process alterations that are affecting ecosystems and species.

Loss of Forests

The loss of the extensive contiguous native forest habitats has had a number of consequences for species and ecosystems. Most forest areas have undergone significant changes due to extensive logging, conversion for agriculture, and/or urban development. Only 10 percent of the state's remaining forests are old growth. There were 5.2 million acres of forest cover in Puget Sound in 2001. Between 1991 and 2001, 2.3 percent of the forest cover was lost. Over the last 50 years, between 66 and 84 percent of old-growth forest has been lost (Ruckelshaus and McClure, 2007). In the Puget Sound region, native vegetation in more than 5 percent of the area has been converted to other types of land uses.

Habitat Loss and Fragmentation

Habitat loss is one of the major reasons that populations of some species are declining and others are threatened in the region. Habitat is lost through replacement or conversion of one type of habitat with another, for example, converting forest to agricultural fields or urban landscapes. Habitat is also lost when key ecological processes are altered. This loss occurs when freshwater wetlands and estuaries are drained or diked to change the hydrology; floodplains are filled or rivers are confined within levees; or oak woodlands and prairies are lost to encroaching forests because fires no longer occur.

Significant habitat losses include more than 80 percent of historical prairie and oak woodland areas, more than 90 percent



Riverbank armoring affects ecosystems.

Source: Wikipedia, 2005b

What is habitat fragmentation?

The creation of smaller and smaller blocks of habitat that are separated by roads or other developed areas. Fragmented habitats typically lack connecting corridors that allow the movement of animals between areas of suitable habitat.

Smaller habitat areas often cannot support viable populations.

of coastal salt marshes, more than 70 percent of estuaries, over one-third of Puget Sound shorelines armored, and from 50 to 90 percent of riparian habitat in the region (Collins and Sheikh, 2005; PSAT, 2007).

The loss of habitat through the development of roads and other infrastructure also occurs through habitat fragmentation. If habitat blocks become smaller and separated from each other by developed areas, then the movement of animals is restricted. Smaller, disconnected habitats are frequently not large enough, or connected enough, to allow the persistence of plants and animals. The result is that the more fragmented a habitat is, the smaller populations become, and the more likely that species will become threatened.

Invasive Species

Changes in habitats and the introduction of nonnative species can threaten native species. Invasive nonnative species tend to be very aggressive, can spread much faster than native species, and typically out-compete native species. Invasive species that have altered the region's ecosystems include the following:

- Purple loosestrife, Himalayan blackberry, reed canarygrass, and Japanese knotweed in wetlands and riparian areas
- English ivy in forested areas
- Smooth cordgrass in salt marshes and mudflats
- Japanese eelgrass and European green crab in intertidal areas
- Nonnative bullfrog and Eurasian water milfoil in open-water wetlands and lakes

Overharvesting

Harvest pressure and overharvesting can directly and indirectly affect species. Overharvesting can reduce the number of individuals in a population to the point at which the population is no longer viable. This has happened with a number of commercially harvested fish species that are no longer abundant enough to support a commercial fishery—for example, Pacific herring, sardines, and some populations of salmonids in Puget Sound.

Southern Resident Orcas

Southern Resident orcas use the waters of the Georgia Strait and Puget Sound and are in serious decline due to pollution and declines in populations of their prey, especially Chinook salmon.

As of October 2007, there were 87 documented Southern Resident orca individuals, compared to historical estimates of 140 to 200 individuals.

Overharvesting can also have indirect consequences on other species. For example, Southern Resident orcas feed on Chinook salmon in Puget Sound. The drastic declines in salmon numbers compared to historical conditions may be resulting in a scarcity of food for the orcas and contributing to the decline of this species.

Impervious Surface, Water Pollution, and Changes in Flow Regimes

Increases in impervious surface across the region have resulted in changes to hydrology and water pollution in streams, rivers, lakes, estuaries, and the nearshore. The total impervious surface area increased by more than 7 percent in the central Puget Sound region during the 1990s, and continues to increase today. Changes in the natural flow regimes of rivers and streams can negatively affect aquatic organisms. For example, increases in peak flows can reduce the survival of salmon eggs and fry. Additional information on water pollution issues related to transportation systems is provided in Chapter 9: Water Quality and Hydrology.

5 How are ecosystems and species regulated?

A number of federal laws that regulate water resources, coastal resources, and endangered species can affect ecosystems and species. These include the Clean Water Act (CWA), Coastal Zone Management Act, ESA, and National Environmental Policy Act (NEPA). At the state level, regulations that govern land use or resource management, such as the State Environmental Policy Act (SEPA), the Shoreline Management Act, the Growth Management Act, and the Forest Practices Act affect ecosystems and species. State regulations that affect waters of the state govern some uses and alterations to the aquatic environment, including primarily the Hydraulic Project Approval process for alterations that affect waters of the state. The Growth Management Act and Shoreline Management Act are administered primarily at the local level through city and county critical areas ordinances and shoreline master plans.

6 What services are provided by the ecosystems of the central Puget Sound region and how do they support human well-being?

The ecosystems of the central Puget Sound region provide a number of important ecosystem services that directly benefit people. These include well-known services such as providing healthy populations of fish, shellfish, and wildlife that support recreational and commercial harvest. Ecosystems also provide valued recreational activities such as shellfish gathering, recreational fishing, bird watching, boating, and hiking, as well as the aesthetic values associated with natural landscapes.

Ecosystems also provide a range of less familiar services, such as mitigating a wide variety of natural hazards—floods, landslides, erosion, and potentially sea level rise due to climate change. Climate regulation services at both the global (through carbon sequestration and regulation of gases) and local scales (temperature regulation through tree shade) are also provided by the region’s natural systems. Forested areas, wetlands, and riparian forests also infiltrate and manage surface water runoff, store flood waters, and improve water quality by filtering sediment, nutrients, and pollutants from the water.

7 What effects on ecosystems and listed species are common to all alternatives?

The specific effects on ecosystems and listed species would be determined by project-level environmental review. The following likely effects would be common to all alternatives.

Climate Change

The expected effects of climate change on ecosystems and species would occur under all of the alternatives. Specific effects of climate change would depend, in part, on the proximity of individual transportation projects to sensitive habitats and/or species. For example, the natural process of beach and bluff erosion could allow adaptation to sea level rise in some locations. New beaches could form by the erosion of bluffs as sea levels rise, with the bluffs becoming narrower and migrating inland from their current location. However, if

What are ecosystem services?

Ecosystem services are the benefits that people receive from ecosystems. They include the mitigation of natural hazards such as floods and storm damage, the provision of clean water, pollination of wild plants and food crops, climate regulation, and cultural, recreational, and aesthetic values.



Transportation facilities near shorelines may be damaged by rising sea levels.

Source: Wikimedia Commons, 2007

shorelines are armored to protect transportation facilities located near the shoreline, then beach migration would not occur and habitat could be permanently lost.

Habitat Loss, Invasive Species, and Fragmentation

Habitat loss/fragmentation, pollution, and alterations of ecological processes would be similar for all alternatives. Much of the region's transportation system is already in place, and the most common type of improvements for all alternatives involve the replacement or expansion of existing facilities within the urban area. The new or expanded transportation facilities are only a small percentage of the overall transportation system, ranging from 3 to 10 percent.

Current conditions of habitat loss, invasive species, and/or fragmentation would likely continue for all alternatives, including the Baseline Alternative. The existing effects of habitat fragmentation would continue unless additional mitigation actions are established.

Some new or expanded transportation facilities would affect existing habitat and increase fragmentation. However, where improvements are located along existing roadways and park-and-ride lots, the impacts would likely not be as great as facilities in new areas. Some improvements would require new rights of way, widening of roadways, expansion of park-and-ride lots, or trail systems. These requirements could increase the amount of habitat lost or fragmented over current conditions. Some of the existing aging transportation infrastructure could be replaced in a manner that would benefit ecosystems and species. For example, more wildlife corridors and/or native landscaping along roadways and park-and-ride lots could be incorporated in the project design.

Loss of Forests

Similar to effects on fragmentation, most of the region's transportation system is already in place, and most improvements for all alternatives would occur within developed or urban areas. Improvements in all alternatives that include expansion of existing footprints, if they occur in areas

that are currently forested, have the potential to increase forest loss in the region.

Impervious Surfaces, Pollution, and Alterations to Processes

Much of the region's transportation system is already in place, with existing levels of impervious surface. The most common type of improvements for all alternatives involves the replacement or expansion of existing facilities within the urban area. While new or expanded transportation facilities could result in impervious surface increases (refer to Chapter 9: Water Quality and Hydrology for more information), these activities provide opportunities to improve the environmental performance for facilities that were built before many of today's environmental regulations were in place. Although all of the alternatives assume the continued operation of the existing transportation system, only a portion would be improved during the 30-year planning horizon for Transportation 2040. The existing effects from water quality impairment and changes in hydrology due to impervious surfaces would be similar to those discussed in Question 8.

Overharvesting

None of the alternatives are expected to affect current levels of, or impacts from, overharvesting.

Construction Impacts

All the alternatives would be affected by construction because new transportation facilities are part of each alternative. Construction impacts include vegetation removal, soil disturbance, potential soil erosion, increased impervious surface, and increased sedimentation in surface waters.

8 Which alternatives would be likely to cause the greatest number of effects on ecosystems and species?

As noted in the sidebar, this plan-level FEIS will not list the specific individual effects that could result from all of the projects contained in each plan alternative. In addition, it is not practicable to conduct a detailed regionwide evaluation of the

What is the difference between plan-level and project-level environmental review?

This FEIS is a plan-level (rather than a project-level) EIS. Accordingly, alternatives are defined and environmental effects are evaluated at a relatively broad level. More detailed project-specific environmental review will be developed as appropriate in the future for projects identified in the Transportation 2040 plan that are selected for implementation by their respective sponsors, for example, WSDOT, transit agencies, and local jurisdictions.

collective effect on the region's ecosystems and species from all projects. Therefore, this plan-level FEIS does not contain a regionwide analysis of ecosystems and species.

However, it is possible to provide an approximation of which alternatives could result in the greatest number of effects on ecosystems and species. The plan alternatives contain varying levels of new transportation infrastructure (Exhibit 10-3). It is likely that the alternatives with the most new infrastructure would result in the greatest number of effects on ecosystems and species.

This section uses two methods to compare potential impacts among alternatives on habitat loss and fragmentation: (1) the amount of new transportation infrastructure in terms of total lane (or rail or trail) miles is used to compare the potential total effect on ecosystems and species, and (2) an estimate of the number of projects that are located within sensitive habitat areas. The overall effect on ecosystems and species is related to the size of the infrastructure footprint, which could affect habitat loss and fragmentation, as well as alterations to processes (e.g., changes in flow regimes). A more specific measure of effects on habitats and species is provided by the overlay of projects from each alternative on critical habitat locations.

The types of effects discussed in the previous section could occur under any of the proposed plan alternatives, including the Baseline Alternative. The alternatives differ in the amount of new transportation infrastructure (refer to Exhibit 10-3) and in the co-location of that infrastructure with significant habitats and floodplains (Exhibits 10-4 and 10-5). Therefore, the potential magnitude of overall effects on habitat loss and fragmentation, alterations to processes, and effects of impervious surfaces could be different among alternatives.

Exhibit 10-3¹**Miles of New Infrastructure Included in Each Alternative**

Facility Type	Base Year 2006	Baseline Alt	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Preferred Alt
Systemwide freeway and arterial lane miles	12,806	13,153	13,352	14,013	13,540	13,489	13,329	13,764
New freeway and arterial lane miles	-	348	546	1,208	735	683	523	958
Portion of new lane miles in new corridors	-	30	40	240	218	159	40	248
Light rail miles	2	55	55	82	55	82	82	86
New light rail miles		53	53	80	53	80	80	84
Commuter rail miles	74	82	82	82	82	82	128	128
New commuter rail miles	-	8	8	8	8	8	54	54
Total new miles of road and rail	-	409	607	1296	796	771	657	1096
Percent increase from 2006	-	3%	4%	9%	6%	5%	4%	7%
Nonmotorized facility miles	570	600	747	745	740	745	1058	1123
New nonmotorized facility miles	-	30	177	175	170	175	488	553

As shown in Exhibit 10-3, the amount of new infrastructure, which is measured as a percentage of the total existing system, range from 3 to 9 percent. Alternative 2 contains the most new miles of roadway and rail improvements and the Baseline Alternative contains the fewest miles of new infrastructure. Of the action alternatives, Alternative 1 contains the fewest new miles of roadway and rail improvements. Therefore, Alternative 2 would likely result in the greatest overall effect on ecosystems and species, and the Baseline Alternative would likely result in the lowest. Among the action alternatives, Alternative 1 would likely result in the fewest overall effects on ecosystems and species. Effects from Alternatives 3, 4, 5, and the Preferred Alternative would fall somewhere in between the overall number of effects from Alternatives 1 and 2.

The Preferred Alternative includes the second-greatest number of new miles of roads and rail. Therefore, the Preferred

¹ This exhibit has changed since the DEIS.

Alternative would likely result in the second-greatest number of effects on habitats and species. However, most of the new miles of roads and rail would be built along existing transportation corridors. New transportation facilities constructed in existing transportation corridors are less likely to negatively affect habitats and species than those built in new corridors. Conversely, the Preferred Alternative adds the most miles of new freeway and arterial lane miles (248) in new corridors. Therefore, effects on habitats and species from the Preferred Alternative in new corridors would likely be higher than other alternatives.

The Preferred Alternative includes the greatest number of miles of nonmotorized facilities, which include bicycle and recreation trails. Nonmotorized trails create less of a barrier to movement by animals and result in less fragmentation of habitat. Projects that expand and enhance nonmotorized travel also result in fewer vehicle miles traveled, with less potential for mortality to wildlife from collisions and reduced sources of pollutants compared to motorized road and rail.

Habitat Loss, Alteration, or Fragmentation

Given the overall infrastructure footprint expected from the alternatives (refer to Exhibit 10-3), Alternative 2 would be expected to have the greatest overall effect on habitat loss or fragmentation, and the Baseline Alternative would have the lowest.

The effects on habitat fragmentation would also depend on whether construction occurs in already developed or in currently undeveloped areas. As shown in Exhibit 10-4, the Baseline Alternative has the fewest projects that are co-located with significant habitats, for both motorized (roadways, transit, and ferry terminals) and nonmotorized project categories. Of the action alternatives, the Preferred Alternative has the most transit, roadway, and ferry-related projects co-located with significant habitat and Alternative 1 has the fewest. Therefore, the Preferred Alternative would likely result in the most impacts to significant habitat areas.

What are the limitations of the proximity analysis?

The purpose of the proximity analysis was to identify relative potential for impacts among alternatives, not to identify absolute numbers of potential impacts. As these projects are implemented, the actual number of impacts would be far less than shown, since the projects would be designed to avoid these impacts.

Exhibit 10-4**Potential Project Impacts to Significant Habitat Areas**

Project Type	Baseline Alt.	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Preferred Alt.
Transit, roadway, and ferry related projects	51	98	210	126	131	128	243
Nonmotorized projects	10	28	42	40	42	111	109*

*Alternative 5 included many small bike concepts in urban centers throughout the region. During review of the DEIS alternatives, it was discovered that many of these concepts were already built, others were unable to find a sponsor, and others were deleted for other reasons. Concurrently, a smaller number of long nonmotorized projects were added to the Preferred Alternative that weren't in Alternative 5. This explains why the total nonmotorized mileage increased for the Preferred Alternative relative to Alternative 5, but the number of project proximity impacts decreased.

Floodplains perform important ecological functions in the region and are also important habitats for listed species, such as Chinook salmon. Construction within or near floodplains can result in habitat loss, loss of flood storage capacity, and impacts on water quality. As shown in Exhibit 10-5, the Baseline Alternative has the lowest potential impact in terms of the number of projects in the vicinity of flood zones. Of the action alternatives, the Preferred Alternative has the greatest number of projects near flood zones and Alternative 1 has the fewest. Therefore, the Preferred Alternative would likely result in the most impacts to flood areas.

Exhibit 10-5**Projects in the Vicinity of Flood Zones**

Project Type	Baseline Alt.	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Preferred Alt.
Transit, roadway, and ferry related projects	50	82	205	113	117	106	232
Nonmotorized projects	7	19	41	39	41	108	105*

*Alternative 5 included many small bike concepts in urban centers throughout the region. During review of the DEIS alternatives, it was discovered that many of these concepts were already built, others were unable to find a sponsor, and others were deleted for other reasons. Concurrently, a smaller number of long nonmotorized projects were added to the Preferred Alternative that weren't in Alternative 5. This explains why the total nonmotorized mileage increased for the Preferred Alternative relative to Alternative 5, but the number of project proximity impacts decreased.

Habitat and Water Quality Impacts to Marine Ecosystems

Alternatives that expand the ferry system could affect marine ecosystems due to new ferry routes, impervious surfaces associated with terminals and parking lots, ferry terminal construction, overwater structures, shoreline armoring, and oil spills or leaks.

Impervious Surface, Changes in Flow Regime, and Impacts to Aquatic Species

Changes to natural flow regimes and impacts to aquatic habitats and species would depend on how much new impervious surface is associated with transportation infrastructure and where this occurs (e.g., in or adjacent to wetlands, streams, or shorelines). Detailed information on project locations is not available for this plan-level FEIS.

9 What cumulative effects could occur if the Transportation 2040 actions coincide with other planned actions?

The existing sources of impacts to ecosystems and species in the central Puget Sound region reflect past and present cumulative effects. Future cumulative effects on ecosystems and species could be affected by other regional plans and actions. Cumulative effects of growth and development could increase the incidence and severity of flooding downstream of areas of increased development, with resultant impacts on aquatic habitats and species. Cumulative effects of growth and development along Puget Sound shorelines could increase the impacts of habitat loss, habitat alteration, process alteration, and habitat fragmentation on marine habitats. Cumulative effects of growth and development could increase the overall loss and fragmentation of habitat and contribute to the decline of already vulnerable species.

Local jurisdictions throughout the region may revise their existing land use plans to be consistent with VISION 2040 and complement the Transportation 2040 Preferred Alternative. New development resulting from these plans could have both positive and negative effects on the environment.

PSRC has performed an analysis of the development pattern changes that could result from the transportation alternatives (refer to Chapter 5: Land Use, Population, Employment, and Housing). They concluded that none of the Transportation 2040 alternatives would induce future land use and development pattern changes that are substantively different than the Baseline Alternative. In addition, all of the Transportation 2040

What are cumulative effects?

Cumulative effects address the impact on the environment that results from the incremental impact of the action being considered when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

alternatives are consistent with the adopted VISION 2040 Regional Growth Strategy. Therefore, none of the Transportation 2040 alternatives would result in additional cumulative effects on ecosystems and species.

10 How can the effects on ecosystems and listed species be mitigated?

While the levels of impact vary across the transportation alternatives, some mitigation would be beneficial regardless of the alternative selected. However, the level of emphasis among the mitigation measures would vary depending on the alternative selected. Some of the beneficial mitigation to minimize the effects to ecosystems and listed species could include:

- Retrofitting existing or expanded transportation facilities to improve their environmental performance
- Minimizing impervious surfaces of new transportation facilities
- Avoiding important habitat areas and areas important for key ecological processes (floodplains, rivers and wetlands, forested slopes, estuaries, and shorelines) by prioritizing projects that do not affect these habitats
- Designing facilities to minimize or avoid creating barriers and fragmenting habitat (e.g., replace culverts with bridges, or by designing culverts to support wildlife passage)
- Minimizing shoreline armoring and overwater structures in construction of new ferry terminals
- Designing new transportation facilities using low-impact development techniques
- Controlling stormwater runoff at the source
- Implementing clean car and fuels technology

11 Are there significant unavoidable adverse impacts to ecosystems or listed species?

It is expected that any of the alternatives would have some significant unavoidable adverse impacts to ecosystems and species; however, the level of impact would vary. The types of

effects associated with the existing transportation systems, such as habitat loss/fragmentation, impervious surfaces, pollution, and alterations of processes, would continue to occur under all alternatives.

A number of regional efforts are underway to address the effects of past development in the region. For example, the Puget Sound Partnership Action Agenda for the recovery of Puget Sound includes actions that are needed to address the impacts of past development and also mitigate for or offset effects of future development. Transportation infrastructure developed with regional environmental recovery strategies incorporated as part of program and project evaluation and design could offset the potential effects of the action alternatives. Depending on the levels of mitigation implemented in subsequent project-level and program-level actions in the region, impacts could be reduced in comparison to the Baseline Alternative.