State Wildlife Action Plan Update

# Appendix A-4

## Species of Greatest Conservation Need

## Fact Sheets

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# FISH

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**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-4

## SGCN Fish – Fact Sheets

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# What is Included in Appendix A-4

**Introduction**
Appendix A-4 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about fish included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the fish identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, description distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**What it means to be an SGCN**
The SGCN list includes both fish that have some form of official protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species program. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards the fish; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of a fish to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 114) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the fish included, please see Section A (page 112).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN fish in the REFERENCES section at the end of this document.

# SUMMARY OF THE FISH SGCN

### Overview

There are 51 fish species or species units included on Washington's Species of Greatest Conservation Need list. A species unit is an "evolutionarily significant unit" (ESU) or a "distinct population segment" (DPS) as designated by NOAA-National Marine Fisheries Service and U.S. Fish and Wildlife Service, respectively, as units of a taxonomic species for ESA-listing purposes, or is a geographically designated population grouping (e.g., Bull Trout – Coastal Recovery Unit). The 18 exclusively marine species represent about 7.5 percent of Puget Sound area marine fishes or about 4.5 percent of marine fishes in all of Washington's marine waters. Of about 50 native freshwater and anadromous (freshwater and marine phases) fishes in Washington, the number of taxonomic species (22; species rather than species units are counted) in SGCN group represent 44 percent of these. Rockfish (genus *Sebastes*) and Pacific salmon and steelhead (genus *Oncorhynchus*) form about half of SGCN list, but species diversity ranges from the Olympic Mudminnow (a Washington freshwater endemic) to the Bluntnose Sixgill Shark. Distribution of these fishes ranges from Pacific coastal waters to mountain streams of the interior Columbia Basin. Threats in common across a broad diversity of SGCN fishes include habitat loss and degradation from land and water uses, lack of abundance trend data, unintentional overharvesting, and passage barriers due to dams, road crossings, diking, and other artificial structures.

### Distribution

Of the 18 SGCN species that live exclusively in marine environments, seven occur within the confined marine waters of the Salish Sea (Puget Sound, Strait of Juan de Fuca, and Strait of Georgia). The other marine fishes and the anadromous fishes occur in these waters and in the Pacific Ocean. Most of the anadromous salmonids have a large Pacific Ocean range during marine phases of their life histories. In freshwater, anadromous fishes generally have well-defined spawning distributions, but rearing distributions may range more widely. Migration corridors between marine and freshwater habitats are essential elements of anadromous fishes' natural distributions, and include vital estuarine habitats. Due to their varied life histories, anadromous fishes are present year-round in freshwater habitats. Of the 13 exclusively freshwater SGCN species (including three non-anadromous salmonid species), eight occur only in eastern (east of Cascades Mountains crest) Washington in Columbia Basin streams and lakes. Only two of the exclusively freshwater fishes (Olympic Mudminnow and Salish Sucker) do not occur in the Columbia Basin. Several freshwater species have relatively small or limited distributions in Washington.

### Abundance Status - Size and Trends

Quantitative abundance and trend data for many SGCN fish species are lacking. Current population or unit size was unknown for 49 percent of the species, and abundance trend was unknown for 59 percent of the species. In many cases, information used to judge abundance status is qualitative, based on fishery-dependent data, or based on few, short-term surveys. Data insufficiency is considered a conservation threat for many SGCN fishes. Of the seven marine fish with status ratings, five were rated at critical and two were rated at low abundances, and trends were rated as stable. All of the ESA-listed anadromous salmonids have long-term abundance data to rate status. For abundance ratings, 11 were low and three were medium; for trend ratings, two were declining, seven were stable, four were increasing and one was unknown. Only one of the freshwater salmonid species (Westslope Cutthroat Trout) was rated, and it had medium abundance and stable trend. Acquiring quantitative data for SGCN species is an action that will clearly benefit the design and evaluation of conservation actions.

### Conservation Concerns

To effectively conserve SGCN fish species we must attend to multiple sources of habitat degradation and loss. For many of the marine species, we need to curtail the loss of and restore degraded nearshore breeding and rearing habitats, such as spawning beaches for Pacific Herring, Sand Lance, and Surf Smelt, and eelgrass and algal habitats. In Puget Sound, residential and industrial shoreline uses and development that reduce and degrade marine habitats and water quality require management by multiple jurisdictions. In freshwater environments, we need to continue mitigation and elimination of impacts from dams, culverts, road crossings, and other instream modifications. Dams pose threats to all anadromous and some freshwater species by reducing, fragmenting, and modifying river habitats and by altering natural flow regimes and water quality. Dams may still impede juvenile and adult passage even where artificial passage has been constructed. Agricultural, urban, residential and commercial land-uses have removed, modified, or degraded estuarine, floodplain, riverine, riparian, and wetland habitats essential to anadromous and freshwater fishes. Restoration of these habitats must continue in order to improve abundance, productivity and persistence of numerous SGCN species. Threats from habitat loss and degradation are intensified for species with small or restricted ranges such as Olympic Mudminnow, Margined Sculpin, Salish Sucker, and Burbot. For anadromous salmonid SGCN species, hatchery production and hatchery-origin fish pose several kinds of threats to natural populations. Management of these risks is on-going and must continue in order to meet ESA-related recovery goals. For many SGCN fish species, mortality due to fishery-related impacts (unintentional or incidental catch, illegal harvest) is a threat that continues to need direct management and public education. The freshwater salmonid species continue to face threats from interbreeding with hatchery bred and released non-native salmonids. Invasive non-native freshwater fishes pose competition and predation threats to various SGCN species, especially those with limited native ranges (e.g., Pygmy Whitefish). Lack of data, such as on abundance, distribution, breeding habitats and/or viability status, is considered a threat for many SGCN species and will require significant investment to rectify.

### Conservation Success

The status of Hood Canal Summer Chum Salmon ESU has improved considerably since ESA-listing in 1999. Threat reduction actions, such as eliminating excessive harvest, and supplementing natural production by short-term hatchery propagation, both of which began prior to ESA-listing, have led to large increases in abundance for the ESU's two independent populations. Re-introductions of summer-run chum salmon to rivers that historically had sub-populations have occurred and continue to be monitored. Improvements to spawning and rearing habitats also have been made. Overall viability conditions are at a relatively high level.

# MARINE FISH

## BLUNTNOSE SIXGILL SHARK *(Hexanchus griseus)*

**Conservation Status and Concern**

This large and long-lived species uses Puget Sound as a nursery/pupping ground. Relatively little is known about their life history, population structure, or abundance trend.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | GNR | SNR | Unknown/unknown | Moderate |

**Biology and Life History**

Photo: Seattle Aquarium

The Bluntnose Sixgill Shark is a benthic species that is widely distributed over continental and insular shelves in temperate and tropical seas throughout the world. They are large and heavy-bodied with males reaching 11.5 feet and females reaching up to 15.8 feet or larger. Acoustic monitoring data suggest that Sixgill Sharks inhabit Puget Sound waters for several years as juveniles, making small seasonal migrations between a couple of core areas before leaving Puget Sound for the open coast. Their movement patterns suggest relatively small home ranges and site fidelity until they are documented leaving Puget Sound. There is documentation of one sixgill moving from Puget Sound to Point Reyes, California during a seven-month period. They are a powerful predator that feeds on a variety of prey species including sharks, rays, fish, and mammals. Predators on Bluntnose Sixgill Sharks primarily consist of other sharks, including their own species. Sixgills are viviparous and produce litters up to 108 pups, which may be sired by nine or more males.

**Distribution and Abundance**

In the absence of specific information about population structure, Sixgill Sharks are treated as a single population throughout Washington waters for assessment purposes. The present population size and abundance trends are not known, though anecdotal evidence suggests populations have declined in some areas of the Sound. Genotypic data collected from Puget Sound samples suggest one intermixing population. Evidence suggests that Puget Sound serves as a pupping and nursery grounds for this population, which is broadly distributed. This species was regularly caught by anglers in Puget Sound in the early 2000s, however all fisheries for Sixgill Sharks, including catch and release, are now closed in Washington.

**Habitat**

In Canadian Pacific waters, sixgills are found in inlets and along the continental shelf and slope typically at depths greater than 300 feet (range 0-8200 feet). They have been observed in shallower waters (less than 65 feet) in Puget Sound and near Hornby Island, B.C. by SCUBA divers, generally at night. Utilization of shallow water habitat observed in Puget Sound may increase exposure to polluted effluents

**References**

Ebert, D. A. 2003. The sharks, rays and chimaeras of California. University of California Press, San Francisco.

Larson, S., J. Christiansen, D. Griffing, J. Ashe, D. Lowry and K. Andrews. 2010. Relatedness and polyandry of sixgill sharks, Hexanchus griseus, in an urban estuary. Conservation Genetics. 10.1007/s10592-010-0174-9

**Bluntnose Sixgill Shark: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population, life history, and movements in WA state waters are data deficient. | Conduct extensive distribution and relative abundance surveys. Tagging studies produced successful results. | Current insufficient | WDFW |
| 2 | Overharvesting of biological resources | Illegal fishing and/or harvest of species. In all WA state waters, Sixgill Shark fisheries are closed. | Ensure no illegal fishing and/or harvest. | Current sufficient | WDFW |
| 3 | Education needs | Educate recreational anglers about shark conservation, catch/release stress on sharks during mating season. | Offer reports or detailed descriptions of reason to close shark fishery. | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Because of their longevity and utilization of shallow waters near urban settings, they may accumulate a variety of chemicals. Potential effects on the fish include impacts on both growth and reproduction. | Assess burdens of toxic compounds throughout Puget Sound. Determine effects on populations and life histories, including reproduction using field studies, epidemiological information and/or laboratory studies. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BROADNOSE SEVENGILL SHARK (*Notorynchus cepedianus*)

Abundance estimates are data deficient for the population known to occur in Washington waters. Willapa Bay may be critical habitat for breeding and seasonal feeding grounds.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | GNR | SNR | Unknown/unknown | Moderate |

**Biology and Life History**

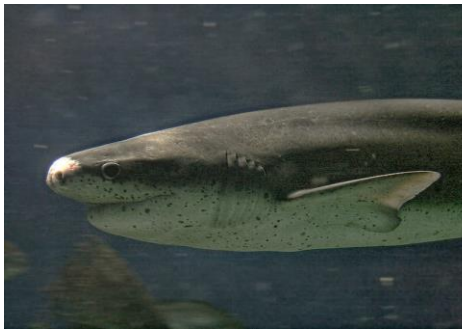
Photo: J.M. Nuñez

The Broadnose Sevengill Shark is one of only two shark species that have seven gill slits. Recent tagging studies in Willapa Bay have shown consistent seasonal patterns of estuary use during the summer and dispersing into nearshore coastal habitats during autumn. They are generally observed swimming slowly near the bottom; however they are capable of bursts of speed to capture prey including sharks, skates, rays, fish, cetaceans, and pinnipeds. Predators of this species primarily consist of other sharks, including their own species, and great white sharks. Maximum length has been observed at 9.5 feet while common length is 5 to 6.6 feet. They are viviparous and produce litters of up to 82 pups. Reproductive cycles may occur biennially with a gestation period of 12 months. The recreational fishery for this shark was closed in 2013, though both catch/release and retention fisheries previously occurred in Willapa Bay and Grays Harbor.

**Distribution and Abundance**

This species occurs in temperate nearshore waters around the world including bays and estuaries, and is known to migrate great distances. Recent tagging studies have detected them over the continental shelf near Oregon and Washington, which also move further south into California, suggesting the feasibility of broad-scale coastal movements to birthing, nursery and mating grounds. Although rarely observed in Puget Sound other than in vicinity of the Nisqually River Delta, Willapa Bay has a consistently returning population in spring and summer. Abundance estimates are data deficient for the population known to occur in Washington.

**Habitat**

Willapa Bay is the best known habitat for this species in Washington, which is likely critical for breeding and/or seasonal feeding grounds during spring and summer. Segregation by size and sex have been observed in Willapa Bay, with males and small females using the peripheral southern estuary channels before joining large females who remain in the central estuary channels. Some individuals consistently returned to specific areas within the estuary year after year.

**References**

Ebert, D. A. 2003. The sharks, rays and chimaeras of California. University of California Press, San Francisco.

Williams, G. D., Andrews, K. S., Katz, S. L., Moser, M. L., Tolimieri, N., Farrer, D. A. and Levin, P. S. (2012), Scale and pattern of broadnose sevengill shark *Notorynchus cepedianus* movement in estuarine embayments. Journal of Fish Biology, 80: 1380–1400. doi: 10.1111/j.1095-8649.2011.03179.x

**Broadnose Sevengill Shark: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population, life history, and movements in WA state waters are data deficient. | Conduct extensive distribution and relative abundance surveys. Tagging studies produced successful results. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Illegal fishing and/or harvest of species. In all WA state waters, Broadnose Sevengill Shark fisheries are closed. | Ensure no illegal fishing and/or harvest. | Current sufficient | WDFW |
| 3 | Education needs | Educate recreational anglers about shark conservation, catch/release stress on sharks during mating season. | Offer reports or detailed descriptions of reason to close shark fishery. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority

## BOCACCIO – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes paucispinis*)

**Conservation Status and Concern**

Bocaccio once supported a commercial set-net fishery in south Puget Sound but catches declined precipitously in the 1990s. Bocaccio are now rarely encountered, and abundance is considered at a critical level.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: NOAA

Bocaccio are a pelagic, long-bodied rockfish with few head spines and a very large mouth. The lower jaw is much longer than the upper jaw and has a small, distinct knob at the end. They are a large rockfish, measuring up to 36 inches and weighing up to 15 pounds. Coloration ranges from pink to gray with some individuals being dark red or golden orange. Black spots (melanistic blotches), a form of skin cancer, are common in adults. Aging for these fish has not been considered reliable, but they may live to be 50 years or more. Off of Oregon, females begin to mature at 21 inches and reach maturity at 24 inches. Spawning peaks in February in central and northern California, with females producing between 20,000 and 2.3 million eggs. Larval and juvenile Bocaccio are opportunistic feeders, consuming a range of micro- and macro-zooplankton, fish larvae, copepods and krill. Large juveniles and adults feed on squid and a range of fishes, including other rockfish, hake, anchovy, herring, and sablefish.

**Distribution and Abundance**

Bocaccio range from southeast Alaska to central Baja California and were once relatively common in localized habitats in south and central Puget Sound. Bocaccio have never been observed in WDFW dive surveys in Puget Sound and only one Bocaccio has ever been captured in WDFW trawl surveys (approximately 2,200 trawls). Several Bocaccio were observed with a remotely-operated vehicle at one location in the San Juan Islands in 2008, and a single individual was observed at that same location in 2012 with the same remotely operated vehicle (ROV). In south Puget Sound, Bocaccio made up 1.4 percent of the recreational catch in the 1960s then declined to 0.2 percent in the 1980s, and have not been recorded since 1996. The most recent abundance estimate for Bocaccio is from 2008 and only for the San Juan Islands. Bocaccio were formally designated as "overfished" in Federal waters. A recovery plan is currently under development.

**Habitat**

In coastal waters and Alaska, juvenile Bocaccio live in nearshore habitats and move deeper with age. Larvae and small juveniles are pelagic and commonly occur in the upper 295 feet of the water column, while juveniles sometimes form dense schools under drifting kelp mats. Adults occur at depths of 39 to 1578 feet (most abundant at 164 to 824 feet) and are often associated with steep slopes consisting of sand or rocky substrate, but also inhabit high relief boulder fields and areas with drop offs. The species forms pelagic schools as both juveniles and adults and may be mixed with Widow, Yellowtail, and

Vermilion Rockfish. Large Bocaccio may be sedentary, living in caves and crevices. Bocaccio observed during WDFW ROV surveys were associated with boulders at the base of a steep rocky pinnacle.

**References**

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfish of the Northeast Pacific. Univ. of California Press. Berkeley, CA. 405pp.

National Marine Fisheries Service (NMFS). 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

Palsson, W. A., T. S. Tsou, G.G. Bargmann, R. M. Buckley, J. E. West, M. L. Mills, Y. W. Cheng, and R. E. Pacunski. 2009. The biology and assessment of Rockfishes in Puget Sound. Washington Department of Fish and Wildlife Report FPT-09-04.

**Bocaccio - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (e.g., ROV). Catch Per Unit Effort (CPUE) is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Bocaccio are closed for retention. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority

## BROWN ROCKFISH (*Sebastes auriculatus*)

**Conservation Status and Concern**

A complete population assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. They have been encountered rarely during WDFW Remotely Operated Vehicle (ROV)-based surveys (approximately 25 individuals between 2004 and 2014).

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Brown Rockfish are a light brown fish with dark- to red-brown mottling, often with a prominent brown blotch on each gill cover. Juveniles appear similar to adults. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Approximately 50 percent of the population is mature between 9.5 to 12 inches and all the population is mature at 15 inches. Parturition of larval young generally occurs between April and June in Puget Sound. This species can reach 22 inches and live to at least 34 years of age.

Photo: S. Axtell, WDFW

Adults are often solitary but may be found in small groups or in association with Quillback and Copper Rockfish. Prey items include small invertebrates and fishes. Depending upon the life history stage, predators may include larger rockfish, salmon, and marine mammals. This species is known to hybridize with Copper and Quillback Rockfishes in Puget Sound.

**Distribution and Abundance**

Brown Rockfish occur between Prince William Sound and southern Baja California and are found throughout Puget Sound, often occurring in bays and areas of low current velocity. Despite reduced population sizes of all rockfish species, the most recent surveys indicate brown rockfish densities are higher in south and central Puget Sound compared to the Strait of Juan de Fuca, the San Juan Islands, and Gulf of Georgia.

**Habitat**

Young-of-the-year Brown Rockfish are found in the water column for the first 2.5 to 3 months then settle in shallow water (to approximately 118 feet) onto rock and other hard substrates. Adults live between the nearshore to 443 feet and are most common above 394 feet on low- to high-relief habitats.

**References**


Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press, Berkeley.

Matthews, K. R. 1990. A comparative study of habitat use by young-of-the-year, subadult, and adult rockfish on four habitat types in Central Puget Sound. Fishery Bulletin 88: 223-239.

Seeb, L. W. 1998. Gene flow and introgression within and among three species of rockfishes, *Sebastes auriculatus, S. caurinus,* and *S. maliger*. Journal of Heredity 89:393-403.

Washington Department of Fish and Wildlife (WDFW), unpublished data

**Brown Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Need to identify degraded habitats, including those impacted by derelict gear, poor water quality, and alteration/ development. | Assess levels of toxic compounds and habitat degradation/ loss throughout Puget Sound. Determine effects on population size, ontogeny, and reproduction through field, epidemiological, and/or laboratory studies. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Closed to harvest but are subject to poaching and bycatch (salmon/other bottomfish fisheries). | Enforce existing regulations. | Current insufficient | WDFW |
| 3 | Education needs | Need to increase public knowledge of species identification, life history, and vulnerability to pressure-related injuries. Also need to increase awareness of descending devices. | Develop materials and techniques for education and outreach to stakeholders (e.g., anglers, divers). | Current insufficient | Both |
| 4 | Resource information collection needs | Need to increase knowledge of distribution, abundance, and life history. | Research and surveys to detect species and their habitat associations for population estimates. | Current insufficient | Both |
| 5 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and/or not known. | Survey to detect habitat preferences of all rockfish life stages using diverse methods (e.g., ROV, SCUBA, trawl). | Current insufficient | Both |

## CANARY ROCKFISH – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes pinniger*)

**Conservation Status and Concern**

The species has been declared overfished along the entire West Coast of North America and this DPS's Threatened status is due to severely reduced populations in Puget Sound and Georgia Basin.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | GNR | SNR | Low/unknown | Moderate-high |

**Biology and Life History**

Photo: S. Axtell and V. Okimura, WDFW

Canary Rockfish are typically distinguishable by their bright orange and white coloration, and juveniles have a distinct black spot on their dorsal fin. Larval release occurs primarily in spring and summer. Larvae and juveniles spend several months in the water column before moving to kelp beds and shallow water. After the juveniles descend to the bottom and become adults they are less vulnerable to predators. Prey typically consists of small crustaceans, such as krill and copepods, but they are also known to prey on small fish. Predators include larger rockfish, lingcod, pinnipeds, and sharks. Like most rockfish, Canary Rockfish are highly susceptible to pressure-related injuries caused by displacement to the water's surface when caught by anglers. Canary Rockfish can grow to 29 inches long and at least 84 years old.

**Distribution and Abundance**

Canary Rockfish occur from southeast Alaska to southern California. Populations have been declining along the entire West Coast since the 1970s and the species was declared overfished in 1999. Trawl fisheries in the past were the likely cause for this significant decline, as they would target large schools. Because of their increased rarity, their overfished condition in coastal waters, and a lack of assessment information in Puget Sound, Canary Rockfish were federally listed as Threatened in Puget Sound and Georgia Basin in 2010.

**Habitat**

A deeper living rockfish associated with a variety of rocky and coarse habitats, adults collect in large numbers around pinnacles and high relief rock, often in high current areas and deeper water (264 to 660 feet). Adults also have been encountered over low-relief habitat, including mud flats and concentrations of shell hash. Some adults tagged in the ocean have moved long distances. Juveniles are known to be pelagic in large schools within depths of 100 feet.

**References**

Kramer, D. E., and V.M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

**Canary Rockfish - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Canary Rockfish are closed for retention. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CHINA ROCKFISH (*Sebastes nebulosus*)

**Conservation Status and Concern**

China rockfish population status is unknown, early life history is especially poorly understood, and relatively few are landed in the coastal recreational fishery.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

China Rockfish are a solitary bottomfish species that reside on rocky reefs and are rarely observed off the bottom. Their cryptic coloration and behavior allow them to be obscured by their surroundings. They reach a maximum size of 45 cm and live to at least age 79 years. Larval release occurs primarily in spring and summer. Prey typically consists of small crustaceans. Predators may include other rockfish, lingcod, sharks, seals, sea lions, and humans. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

Photo: S. Axtell, WDFW

**Distribution and Abundance**

China Rockfish are considered a nearshore species and live at depths from 10 to 420 feet, and are distributed from the Gulf of Alaska to Southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are uncommon throughout the Sound. Reportedly China Rockfish were an important commercial species in Puget Sound during the nineteenth century but have been reported in catch statistics at very low levels since at least the 1970s. The population of China Rockfish is unknown, and their early life stage history is poorly understood.

**Habitat**

Adults prefer high energy, high-relief rocky habitat with numerous cavities and crevices for resting. The species appears to be very territorial with small home ranges, moving less than 33 feet for lengthy periods. This distinct habitat preference is a limited area along the Washington coast.

**References**

Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

**China Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COPPER ROCKFISH (*Sebastes caurinus*)

**Conservation Status and Concern**

A complete assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. In a 2008 San Juan Islands survey, they were most abundant rockfish species encountered, other than Puget Sound rockfish. Overall, populations have declined recently.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Critical/stable | Moderate-high |

**Biology and Life History**

Copper Rockfish is an important species of the nearshore, benthic rockfish assemblage in Puget Sound. Adults are relatively sedentary and have well defined home ranges. Maximum size is 26 inches and maximum age is 50 years. Larval release occurs primarily in spring and summer. Prey typically consists of small crustaceans. Predators include larger rockfish, lingcod, pinnipeds, and sharks. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

Photo: S. Axtell and V. Okimura, WDFW

**Distribution and Abundance**

Copper Rockfish are found throughout Puget Sound and nearshore coastal marine waters from the Gulf of Alaska to southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are common throughout the Sound. Historically they have been the most commonly encountered rockfish species in Puget Sound, and in an ROV-based study of the San Juan Archipelago in 2008 they were the second most common rockfish species encountered, after Puget Sound rockfish. Their populations in both North and South Sound have precipitously declined to low levels in recent years.

**Habitat**

Copper Rockfish live predominantly in rocky areas as adults, shoaling with other rockfish species. They inhabit depths less than 200 feet and associate with high-relief rocky habitats throughout the inland marine waters of Washington. Juveniles settle fairly rapidly and inhabit upper layers of the kelp canopy, moving to deeper layers before occupying adult habitat.

**References**


Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

Matthews, Kathleen R. 1990. "An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (Sebastes spp.)." *Environmental Biology of Fishes* 29.3 (1990): 161-178.

Pacunski R. E., W. Palsson, and H. G. Greene. 2013. Estimating fish abundance and community composition on rocky habitats in the San Juan Islands using a small remotely operated vehicle. Olympia, WA: Washington Department of Fish and Wildlife. FPT 13-02 FPT 13-02. 57pp.

**Copper Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Copper Rockfish are long lived, commonly occurring in urbanized basins of Puget Sound. They accumulate and concentrate persistent organic pollutants and heavy metals. | Determine effects on populations, life histories, reproduction, and epidemiological information in laboratory studies. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GREENSTRIPED ROCKFISH (*Sebastes elongatus*)

**Conservation Status and Concern**

Abundance and distribution of this species are poorly known. A status assessment of Greenstriped Rockfish in Puget Sound concluded that federal Endangered Species Act (ESA) listing was not warranted.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: WDFW

Greenstriped Rockfish are slender with four distinctive horizontal green stripes over a background body coloration of white to pinkish, and both juveniles and adults are colored similarly. The species reaches a maximum size of 43 cm, with females growing slightly larger than males, and lives to about 54 years. Off of Oregon and Washington, 50 percent of males matured by 9.5 inches or 10 years, while 50 percent of females matured by 8.7 inches or 7 years. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Larvae are released January-July off Oregon but after June in British Columbia; timing of larval release in Washington waters is unknown. At a length of about 1.2 inches, juveniles settle to depths 131 feet or deeper; they grow at a mean rate of 0.2 inches per month, and move to deeper water as they mature. Both juveniles and adults tend to be solitary. Depending on life history stage, they prey on krill, shrimp, copepods, amphipods and small fish and squid, and are preyed upon by larger rockfish, lingcod, salmon, birds, and marine mammals.

**Distribution and Abundance**

Greenstriped Rockfish are found in coastal waters from the Eastern Aleutian Islands (Alaska) to northern Baja California (Mexico). Within Puget Sound, WDFW has occasionally encountered the species during fishery-independent trawl and remotely-operated-vehicle surveys in relatively low densities (typically less than 4 fish per 2.5 acres) in the Strait of Juan de Fuca, Whidbey Basin, and Hood Canal.

**Habitat**

Greenstriped Rockfish are primarily found at depths of 328 to 984 feet, although they have been found as shallow as 40 feet and as deep as 3,757 feet. While most rockfish species inhabit rocky habitats, they tend to occur more frequently on less-complex substrates such as sand, mud, and low-relief cobble patches. Due to their substrate preferences, this species was regularly caught as bycatch in commercial trawl fisheries in Puget Sound until closure of these fisheries in 2010.

**References**

Butler, J. L., M. S. Love, and T. E. Laidig. 2012. A guide to the rockfishes, thornyheads, and scorpionfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 185pp.

Drake J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, and E. E. Holmes. 2010. Status review of five rockfish species in Puget Sound, Washington: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and redstripe rockfish (*S. proriger*). Seattle, WA: NOAA Fisheries. 234pp.

Lamb, A. and P. Edgell. 2010. Coastal fishes of the Pacific Northwest. Harbour Publishing Co. Ltd. Madeira Park, BC. 335pp.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 404pp.

Pacunski R. E., W. Palsson, and H. G. Greene. 2013. Estimating fish abundance and community composition on rocky habitats in the San Juan Islands using a small remotely operated vehicle. Olympia, WA: Washington Department of Fish and Wildlife. FPT 13-02 FPT 13-02. 57pp.

### Greenstriped Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers) because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, particularly trawls. | Offer information on avoiding fishing in rockfish areas and methods to avoid by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## QUILLBACK ROCKFISH (*Sebastes maliger*)

**Conservation Status and Concern**

This species is currently considered depleted in both North and South Puget Sound, though increased fishery regulations and reductions in harvest have produced an increasing abundance trend in some areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Critical/stable | Moderate-high |

**Biology and Life History**

Photo: S. Axtell, WDFW

Quillback Rockfish are distinguished by their strong head spines and deeply notched dorsal fin spines, which are mildly venomous. Adults exhibit limited movements away from the bottom and often have a small home range, and have been observed returning to the same site seasonally. Larval release occurs primarily in spring and summer. Their primary source of prey is small crustaceans and fishes. Predators include larger rockfish, lingcod, pinnipeds, and sharks. They reach a maximum size of 24 inches and live to age 95 years (73 is the oldest age from Puget Sound). Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

**Distribution and Abundance**

Quillback Rockfish are found throughout Puget Sound and nearshore coastal marine waters from the Gulf of Alaska to southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are common throughout the Sound. Historically, Quillback Rockfish was the second most common rockfish species in Puget Sound. This species is currently considered depleted in both North and South Puget Sound, though increased fishery regulations and reductions in harvest have produced an increasing abundance trend in some areas.

**Habitat**

Inhabits nearshore and deep waters to 700 feet in Puget Sound and commonly prefers crevices within low and high relief rocky reef, as well as sponges or mud substrate. It is one of the few rockfish species that is observed nearly as often over soft substrate as over hard bottoms. Surveys for post-larval Quillback Rockfish found them in similar but fewer places as settling Copper Rockfish.

**References**


Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson, 2002. The rockfishes of the northeast Pacific. University of California Press.

Matthews, K. R. 1990. "An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (Sebastes spp.)." *Environmental Biology of Fishes* 29.3 (1990): 161-178.

**Quillback Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is a distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## REDSTRIPE ROCKFISH (*Sebastes proriger*)

**Conservation Status and Concern**

Abundance and distribution of this species is poorly known. A 2010 status assessment of Redstripe Rockfish in Puget Sound concluded that federal ESA listing was not warranted.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Redstripe Rockfish are streamlined with reduced spines relative to other rockfishes and a strong, dark symphyseal knob on their lower jaw. Both juveniles and adults are colored similarly, with red/pink/yellowish bodies (sometimes with tan dorsal saddles) and a clear lateral line that forms a distinctive, lighter-color stripe. The species reaches a maximum size of 20 inches, with females becoming slightly larger than males, and lives to about 55 years. Off of Oregon and Washington, 50 percent of males matured by 10 inches or 7 years, while 50 percent of females matured by 11 inches or 7 years. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Larvae are released April-July throughout their coastal distribution, but little else is known about their settlement patterns. Adults can be solitary or exist in small groups or schools. In British Columbia, the species has been noted to form near-bottom schools during the day but disperse into the water column at night. Depending on life history stage, they prey on krill, shrimp, and small fishes, and are preyed upon by larger rockfish, lingcod, salmon, birds, and marine mammals.

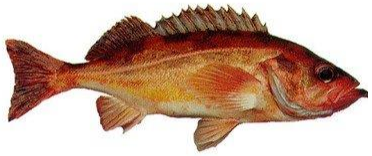

Photo: WDFW

**Distribution and Abundance**

Redstripe Rockfish are found in coastal waters extending from the southeastern Bering Sea (Alaska) to southern Baja California (Mexico), while being most abundant from southeastern Alaska to central Oregon. Within Puget Sound, WDFW has occasionally encountered the species during fishery-independent trawl and remotely-operated-vehicle surveys in relatively low densities (typically less than four fish per 2.5 acres) in the eastern Strait of Juan de Fuca, central San Juan Channel, and South Sound basin.

**Habitat**

Redstripe Rockfish are primarily found at depths of 492 to 902 feet, although adults have been found as shallow as 121 feet (juveniles, 16 feet) and as deep as 1677 feet. Like many rockfish species, they tend to occur on or slightly above high-relief, complex habitats, and can be solitary or exist in small groups or schools. The species is commonly targeted in mid-water trawls and sometimes caught in bottom trawls and hook-and-line fisheries, though retention of all rockfish species in Puget Sound was made illegal in 2010.

**References**

Butler, J. L., M. S. Love, and T. E. Laidig. 2012. A guide to the rockfishes, thornyheads, and scorpionfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 185pp.

Drake J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, and E. E. Holmes. 2010. Status review of five rockfish species in Puget Sound, Washington: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and redstripe rockfish (*S. proriger*). Seattle, WA: NOAA Fisheries. 234pp.

Lamb, A. and P. Edgell. 2010. Coastal fishes of the Pacific Northwest. Harbour Publishing Co. Ltd. Madeira Park, BC. 335pp.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 404pp.

### Redstripe Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers) because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries. | Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## TIGER ROCKFISH (*Sebastes nigrocinctus*)

**Conservation Status and Concern**

Tiger Rockfish population size and structure in Washington waters are unknown, early life history is poorly understood, individuals of all life history stages are rare in WDFW ROV surveys, and none have been captured in WDFW trawl surveys.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: V. Okimura and S. Axtell, WDFW

Tiger Rockfish are red, pink or white with five vertical red, brown or black bars and two bars radiating from each eye. Juveniles appear similar to adults and may have spots between the bars that disappear with age. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Age at maturity is unknown for this species, though most rockfishes mature at approximately 50 percent of their maximum length. Parturition of larval young occurs from at least February to June. This species can reach 24 inches and live to at least 116 years of age. Adults are often solitary and territorial but may be found in association with other rockfishes, especially Yelloweye Rockfish. Studies indicate high site fidelity and little vertical movement. Prey items include small benthic invertebrates, especially crab. Depending upon life history stage, predators may include larger rockfish, lingcod, birds, and marine mammals.

**Distribution and Abundance**

Tiger Rockfish occur between the Aleutian Islands and Southern California. This species has apparently always appeared in limited numbers in Puget Sound fisheries due to their solitary nature and the limited gear types (e.g., set line, bottomfish jig) that would be able to access them on their preferred habitat. The rockfish fishery was closed in 2010 following ESA listing of Bocaccio, Canary Rockfish, and Yelloweye Rockfish. Fishery independent surveys have subsequently found limited numbers of Tiger Rockfish, with no individuals encountered during annual WDFW bottomfish trawls and few encountered in the San Juan Islands during WDFW ROV survey operations since 2004.

**Habitat**

Post-larval Tiger Rockfish have been observed in drift kelp and in association with other floating debris. Juveniles have been observed on shallow rock piles, though little is known about their settlement patterns. Adults live between 30 to 980 feet, with most individuals found in or near crevices on high-relief, complex rock formations below 100 feet.

**References**

Hannah, R. W. and P. S. Rankin. 2011. Site fidelity and movement of eight species of Pacific rockfish at a high-relief rocky reef on the Oregon Coast. North American Journal of Fisheries Management 31: 483-494.

Lamb, A. and P. Edgell. 1986. Coastal fishes of the Pacific Northwest. Harbour Publishing Company Limited, Madeira Park, BC, Canada.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press, Berkeley.

Palsson, W. A., T. S. Tsou, G. G. Bargmann, R. M. Buckley, J. E. West, M. L. Mills, Y. W. Cheng, and R. E. Pacunski. 2009. The biology and assessment of rockfishes in Puget Sound. Washington Department of Fish and Wildlife.

### Tiger Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Need to identify degraded habitats, including those impacted by derelict gear, poor water quality, and alteration/development. | Use land acquisitions, conservation easements and landowner agreements to protect significant colonies. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Closed to harvest but are subject to poaching and bycatch (salmon/other bottomfish fisheries). | Enforce existing regulations. | Current insufficient | WDFW |
| 3 | Education needs | Need to increase public knowledge of species identification, life history, and vulnerability to pressure-related injuries. Also need to increase awareness of descending devices. | Develop materials and techniques for education and outreach to stakeholders (e.g., anglers, divers). | Current insufficient | Both |
| 4 | Resource information collection needs | Need to increase knowledge of distribution, abundance, and life history. | Research and surveys to detect species and their habitat associations for population estimates. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## YELLOWEYE ROCKFISH – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes ruberrimus*)

**Conservation Status and Concern**

The species is declared overfished along the entire West Coast and has ESA Threatened status due to severely declining populations in Puget Sound and Georgia Basin.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | GNR | SNR | Critical/unknown | Moderate-high |

**Biology and Life History**

Yelloweye Rockfish are one of the largest rockfish species and typically distinguished by their bright yellow eyes and red-orange color. They are a solitary fish that rarely leaves the rocky reef, wall, or crevices on the bottom. Larval release occurs primarily in spring and summer. Little is known about their first year of life. Prey typically consists of small fish and crustaceans. Predators include larger rockfish, lingcod, pinnipeds, and sharks. These rockfish can reach 36 inches in length and a weight of 25 pounds, and can live to an age of 118 years (the oldest aged in Puget Sound to date was 73). They are known to mature relatively late in life, with about one half of the fish reaching sexually maturity at age 22 for males and 19 for females. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

Photo: S. Axtell, WDFW

**Distribution and Abundance**

Yelloweye Rockfish occur from the Aleutian Islands to southern California. This ESA-listed DPS includes Yelloweye Rockfish in Puget Sound and Strait of Georgia areas. They may be found in the rocky reefs of northern coastal Washington, Strait of Juan de Fuca, San Juan Islands, and Hood Canal. Although uncommon in Puget Sound, fishers who targeted very specific locations and habitat types would catch them. Where abundance has been assessed, current population levels are well below historic reference levels. Assessments are ongoing.

**Habitat**

Juveniles occupy shallow to deep water with the more common rockfish species (e.g., Copper and Quillback Rockfishes) and move into deeper water as they age. Adults are relatively sedentary, living in association with high-relief rocky habitats and often near steep slopes. Adults are most common at depths from 300 to 600 feet.

**References**


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NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

**Yelloweye Rockfish - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Yelloweye Rockfish are closed for retention. May be caught along with legal bottomfish species. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC COD – SALISH SEA POPULATION (*Gadus macrocephalus*)

**Conservation Status and Concern**

Abundance and distribution patterns of Pacific Cod in Washington waters are incompletely known. Historic overharvest has led to dramatic declines in encounter rate and the curtailment of both commercial and recreational fisheries.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: S. Axtell, E. Wright, WDFW

Pacific Cod are a large-bodied fish typically colored brown or gray with brown spots or mottling on back and sides, with three dorsal fins, two anal fins, and a long chin barbel. The species mainly occurs at depths up to 1,640 feet over sand, mud, and clay substrates. They are moderately fast growing and relatively short-lived, reaching a maximum total length of 4 feet and maximum weight of 44 pounds. Average size observed in WDFW trawl surveys since 1987 is 1.4 feet and largest captured fish was 2.8 feet. Maximum age reported In Alaska was about 18 years. Preferred water temperatures appear to be between 32 to 50°F. Spawning occurs in winter and may be associated with onshore-offshore migrations depending on stock and local water temperatures. Females grow larger than males, reaching 50 percent maturity between 4 and 5 years of age, and produce from 225,000 to 6.4 million eggs annually. They are opportunistic feeders, consuming worms, crustaceans, fish, and fishery offal, and are prey for seabirds, fishes, and many marine mammals.

**Distribution and Abundance**

Pacific Cod occur throughout the coastal North Pacific Ocean. In Puget Sound, they are categorized into three components: North Sound (U.S. waters north of Deception Pass, including San Juan Islands, Strait of Georgia, and Bellingham Bay); West Sound (west of Admiralty Inlet and Whidbey Island, and U.S. Strait of Juan de Fuca); South Sound (south of Admiralty Inlet). Although they have been observed in all Puget Sound sub-basins during WDFW trawl surveys, they are uncommon in South Sound and only rarely encountered in Hood Canal and Whidbey Basin. Pacific Cod once supported large recreational and commercial fisheries in Puget Sound. Catch rates were highest in the 1970s then declined in the late 1980s, reaching a low point in the early 1990s, and showing no signs of recovery since. No Puget Sound abundance estimates have been made in over a decade.

**Habitat**

In Puget Sound, Pacific Cod are most commonly associated with soft bottom and low-relief habitats, including mud, sand, and gravel, but larger individuals may occasionally inhabit rock and boulder habitats. They can be found at most depths but are most commonly encountered at depths greater than 240 feet (WDFW trawl survey data). Puget Sound water temperatures are at high end of species' normal range and have been hypothesized as one factor limiting population size/recovery in the region.

**References**

Love, M. S. 2011. Certainly more than you want to know about the fishes of the Pacific coast. Really Big Press. Santa Barbara, CA. 649pp.

Palsson, W. A. 1990. Pacific cod (*Gadus macrocephalus*) in Puget Sound and adjacent waters: Biology and stock assessment. Wash. Dept. Fish. Tech. Rep. No. 112. 137pp.

### Pacific Cod - Salish Sea Population: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey). | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Pacific Cod are closed for retention in Marine Areas 8-1 to 13. Need to conduct updated population assessment to assess viability of fishery in currently open areas. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Climate change and severe weather | Puget Sound temperatures are at the upper end of the species normal range. Increasing sea-surface temperatures may preclude recovery. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 6 | Education needs | Recreational anglers unable to identify species. | Educate anglers on species identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC HAKE – GEORGIA BASIN DPS (*Merluccius productus*)

**Conservation Status and Concern**

Pacific Hake populations in Puget Sound have not been assessed in over a decade, but prior to this time a marked decline was observed, resulting in cessation of commercial fisheries.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/stable | Low-moderate |

**Biology and Life History**

Photo: S. Axtell and V. Okimura, WDFW

Pacific Hake is a cod-like fish with deeply notched second dorsal and anal fins. Both males and females mature between ages 3 to 4 years and release planktonic eggs in spawning aggregations located in several geographically segregated areas from late winter to spring. Planktonic larvae metamorphose at age 3 to 4 months. Individuals can grow to 36 inches and to live up to 20 years. The average size of Pacific Hake in WDFW trawl surveys since 1987 is 10 inches and the largest captured fish measured 30 inches. Juveniles and adults generally live in separate mid-water schools and both groups complete diurnal migrations from the bottom during the day and move up to feed at night. They also exhibit seasonal movements from deeper waters in fall and winter to more shallow waters during spring and summer. Prey include krill, copepods, shrimp, squid and small fishes, including other hake. Predators include Dogfish Sharks, other fishes, birds, marine mammals, and Humboldt Squid. Hake in this DPS are not affected by the parasite *Kudoa paniformis,* which is present in more than 50 percent of fish in Pacific coastal population and weakens muscle tissue.

**Distribution and Abundance**

There are three known populations of Pacific Hake in Washington: a migratory Pacific coastal population, a Strait of Georgia population, and a Puget Sound population. These last two form the Georgia Basin DPS. In Puget Sound, spawning aggregations are known in Port Susan and Dabob Bay. WDFW's Puget Sound assessments found a decline in biomass and size-at-age through 1999 after closure of a long-term fishery in 1991. In 2009 NOAA described Puget Sound Hake as severely depressed. A recent study found the Puget Sound population to be generally self-sustaining, with few immigrants, while relatively higher numbers of emigrants to Strait of Georgia population were observed. No abundance estimates have been made for Puget Sound population in over a decade.

**Habitat**

Juveniles are often found in mid-water schools above 650 feet. They also have been observed resting on soft substrates during visual studies, including WDFW remotely operated vehicle (ROV) surveys. In the Georgia Basin DPS, fish are restricted to depths of approximately 1,150 feet. Adults in the Pacific coastal population are found at depths between 40 to 4,600 feet.

**References**

Chittaro, P. M., R. W. Zabel, W. Palsson, and C. Grandin. 2013. Population interconnectivity and implications for recovery of a species of concern, the Pacific hake of Georgia Basin. Marine Biology 160: 1157-1170.

Gustafson, R. G., W. H. Lenarz, B. B. McCain, C. C. Schmitt, W. S Grant, T. L. Builder, R. D. Methot. 2000. Status review of Pacific hake, Pacific cod, and walleye pollock from Puget Sound, Washington. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-44, 275pp.

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McFarlane, G. A. and R. J. Beamish. 1985. Biology and fishery of Pacific whiting, *Merluccius productus*, in the Strait of Georgia. Marine Fisheries Review 47: 23-34.

National Oceanic and Atmospheric Administration (NOAA). 2009. Pacific hake (*Merluccius productus*) Georgia Basin DPS fact sheet. http://www.nmfs.noaa.gov/pr/pdfs/species/pacifichake_detailed.pdf

Pedersen, M. 1985. Puget Sound Pacific whiting, *Merluccius productus*, resource and industry: an overview. Marine Fisheries Review 47: 35-38.

**Pacific Hake - Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey) | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Pacific Hake are closed for retention in Marine Areas 8-1 to 13. Need to conduct updated population assessment to assess viability of fishery in currently open areas within the DPS. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on species identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC HERRING – GEORGIA BASIN DPS (*Clupea pallasii*)

**Conservation Status and Concern**

A 2006 status assessment determined that ESA listing was not warranted. However, the Cherry Point stock is at critically low abundance, the Squaxin Pass stock is stable, and abundance of all other stocks has fluctuated substantially since the 1970s but exhibits a slight downward trend.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | Yes | GNR | SNR | Critical/stable | Moderate |

**Biology and Life History**

Photo: WDFW

Pacific Herring spawn by depositing eggs on vegetation or other shallow water substrate in lower intertidal and shallow sub-tidal marine zones. Most herring in Washington spawn between mid-January and early April. The Cherry Point stock spawns from April to June. Eggs hatch in 10 to 14 days, depending on water temperature and larvae drift in ocean currents. After metamorphosis to juvenile stage about 3 months after hatching, juveniles of Puget Sound stocks spend at least their first year in Puget Sound. Some Puget Sound stocks are thought to be migratory between continental shelf feeding grounds and Puget Sound spawning grounds. Other stocks are non-migratory, spending entire lives in Puget Sound/Georgia Basin, and some are likely a mix of migratory and non-migratory individuals. Pacific Herring reach sexual maturity at age two or three, can spawn repeatedly and can live 9 or more years. In recent years the majority of Puget Sound spawning herring were 2 to 4 years old, indicating an increase in natural mortality that prevents individuals from recruiting to older age classes. Among sampled stocks, the Cherry Point stock and Squaxin Pass stock were genetically distinct, while all other stocks were indistinguishable from each other. This suggests that, with exception of Cherry Point and Squaxin Pass stocks, sufficient gene flow occurs among Puget Sound herring stocks to suppress meaningful genetic divergence.

**Distribution and Abundance**

Pacific Herring are found throughout Washington's marine waters and typically spawn annually at approximately 20 spawning grounds: 2 Pacific coastal locations and 18 locations east of Cape Flattery. The Georgia Basin DPS contains Puget Sound, Strait of Georgia, and Strait of Juan de Fuca stocks. Trends in herring abundance based on results of genetic studies indicate that Washington's Cherry Point stock (southern Strait of Georgia) is critically low, the Squaxin Pass stock (south Puget Sound) is stable, and abundance of all other Puget Sound stocks has declined since the 1970s but is fairly stable. In recent years the Quilcene Bay herring stock has offset losses in some other stocks in the 'other stocks complex' and is currently the largest Pacific Herring spawning population in Puget Sound.

**Habitat**

Pacific Herring in this DPS live in Puget Sound and Strait of Georgia and often occur in Pacific coast waters. Prior to spawning, adults form concentrations near their spawning grounds and then move to nearshore areas to deposit their eggs primarily on marine vegetation. Eggs are adhesive and stick to whatever substrate is present, including eelgrass, numerous algal species, and other objects. Juveniles congregate in bays, inlets, and channels in summer, and typically spend at least their first year in Puget

Sound/Strait of Georgia. Juveniles from migratory stocks then move to offshore feeding areas spending late spring, summer and fall months off Washington's west coast and off Vancouver Island, B.C.

**References**

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Stick, K. C., A. Lindquist and D. Lowry. 2014. 2012 Washington State herring stock status report. Olympia, WA: Washington Department of Fish and Wildlife. FPA 09-05 FPA 09-05. 97pp.

**Pacific Herring - Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Maintaining viable spawning grounds and water quality in Puget Sound is a challenge to herring management in Washington. | Enforcement of shoreline management regulations; control and monitor pollution in aquatic habitat; minimize risk of oil spills; overall protection of herring spawning grounds. | Current sufficient | Both |
| 2 | Resource information collection needs | An observed increase in non-fishing mortality. | Investigate and evaluate potential sources of adult herring mortality such as disease patterns, predator/prey abundance changes, pollution. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC SAND LANCE (*Ammodytes hexapterus*)

**Conservation Status and Concern**

Pacific Sand Lance abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but difficult to capture with most traditional sampling methods.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: WDFW

Although Pacific Sand Lance is common and widespread in Washington nearshore marine waters, very little is known about its life history or biology. Spawning sites appear to be used year-after-year during the November to February spawning season. Adhesive eggs are deposited on upper intertidal beaches consisting of sand and gravel. Incubating eggs may occur in the same substrate as eggs of surf smelt during winter when the two species' spawning seasons overlap. However, Pacific Sand Lance spawn deposition can be found lower on beach than that of Surf Smelt, between about 5 feet and mean higher high water. Incubation time is approximately one month. Pacific Sand Lance is a key prey species for many predators including birds (especially seabirds), fishes (including halibut, rockfishes, and salmon) and marine mammals because of its high energy content. Its ecological importance in local marine food webs is high. Defense tactics used against predation include burrowing into soft, wet sand in intertidal/subtidal zones and contraction of the fish school into a ball of closely packed fish.

**Distribution and Abundance**

Pacific Sand Lance occur in nearshore marine waters throughout Washington. Currently, about 10 percent of the Puget Sound shoreline has been documented as sand lance spawning habitat. Abundance is not known.

**Habitat**

Pacific Sand Lance use nearshore and intertidal marine habitats. Upper intertidal sand and sand/gravel spawning sites on Puget Sound beaches are documented as important breeding areas throughout Puget Sound. Spawning substrate is typically finer grained (0.007-0.012 inch diameter range) sand. Burrowing habitat is typically well washed fine sand and fine gravel, free of mud, usually with a strong bottom current keeping oxygen levels high. They prefer well-lighted habitat and are most common at depths less than 165 feet, but may be found at depths to 900 feet. Feeding schools occur in littoral waters within proximity of burrowing habitat. In Alaska, highest abundance was found in burrowing habitat sheltered from onshore wave action and disturbance by winter storms.

**References**

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### Pacific Sand Lance: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Need for initial baseline survey to estimate abundance or index of abundance. | Development of techniques to understand species biology and to estimate species abundance. | Nothing current - new action needed | WDFW |
| 2 | Resource information collection needs | Need to evaluate species status. | Development of techniques to evaluate species status. | Nothing current - new action needed | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Lack of erosional sediment inputs due to shoreline armoring. | Develop appropriate land use planning that adequately protects spawning beaches. | Current insufficient | WDFW |
| 4 | Outreach needs | Lack of erosional sediment inputs due to shoreline armoring. | Partner with/educate other regulatory agencies to support protection of sand lance spawning beaches. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## SURF SMELT (*Hypomesus pretiosus*)

**Conservation Status and Concern**

Surf Smelt abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but has not been sampled comprehensively due to lack of funding and personnel.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: WDFW

Little is known about the life history of Surf Smelt, other than the location of spawning activity. Most spawning Surf Smelt are one or two years old, with few older than age four. They do not appear to form large open-water pelagic schools and there is no evidence that they migrate significant distances from their spawning sites. Depending on location, Surf Smelt spawning activity occurs year-round in Washington. Spawning regions are commonly used during summer, fall-winter, or year-round (spawning every month with a seasonal peak). Surf Smelt eggs adhere tightly to beach surface substrates. The thickness of the spawn-bearing substrate layer varies depending on local wave-action and sediment-supply regimes, ranging from 0.4 to 4 inches. Incubation times vary depending on temperature; during the summer, incubation times are about 2 weeks, while during winter it may be 4 to 8 weeks. Larvae are planktonic drifters. Young-of-the-year occur throughout Puget Sound nearshore. Although the occurrence of spawning activity on a spawning beach is generally predictable each year, the degree to which surf smelt may "home" back to their natal beaches is unknown. Genetic studies to date have not shown any significant genetic distinctions among Washington stocks.

**Distribution and Abundance**

Surf Smelt are widespread in Washington marine waters, occurring in the outer coastal estuaries, Olympic Peninsula shorelines, and most of Puget Sound basin from Olympia to US-Canada border. Spawning activity is distributed from southernmost Puget Sound to Olympic Peninsula Pacific coast. Their spawning/spawn incubation zone primarily includes the upper one third of the tidal range, from about 7 feet up to extreme high water. Although not measured, surf smelt spawning distribution and fishery activity suggest that their abundance is stable, or at least not dramatically decreasing.

**Habitat**

Surf Smelt are a common and widespread species found throughout Washington nearshore marine waters. Spawning occurs around high tides on mixed sand-gravel substrates in the upper intertidal zone in a wide variety of wave-exposure regimes, from very sheltered beaches to fully exposed pebble beaches. Spawning substrate grain size is generally a sand-gravel mix, with most material in the 0.04 to 0.28 inches diameter range.

**References**

Fradkin, S. C. 2001. Rialto Beach Surf Smelt Habitat Monitoring: Quillayute River Navigation Project. Olympic National Park. 16pp.

Langness, M., P. Dionne, E. Dilworth, and D. Lowry. 2014. Summary of coastal intertidal forage fish spawning surveys: October 2012-September 2013. Washington Department of Fish and Wildlife, Olympia, WA. FPA 14-01 FPA 14-01. 51pp.

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WDFW. Undated. Washington State Surf Smelt Fact Sheet http://wdfw.wa.gov/publications/01219/wdfw01219.pdf

**Surf Smelt: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | A lack of fishery statistics relating to the recreational harvest of Surf Smelt. | Conduct recreational fishery monitoring and fishery-independent net sampling from a variety of surf smelt spawning stocks. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Widespread shoreline armoring practices on Surf Smelt spawning beaches. | A systematic complete inventory of all shoreline areas is needed to document all existing surf smelt spawning beaches in Washington marine waters to fully protect them from development effects. | Current insufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Shoreline armoring practices. | Develop appropriate land use planning that adequately protects spawning beaches. | Current insufficient | WDFW |
| 4 | Outreach Needs | Shoreline armoring practices. | Partner with/educate other regulatory agencies to support protection of surf smelt spawning beaches. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WALLEYE POLLOCK – SOUTH PUGET SOUND (*Gadus chalcogrammus*)

**Conservation Status and Concern**

Walleye Pollock abundance and distribution in South Puget Sound are incompletely known. Declines in encounter rate have led to increased fishery regulation and decreased harvest in recent years, especially in southern Puget Sound.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Low/unknown | Moderate |

**Biology and Life History**

Photo: S. Axtell, WDFW

Walleye Pollock is a fast-growing, relatively short-lived fish that lives throughout temperate and sub-arctic North Pacific Ocean. Puget Sound is near the southern limit of their range. They have three dorsal fins, two anal fins, and either no chin barbel or a very small one. Younger pollock form large schools in mid-water whereas older pollock are more common near the seafloor. Pollock have been recorded at depths up to 1,200 feet but are more commonly found in water from 330 to 990 feet deep. In Alaska, Walleye Pollock reach a maximum size of 3.4 feet and live up to 22 years, whereas Puget Sound Walleye Pollock are smaller and shorter-lived, reaching a maximum size of 3 feet and a maximum age of 10 years. Average size of Walleye Pollock in WDFW trawl surveys is 8.7 inches, with the largest captured fish measuring 25 inches. Approximately 50 percent of females are sexually mature at 4 years of age (approximately 16 inches). In Alaska, spawning aggregations form in late winter/early spring and larvae begin settling to the seafloor in late spring. WDFW trawl surveys have captured pollock in all stages of spawning condition during April and May. Larvae and young of the year fish feed on zooplankton such as krill, copepods, mysids and amphipods. Larger fish also utilize these prey and target shrimp, squid and other fish. Adult pollock are cannibalistic, often preying on juveniles.

**Distribution and Abundance**

WDFW trawl surveys have documented Walleye Pollock in every sub-basin of Puget Sound, with the lowest abundances in South Puget Sound, Hood Canal and Whidbey basin. Walleye Pollock once supported a recreational fishery in Puget Sound but catches are now so low that fishing is prohibited except in several small areas around San Juan Islands and in Strait of Juan de Fuca. No abundance estimates have been made for Puget Sound pollock in nearly a decade.

**Habitat**

Juveniles and adults usually occur over soft and unconsolidated substrate habitats although adults can also be found in high relief habitats near rocks. Young juveniles may use relatively shallow nearshore areas. In Puget Sound, most trawl-sampled Walleye Pollock were found at depths from 130 feet and greater.

**References**

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**Walleye Pollock – Southern Puget Sound: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey) | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Walleye Pollock are closed for retention in south Puget Sound. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# ANADROMOUS FISH – NON-SALMONIDS

## EULACHON – SOUTHERN DPS (*Thaleichthys pacificus*)

A complete population assessment for this species is unavailable but precipitous declines in spawner abundance in the Fraser and Columbia rivers led to the Southern DPS being ESA-listed in 2010.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5 | S4 | Variable/ variable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Eulachon are an anadromous smelt. Adults and juveniles spend most all of their lives in the ocean, returning after 2 to 5 years to freshwater river areas from late fall through winter to spawn. Peak spawning migration occurs during Feb. and March in Washington. Certain sites are utilized each year for spawning, while other sites/rivers are used more sporadically, with occasional heavy use, then less-so for several years. Adults die after spawning. Eggs attach to and incubate in coarse sand substrates. After hatching, larvae immediately wash out to the ocean. Larvae have been detected in the Columbia River from November through June.

**Distribution and Abundance**

Eulachon are endemic to northeastern Pacific Ocean. The Southern DPS extends from Mad River, northern California, northward to British Columbia. In Washington, they occur in lower Columbia River and its tributaries below Bonneville Dam, several Pacific coastal river systems, and Elwha River. Their ocean distribution includes nearshore and offshore areas. Abundance is variable in both time and space, with dramatic population swings depending on ocean conditions. However, since 1993 the species has had extended periods of extremely poor spawning runs coast-wide. Columbia River abundance was extremely low between 2005 and 2010. Moderately strong adult returns occurred from 2001 to 2003 and from 2011 to 2013, and a very large return occurred in 2014.

**Habitat**

Columbia Basin habitats (below Bonneville Dam) support the majority of spawning in Washington. Timing and locations of spawning appear to be highly influenced by river conditions, primarily water temperature and bottom substrate. Eggs incubate in coarse sand until hatching, and larvae drift downstream through freshwater and estuarine habitats and enter ocean waters. Juveniles disperse into continental shelf waters within first year of life. Eulachon have been captured in trawl fisheries targeting marine shrimp over muddy bottom within continental shelf waters.

**References**

Gustafson, R. G., M. J. Ford, D. Teel, and J. S. Drake. 2010. Status review of eulachon (*Thaleichthys pacificus*) in Washington, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-105, 360pp.

NMFS. 2013. Federal Recovery Outline Pacific Eulachon Southern Distinct Population Segment. 24 pp.

NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for Southern Distinct Population Segment of eulachon. Federal Register, 50 CFR Part 223. pp. 13012-13024.

Oregon Department of Fish and Wildlife (ODFW) and WDFW. 2014. Studies of Eulachon Smelt in Oregon and Washington. C. Mallette, editor. Oregon Dept. of Fish and Wildlife and Washington Dept. of Fish and Wildlife project completion report to NOAA Fisheries. 159pp.

**Eulachon – Southern DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Climate change and severe weather | Natural climate variability and anthropogenic-forced climate change on ocean conditions have been identified as posing the greatest risk to Eulachon persistence. | Investigate the causal mechanisms and migration/behavior characteristics affecting survival of larval Eulachon during their first weeks in the Columbia River plume and nearshore ocean environments. | Current insufficient | Both |
| 2 | Climate change and severe weather | Natural climate variability and anthropogenic-forced climate change on ocean conditions have been identified as posing the greatest risk to Eulachon persistence. | Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and ocean conditions that affect Eulachon survival. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Bycatch in marine shrimp trawl fisheries has been identified as a major threat to Eulachon persistence. | Develop gear modifications that reduce Eulachon bycatch in pink shrimp fisheries. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC LAMPREY (*Entosphenus tridentatus*)

**Conservation Status and Concern**

The declining status of Pacific Lamprey led to a west coast-wide joint tribal/federal/state "Pacific Lamprey Conservation Initiative". Limiting factors include passage obstruction and mortality at mainstem dams and tributary water diversion dams and intakes, and low abundance in upper Columbia.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Monitor | Yes | G4 | S1 | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: USFWS

Pacific Lamprey are anadromous. Juveniles spend 4 to 7 years as filter feeders in streams and rivers, and migrate to the ocean to mature. Adults are parasitic on fishes for 1 to 3 years and then migrate back to freshwater between February and June. Adults stop feeding during the return migration, overwinter in freshwater until they spawn the following year, and then die. The timing of migration to spawning streams varies geographically, and different runs may occur in a single river system. Upstream migrations may be as long as a few hundred miles. Degree of homing to natal streams is unknown. Spawning occurs from June to July in Washington. Eggs hatch in 2 or 3 weeks. Ammocoetes (larval filter-feeder life stage) burrow and rear in fine substrate stream beds for 4 to 6 years, then metamorphose into macropthalmia (juvenile parasitic life stage) and migrate to the ocean.

**Distribution and Abundance**

In Washington, Pacific Lamprey are distributed throughout streams and rivers of Columbia Basin up to Chief Joseph Dam, and throughout streams and rivers west of the Cascade Mountains. Population abundance data are limited, but the Columbia Basin's Pacific Lamprey appear to be on the decline according to dam counts and anecdotal information. Impassable dams and other made-made barriers have reduced historic distribution in Washington. Conservation actions have included translocation of adults trapped at lower Columbia River dams (Bonneville, The Dalles, John Day and McNary) to upper basin areas with low abundance.

**Habitat**

Spawning habitat is similar to that of Pacific salmon, such as gravel substrates at upstream ends of stream riffles. Ammocoetes use stream areas of low velocity and fine substrates (silt, mud). Free-swimming macropthalmia juveniles migrate downstream through freshwater and estuarine areas to enter the ocean. The predatory life stage occurs in marine areas, primarily near stream mouths in estuaries and in ocean coastal zones, but sometimes more offshore. Freshwater-resident populations exist in several areas in British Columbia and elsewhere.

**References**

US Fish and Wildlife Service (USFWS). 2012. Conservation Agreement for Pacific Lamprey (*Entosphenus tridentatus*) in the States of Alaska, Washington, Oregon, Idaho and California. 57pp.

**Pacific Lamprey: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Abundance data are limited and inadequate for trend assessment. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Fish passage facilities. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Further development of hydropower (energy) dams may block or impede passage. | Fish passage facilities. | | Both |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Dam and barrier removal. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## RIVER LAMPREY (*Lampetra ayresii*)

**Conservation Status and Concern:**
Abundance and distribution information is inadequate for status assessment. Breeding and rearing freshwater habitats are likely at risk throughout much of distribution from land-use degradation; dams and other passage barriers (e.g., culverts) impede or prevent migration.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S2 | Unknown/unknown | Moderate-high |

**Biology and Life History**
River Lamprey are anadromous and have three distinct life stages: the ammocoete, an eyeless, filter-feeding, larval stage; the macropthalmia, an eyed, toothed, sub-adult; and adult. The ammocoete stage lasts several years, followed by metamorphosis to the macropthalmia stage. Macropthalmia were observed from February to August in Puget Sound rivers. Once transformation to the adult stage occurs, they migrate to saltwater in late spring/early summer and feed on a variety of fish species. It is likely that adults spend a year or less in saltwater, after which they migrate back to freshwater, spawn from April to June, and die. The degree of adult fidelity to natal streams is unknown.

Photo: USGS, Mike Hayes

**Distribution and Abundance**
Species range is Alaska to California. River Lamprey probably historically occurred in most major Washington rivers. Current Washington distribution is not well-known, but includes Pacific coast rivers from Columbia River northward, Puget Sound rivers, and within Columbia Basin, with documentation for the Yakima Basin. Quantitative abundance information for Washington occurrences is not available, and thus no abundance trend estimates exist.

**Habitat**
Ammocoetes (larvae) use fine silt and mud substrates in slow current areas of rivers and streams, feeding on algae and microscopic organisms. They burrow and are relatively immobile in these substrates and thus good water quality is required year-round. Adults use estuarine and marine habitats, and appear to use relatively shallow marine waters. Adults spawn in gravel substrates in riffle areas of clear, cool streams, constructing nests by moving substrate materials. Adults and juveniles use river mainstems as migration corridors, with some populations having very long migration distances to and from the sea.

**References**
Hayes, M. C., R. Hays, S. P. Rubin, D. M. Chase, M. Hallock, C. Cook-Tabor, C. W. Luzier and M. L. Moser. 2013. Distribution of Pacific lamprey *Entosphenus tridentatus* in watersheds of Puget Sound based on smolt monitoring data. Northwest Science 87(2): 95-105.
Wydoski, R. S., and R. R. Whitney. 2003. Inland fishes of Washington, 2nd edition. University of Washington Press. Seattle, WA. 322pp.

**River Lamprey: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Abundance and distribution information is inadequate for status assessment. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Dams, culverts, road crossings, and other instream modifications impede passage. | Dam and barrier removal. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Fish passage facilities. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## GREEN STURGEON – SOUTHERN DPS (*Acipenser medirostris*)

**Conservation Status and Concern**

Green Sturgeon-Southern DPS has one spawning population with multiple habitat-related threats, and juvenile production may be declining. Harvest-related risks and estuarine degradation are threats in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G3 | S2N | Medium/declining | Moderate |

**Biology and Life History**

Photo: B. James, WDFW

Green Sturgeon is an anadromous fish with long life-span (up to 70 years) that reaches maturity at around fifteen years or 5 to 6 feet in length. It spawns infrequently, approximately every 3 to 5 years, in natal streams. Southern DPS Green Sturgeon spawn in upper mainstem Sacramento River, California. Larvae and juveniles migrate downstream to river delta and estuaries where they rear for 1 to 4 years prior to migrating to ocean. Sub-adults and adults of this DPS live in coastal waters from Baja California, Mexico to British Columbia, Canada, and utilize coastal bays and estuaries of Washington, Oregon, and California during summer and fall. Adults/sub-adults feed on benthic fauna such as clams and crustaceans. Fish in spawning condition migrate from these areas and enter San Francisco Bay between mid-February and early-May, and spawn from April to early July. They re-enter ocean from November through January and resume coastal migrations.

**Distribution and Abundance**

The Green Sturgeon Southern DPS includes all spawning populations south and exclusive of Eel River, California, but principally includes the Sacramento River spawning population. Sub-adults and adults of this DPS are distributed in marine waters from Baja California to British Columbia, and in Washington occur in marine and estuarine areas, such as the lower Columbia River, Willapa Bay and Grays Harbor. Green Sturgeon from the northern DPS (federal species of concern) may also be present in these same Washington areas. Current total abundance for the Southern DPS is unknown. A genetic analysis estimated that between 10 to 28 spawners contributed to juvenile production between 2002 and 2006 in the Sacramento River upstream of Red Bluff Diversion Dam. Population modeling has suggested that sub-adults comprise the majority of the population and that annual spawner fish represent a small fraction of census population.

**Habitat**

No spawning habitat for this DPS occurs in Washington. Federally-designated critical habitat within marine waters includes areas within the 360 foot isobath from Monterey Bay to the U.S.-Canada border. Many coastal bays and estuaries are designated as critical habitat, including Willapa Bay and Grays Harbor (Washington) and the lower Columbia River estuary from the mouth to river-mile 46 (Washington and Oregon). Green Sturgeon forage in benthic substrates in marine and estuarine waters.

**References**

Israel, J. A., and B. May. 2010. Indirect genetic estimates of breeding population size in the polyploidy green sturgeon, *Acipenser medirostris*. Molecular Ecology 19:1058-1070.

NMFS, Southwest Region. 2010. Federal Recovery Outline - North American Green Sturgeon, Southern Distinct Population Segment. http://www.westcoast.fisheries.noaa.gov/publications/protected_species/other/green_sturgeon/green_sturgeon_sdps_recovery_outline2010.pdf

**Green Sturgeon-Southern DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Insufficient data on distribution, ecology and abundance for sturgeon in WA areas. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Coastal bays and estuaries habitat quality may be degraded relative to sturgeon needs. | Preserve estuarine habitat, restore lost estuarine habitat and restore natural functions (e.g. adequate flows and sediment delivery). | Current insufficient | External |
| 3 | Overharvesting of biological resources | Green Sturgeon may be incidentally harvested in various fisheries (bycatch). | Monitor catch and mortality of Green Sturgeon in fisheries targeting other species. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE STURGEON – COLUMBIA RIVER (*Acipenser transmontanus pop. 2*)

**Conservation Status and Concern**

Although stable and numerous in lower Columbia River, they are increasingly rare upstream. Dams impede and prevent passage and have negatively impacted spawning habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4T3T4 | S3B,S4N | Low to abundant/ declining to stable | Moderate |

**Biology and Life History**

Photo: Wikimedia Commons

White Sturgeon is North America's largest freshwater fish, with maximum length about 20 feet, and a maximum mass of 1800 pounds. They are long-lived (over 100 years) and slow growing. They spawn exclusively in freshwater, typically during late spring to early summer when water temperatures reach 54 to 57°F. Spawning may occur later in year and over shorter time periods in upper basin. Males mature between 39 to 60 inches in length and at ages 12 to 25 years, while females typically mature at 47 to 71 inches and at ages 15 to 30 years. They spawn more than once during lifetime, with reproductive periodicity in lower Columbia River ranging between 3 to 5 years for males and females. Larvae hatch from eggs in 1 to 2 weeks. Juveniles typically feed on benthic invertebrates (amphipods, Chironomid larvae, isopods, mysids, snails, freshwater mussels and clams), while larger White Sturgeon are increasingly piscivorous. Inhabitants of lower river reaches can be amphidromous, with individuals moving between fresh and saltwater to feed.

**Distribution and Abundance**

The species ranges from Ensenada, Mexico to Aleutian Islands, Alaska, inhabiting large rivers, estuaries, and nearshore ocean. Riverine range of this Columbia River population includes spawning aggregations in the mainstem from its mouth to confluence with Kootenai River in British Columbia, including extreme lower reaches of its major tributaries except for Snake and Kootenai rivers. Fish in upstream areas may be freshwater-residents, and may be isolated between dams without passage facilities. Fish in lower river reaches utilize fresh and marine waters. Throughout its Columbia River range, population status and recruitment success vary widely. Currently, status is stable at high abundance in free-flowing lower Columbia River. In areas upstream of Bonneville Dam to Priest Rapids Dam, abundance is moderate and trend is stable. Abundance is low, with a declining trend, for wild fish residing in impoundments upstream of Priest Rapids Dam, an area where hatchery supplementation is underway.

**Habitat**

Large, cool rivers are primarily utilized. Sturgeon in spawning condition migrate to spawning sites comprised of a combination of moderate to high water velocities and turbulence over cobble or rock substrate, often in close proximity to deeper, slower-moving staging and resting areas. Such sites are limited to dam tailraces for impounded sub-populations, otherwise are typically located in rapids near large eddies. Spawning sites have been identified at the confluence of the Pend d'Oreille and Columbia rivers and further downstream in the Columbia River. Flow regulation has likely contributed to poor

spawning and early-rearing success of White Sturgeon in the upper Columbia River by reducing spring flows and increasing water clarity.

**References**

Columbia Basin White Sturgeon Planning Framework. 2013. Prepared by CRITFC, WDFW and ODFW for the Northwest Power and Conservation Council. R. Beamesderfer and P. Anders (eds). 285pp.

### White Sturgeon – Columbia River: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat fragmentation: downstream dams isolate populations from lower basin populations and anadromous food resources. Upstream dam (Keenleyside) cut off access to historical spawning, rearing and feeding habitats. Former highly diverse and productive riverine ecosystem replaced by homogenous, oligotrophic reservoir that provides marginal habitat. Fragmentation eliminated full spectrum of habitats necessary for resident sturgeon to complete their life cycle. | Investigate using fish from adjacent populations in the supplementation program. | Current sufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Flow regulation: Increased storage in upper basin and hydro operation have reduced spring flows. Riverine habitats and seasonal floods provide suitable spawning conditions by dispersing newly hatched free embryos to suitable rearing habitat, floods flush fine sediment and prevent armoring, and increased turbidity provides cover from potential predators. | Investigate habitat modifications, including enhancing spawning substrates. | Current insufficient | Both |
| 3 | Resource information collection needs | Need to monitor population trends and success of restoration actions. | Continue to monitor the status and trends of populations within the recovery areas. | Current sufficient | Both |
| 4 | Management Decision Needs | Need to monitor restoration planning, supplementation program, impacts and success. | Continue supplementation to rebuild abundance and maintain genetic diversity. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SALMONIDS

## LOWER COLUMBIA CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 1*)

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

The season that adults return to freshwater distinguishes populations. For spring-run populations, adults enter rivers in early March not fully mature and spawn from late August to early October. For fall-run populations, adults enter rivers in early to late August and spawn from mid-September to mid-December. Spawning sites are usually in river's mainstem and large tributaries where flows and gravel sizes are optimal for egg deposition and survival. Most juveniles rear in freshwater for several months, out-migrating to estuary or ocean as fry or subyearlings from late winter to summer, and some may rear for a year before out-migrating. Sub-adults live in coastal Pacific Ocean as far north as southeastern Alaska and off British Columbia, Washington and Oregon, where they are largely piscivorous and grow to maturity for 1 to 6 years before migrating back to natal rivers. Most spawners are ages 2 to 5.

**Distribution and Abundance**

The ESU includes Chinook salmon in Washington and Oregon rivers that are Columbia River tributaries from its mouth up to Hood (Oregon) and White Salmon (Washington) rivers, and includes Willamette River to Willamette Falls, Oregon. Dams in several rivers significantly reduced or eliminated the historical distribution. Of 32 historical populations, 22 are in Washington. Washington's seven spring-run populations are extirpated or at high extinction risk. Of 15 fall-run populations, several are extirpated and most others are at high extinction risk. Chinook in 10 Washington hatchery programs are included in ESU, but introduced Chinook from other ESUs are not included, even if naturally spawning. Abundance remains very low for spring-run Chinook in restoration programs. Most fall-run populations also are at low abundance, especially in terms of wild-origin spawners, and at high extinction risk. The Lewis River late fall-run population is the only one with abundance trend nearing interim recovery goal.

**Habitat**

Adults and juveniles use a variety of riverine habitats depending on life stage. Spawners use pool and riffle areas in channels that have adequate depth, velocity, gravel substrate and temperature. Young juveniles use lower velocity and shallower areas including stream margins and non-mainstem channels, such as those found in natural floodplains. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are important due to habitat-forming large woody debris contributed to channels, and shading that moderates temperature. Columbia River estuary is an important juvenile rearing habitat. Sub-adults rear in Pacific Ocean continental shelf areas west of southeastern Alaska, British Columbia, Washington and Oregon.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

**Lower Columbia River Chinook Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish and maintain adequate passage. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Add or improve fish passage in multiple localities (esp. Cowlitz and Lewis). | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## PUGET SOUND CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 15*)

**Conservation Status and Concern**

All populations in ESU are well below recovery plan target ranges for spawner levels. Risk factors are still present, including high fractions of hatchery fish and widespread habitat loss and degradation.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults enter rivers from mid-April to mid-September and spawn from late July to early November, with a population's return and spawn timing adapted to their spawning habitat. Spawning sites are usually in mainstem rivers and large tributaries where flows and gravel sizes are optimal for egg deposition and survival. Most juveniles rear in freshwater for several months before transforming to smolts and migrating to saltwater during spring and summer, and some may rear for a year before out-migrating. Juveniles may live in estuaries for a short time before entering marine waters. Sub-adults typically live in Puget Sound and coastal Pacific Ocean off Canada where they are largely piscivorous and grow to maturity for 1 to 6 years before migrating back to their natal rivers. Most spawners are ages 2 to 5 years, with age 4 predominating.

**Distribution and Abundance**

This ESU includes all wild Chinook salmon in rivers flowing into Puget Sound, Hood Canal, and eastern Strait of Juan de Fuca (Elwha River and eastward) in Washington, and hatchery-born Chinook from 26 artificial propagation programs. Currently, of 31 quasi-independent populations identified as historically present, 22 are extant and all of these are monitored annually for adult abundance. Marine distribution includes Puget Sound and coastal Pacific Ocean. Spawner abundance remained fairly constant between 1985 and 2009 but productivity (recruits per spawner) declined. The percentage of naturally spawning hatchery-origin fish averaged greater than 50 percent in one third of populations from 2005 to 2009.

**Habitat**

Adults and juveniles use a variety of riverine habitats depending on life stage. Spawners use pool and riffle areas in channels that have adequate depth, velocity, gravel substrate and temperature. Young juveniles use lower velocity and shallower areas including stream margins and non-mainstem channels, such as those found in natural floodplains. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are important due to habitat-forming large woody debris contributed to channels, and shading that moderates temperature. Estuaries serve as important rearing habitats, and juveniles use shallow nearshore areas as they migrate through Puget Sound. Sub-adults use deeper, more offshore Puget Sound areas for foraging. Other marine rearing areas include Strait of Georgia and Pacific Ocean continental shelf areas west of Vancouver Island and central British Columbia.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Ruckelshaus, M. H., K. P. Currens, W. H. Graeber, R. R. Fuerstenberg, K. Rawson, N. J. Sands, and J. B. Scott. 2006. Independent populations of Chinook salmon in Puget Sound. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-78, 125pp.

**Puget Sound Chinook Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, estuarine, and nearshore-marine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrologic functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation, estuarine and nearshore marine habitats and processes. | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Loss of natural productivity; percent of hatchery-origin fish on spawning grounds is often higher than management goal. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal; add or improve fish passage facilities in some localities. | Current insufficient | External |
| 4 | Energy development and distribution | Dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish. | Current insufficient | External |
| 5 | Climate change and severe weather | River scour and excessive sedimentation from high flows and bank/hillsides erosion. | Restore and manage forests to protect channels, stream banks, and floodplains, and reduce effects of heavy rains and high flows. | Current insufficient | External |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## UPPER COLUMBIA RIVER SPRING CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 12*)

**Conservation Status and Concern**

Although there have been increases in natural-origin spawner abundance, average productivity levels remain extremely low. Risks due to relatively high percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Candidate | Yes | G5T1Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in March and enter their natal upper Columbia tributaries from early May to early August. Spawning occurs from August to mid-September. Juveniles rear for over a year in freshwater and then migrate through Columbia River mainstem to saltwater during spring to early summer. Pacific Ocean areas used by sub-adults for 2 to 3 years of rearing are not well-known, but likely occur offshore of northern continental shelf waters. Most spawners are ages 4 or 5 years. Upper Columbia River spring-run Chinook are part of a highly distinct evolutionary lineage and are genetically well-differentiated from most other Chinook salmon in Washington.

**Distribution and Abundance**

This ESU includes spring-run Chinook salmon in tributaries of upper Columbia River upstream of Yakima River confluence. Three extant populations occur in Wenatchee, Entiat, and Methow rivers, which drain eastside of the Cascades Mountains. Tributaries within these rivers support sub-populations containing important biological diversity (e.g., White River and Twisp River). Historical populations in Okanogan River and in upper Columbia River areas upstream of Grand Coulee Dam are extirpated. Six artificial propagation programs are included in the ESU. Abundance has increased since 1991 but this ESU did not meet viability criteria when last reviewed, and was rated at moderate-to-high extinction risk.

**Habitat**

Adults and juveniles use riverine and stream habitats in Wenatchee, Entiat, and Methow basins. Snow is major form of precipitation and rainfall is low. Snowmelt creates high flows in spring that adults utilize to access spawning habitat. Adequate stream conditions (e.g., flow, temperature, cover, prey) are required year-round because juveniles rear for more than a year before out-migrating. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are particularly important for moderating water temperature, and for contribution of large woody debris for in-stream habitat formation. Numerous dams in Columbia R. migration corridor negatively affect passage, flow and temperature conditions. Sub-adults rear in the North Pacific Ocean.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

**Upper Columbia River Spring Chinook ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows and maintain adequate passage for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SNAKE RIVER FALL CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 2*)

This ESU includes one extant population. Abundance has improved substantially since ESA-listing, however hatchery-origin spawner proportions are high and dams continue to compromise habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T1Q | SNR | Medium/increasing | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in August and enter Snake River in September. Spawning occurs from mid-October through mid-December in mainstem and lower areas of Snake River tributaries. Juveniles rear for several months and sometimes over a year in freshwater, and rearing may occur in Snake mainstem reservoirs. Migration to sea through Snake and Columbia rivers' mainstems occurs from spring through summer. Sub-adults rear in Pacific Ocean coastal areas off British Columbia and Washington, and most rear for one to three years before returning to spawn.

**Distribution and Abundance**

Distribution of historical spawning habitat has been significantly altered by Snake River mainstem dams. Habitat upstream of Hells Canyon Dam is inaccessible, and a 108 mile mainstem reach between that dam and upper end of Lower Granite Dam reservoir is remaining primary spawning habitat. Spawning also occurs now in lower areas of Snake River tributaries such as Grande Ronde, Clearwater and Tucannon rivers. Fish in two artificial production programs are included in ESU. Abundance of wild-born fish has increased in recent years due to on-going hatchery supplementation, and majority of naturally spawning fish are hatchery-origin. Returning wild-born adults have been estimated at over 4,000 fish since 2005, with an increasing trend to 2013.

**Habitat**

Adults and juveniles use riverine and reservoir habitats of the Snake River and lower mainstem areas of its tributaries. Habitat available is significantly reduced from historical conditions. Snake Basin rainfall is generally low and snow is major form of precipitation. High spring-time flows are important for successful juvenile outmigration. Natural seasonal hydrology has been altered by dams that control Snake River mainstem and some tributaries' flows. Four dams in lower Snake River and four dams in the Columbia River migration corridor negatively affect passage, flow and temperature conditions needed for adult and juvenile survival. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Sub-adults rear in the North Pacific Ocean and appear to predominately use British Columbia and Washington coastal areas.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Waples, R. S., R. P. Jones, B. R. Beckman and G. A. Swan. 1991 Status Review for Snake River Fall Chinook Salmon. NOAA Technical Memorandum NMFS F/NWC-201, 80pp.

**Snake River Fall Chinook Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 2 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 4 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SNAKE RIVER SPRING/SUMMER CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 8*)

**Conservation Status and Concern**

The entire ESU is rated at high extinction risk. Besides low abundance, risks due to percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T1Q | SNR | Low/increasing | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in March and enter their natal Snake River tributaries from April to mid-May. Spawning occurs from August through September. Timing is influenced by spawning habitat elevation. Juveniles rear for over a year in freshwater and then migrate through Snake and Columbia rivers' mainstems to saltwater during spring to early summer. Pacific Ocean areas used by sub-adults for 2 to 3 years of rearing are not well-known, but likely occur offshore of northern continental shelf waters. Most spawners are ages 4 or 5 years. Snake River spring/summer Chinook are part of a highly distinct evolutionary lineage and are genetically well-differentiated from most other Chinook salmon in Washington.

**Distribution and Abundance**

This ESU includes spring/summer-run Chinook salmon in tributaries of the Snake River (Idaho, Oregon and Washington), and 31 historic populations were identified, with 4 being extirpated, in areas that are currently accessible. Numerous historical populations in Idaho were extirpated by Lewiston Dam and in upper Snake Basin by Hells Canyon Dam. Distribution in Washington includes the Tucannon River, Asotin Creek, and part of Wenaha River. The Asotin population is considered extirpated, but hatchery strays may be present. Fifteen artificial propagation programs are included in the ESU, including the Tucannon hatchery program in Washington. Abundance and productivity remain low for Tucannon wild population. Natural spawning abundance in Tucannon River has increased since 2009 but remains well below the minimum abundance threshold.

**Habitat**

Adults and juveniles use riverine and stream habitats of tributaries to the Snake River and occur in relatively high elevation areas. Rainfall is generally low and snow is major form of precipitation. Snowmelt creates high flows in spring that adults utilize to access spawning habitat. Adequate stream conditions (e.g., flow, temperature, cover, prey) are required year-round because juveniles rear for more than a year before out-migrating. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. The Tucannon River includes low elevation habitats within grasslands or agricultural fields and higher elevation habitats within evergreen forests. Riparian trees are particularly important in lower elevation areas for moderating water temperature, and throughout for contribution of large woody debris for in-stream habitat formation. Numerous dams in Snake and Columbia rivers'

migration corridors negatively affect passage, flow and temperature conditions. Sub-adults rear in the North Pacific Ocean.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

**Snake River Spring/Summer Chinook Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COLUMBIA RIVER CHUM SALMON ESU (*Oncorhynchus keta pop. 3*)

**Conservation Status and Concern**

After near extirpation, abundance of this ESU remains very low, and extinction risk was rated very high.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/declining | Moderate |

**Biology and Life History**

Photo: WDFW

Adults return to Columbia River from mid-October to November and reach spawning grounds from late October to early December. Spawning occurs from early November to mid-January in Columbia River mainstem and its tributaries. Early or 'summer' returning chum salmon occur in Cowlitz River, with earlier spawn timing than fall-run chum. Spawners use lower reaches of rivers, tributaries and side-channels from just above tidal influence to upstream areas below where gradients increase and partial natural barriers are more common. They often choose spawning sites with upwelling groundwater or that are spring-fed. Emerged fry spend little time rearing in freshwater and begin seaward migration at relatively small sizes, with an early capability for seawater adaptation. Outmigration occurs from March through May and peaks from mid-April to early May. Juveniles use lower Columbia estuarine areas for feeding and rearing and may be present from February through June. Sub-adults use Pacific Ocean areas for rearing but migration distances and specific distributions over multiple years at sea are not well-known. Returning adults are usually ages 3 to 5 years.

**Distribution and Abundance**

This ESU includes all chum salmon in the Columbia River and its Washington and Oregon tributaries. Of 17 historical populations, 11 are in Washington. Chum salmon from three Washington artificial propagation programs are included in the ESU. Lower Columbia Chum Salmon were nearly extirpated in the 1940's. Among Washington populations, Grays River and Lower Gorge populations are the only ones that have consistently maintained natural spawning and relatively stable abundance. All others are at very low abundance. In 2010 total abundance was less than 12 percent of 1951 estimated abundance. ESU status was rated at very high risk.

**Habitat**

Lower elevation and lower gradient riverine areas of Columbia River tributaries and sections of the Columbia River mainstem below Bonneville Dam are primary spawning habitats. Areas with upwelling groundwater and spring-fed flows are important for spawners. Juveniles use these same areas for a short time. Lower Columbia estuarine habitats are important feeding and rearing areas for juveniles prior to ocean entry. Pacific Ocean habitats used for rearing are likely to be coastal and continental shelf areas but oceanic distribution of sub-adults through their growth period is not well-known.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311 p.

**Columbia River Chum Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Remove structures that increase delivery or accumulation of fine sediments, that block or impede passage, or modify flows. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Optimum flows for chum need to be restored or maintained (e.g., mainstem redd de-watering threat), adequate passage maintained and flooded spawning habitat restored. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## HOOD CANAL SUMMER CHUM SALMON ESU (*Oncorhynchus keta pop. 2*)

**Conservation Status and Concern**

Abundance has improved significantly since time of ESA-listing, but viability conditions have not been met completely. Evaluation of efficacy of habitat improvements and reintroductions is needed.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Medium/increasing | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults return to natal streams from early August into October. Spawn timing ranges from mid-August to late October. Spawners use lower reaches of rivers, their tributaries and side-channels from just above tidal influence to upstream areas below where gradients increase and partial natural barriers are more common. Juvenile emergence from redds (nests) usually begins in February and continues for several months. Their freshwater residence time is short and they move rapidly downstream to rear in nearshore marine waters, including estuaries. As juveniles grow they move to more offshore waters, and during summer migrate to oceanic waters. Sub-adults rear in Pacific Ocean areas and likely migrate to North Pacific off British Columbia and Alaska, but migration distances and rearing localities over their multiple years at sea are not well-known. Adults mature and return to natal streams at ages two to five, but most are age three or four.

**Distribution and Abundance**

This ESU includes summer-run chum salmon in rivers draining to Hood Canal and Strait of Juan de Fuca, westward to and including Dungeness River. Two independent populations exist and each includes multiple sub-populations inhabiting separate rivers or creeks. Some sub-populations had been extirpated and overall abundance was at historically low levels by about 1990. Abundance levels have generally increased since 2000, due to implementation of recovery measures, including harvest management, short-term hatchery supplementation, and reintroduction. Extinction risks are likely relatively low currently, but full recovery has not been achieved yet. Reintroductions appear to be succeeding at re-establishing historic distribution, but those sub-population abundances are low.

**Habitat**

The most downstream and lowest gradient areas of rivers and creeks are primary spawning habitats. Spawners enter rivers during typically low flow periods in late summer and early fall, thus adequate water flow and quality need to be maintained. Juveniles spend very little time in natal stream habitats. Estuaries and nearshore areas of Hood Canal, Admiralty Inlet zone of Puget Sound, and Strait of Juan de Fuca are very important early rearing habitats for juveniles prior to Pacific Ocean entry. Sub-adults likely use Pacific Ocean coastal or continental shelf habitats, but oceanic habitats throughout growth period are not well-known.

**References**

Point No Point Treaty Tribes and Washington Department of Fish and Wildlife. 2014. Summer Chum Salmon Conservation Initiative (SCSCI) Five-year Review: Supplemental Report No. 8 of SCSCI - An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. WDFW, Olympia, WA. 237pp.

### Hood Canal Summer Chum Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Lower river areas, estuarine, and nearshore-marine habitats to some extent have been lost, modified or degraded by agricultural and residential development, and there is threat of further build-out and development. | Land use planning needs. | Current insufficient | Both |
| 2 | Resource information collection needs | Reintroduction programs in several localities need long-term monitoring. | Research, survey or monitoring - fish and wildlife populations. | Current sufficient | WDFW |
| 3 | Climate change and severe weather | Adequate flows during late summer spawn timing are needed. | Land use planning. | Current insufficient | External |
| 4 | Overharvesting of biological resources | Harvest impacts are currently low, but management for low impacts needs to be maintained. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## LOWER COLUMBIA COHO SALMON ESU (*Oncorhynchus kisutch pop. 1*)

**Conservation Status and Concern**

Washington coho salmon populations in this ESU are dominated by hatchery-origin spawners, are not demonstrably self-sustaining, and considered at very high extinction risk.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G4T2Q | SNR | Low/unknown | Moderate-high |

**Biology and Life History**

Photo: WDFW

Coho salmon in this ESU exhibit 'early' (mid-August to September) and 'late' (late September to October) adult return timing, with peak spawning occurring in late October and in December to early January, for each type respectively. Spawning can extend through February. Historically, early-returning coho spawned in upper reaches of large rivers in lower Columbia sub-basin and in rivers upstream of Cascade Crest (approximately Bonneville Dam), and late-returning coho spawned in smaller rivers or lower reaches of large rivers, with timing adapted to annual flow regimes and elevation. Juveniles usually rear for over a year (e.g., 18 months) in freshwater and move throughout natal river as they grow; some may leave freshwater early and rear in estuarine areas. Most juveniles migrate seaward from March to June, predominately in April and May, during their second year. Sub-adults typically rear for about 18 months in the ocean, inhabiting coastal waters north and south of Columbia River mouth. Ocean rearing locality may be correlated with early and late return-timing types. Most adults are age three at spawning, and some return at age two after 5 to 7 months at sea.

**Distribution and Abundance**

This ESU includes coho salmon in Columbia River tributaries from its mouth up to and including Big White Salmon and Hood rivers and Clackamas River (Willamette sub-basin). Dams in several rivers significantly reduced or eliminated historical distribution. Of 24 historical populations, 17 are in Washington. Coho salmon from 12 Washington artificial propagation programs are included in the ESU. Data on abundance trends for Washington populations are generally only available from 2010 forward, and these show low abundance for wild-born coho overall.

**Habitat**

Adult coho salmon use mainstem and tributary habitats. They often hold in pools in lower river areas prior to rain events that allow access to smaller tributaries upstream. Spawners use stream reaches where gravel sizes are optimal for redd (nest) construction and egg survival. Coho fry use shallow, low velocity areas for rearing, such as stream edges and side channels. During their long-term freshwater rearing, juveniles may move to higher flow areas and disperse into areas inaccessible to adults. Juveniles most often occur in pool rather than riffle habitat. Intact riparian vegetation, in-stream large woody debris and natural floodplain structure are important for juvenile productivity and survival. Summer low-flow conditions may reduce rearing habitat in area and quality (elevated temperature). Optimal freshwater temperature range is 54 to 57$^{o}$ F and temperatures over 77$^{o}$ F may be lethal. Columbia River estuarine areas are used for feeding during seaward migration. Sub-adults rear in Pacific Ocean continental shelf areas predominately off of Washington and Oregon, and to lesser extent off British Columbia and California.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

### Lower Columbia Coho Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current Sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Adequate harvest management planning and monitoring. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## OZETTE SOCKEYE SALMON ESU (*Oncorhynchus nerka pop. 2*)

**Conservation Status and Concern**

Ozette sockeye salmon are at very low abundance compared to historic condition, and quantity and quality of adequate lake beach spawning habitat may be declining.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate |

**Biology and Life History**

Photo: WDFW

Adult sockeye salmon return to Ozette River from April to July, and hold in Ozette Lake between April and January. Spawning, either on lake's beaches or in river and tributary creeks, occurs from October to January. Following emergence in March and April, juveniles migrate to Ozette Lake, where nearly all rear for about a year and then emigrate to the sea the following March through June. During lake rearing they feed on planktonic crustaceans (e.g. *Daphnia* spp.), benthic invertebrates and insects. Ocean distribution and behavior of sub-adults are not well-known, but young fish may use nearshore ocean areas and move offshore as they growth. Ocean rearing may last from 1 to 3 years, but majority rear for about 2 years before returning to spawn. Adult total age ranges from 3 to 5 years, with most being 4 years of age.

**Distribution and Abundance**

This ESU consists of one sockeye salmon population in Ozette River basin on Washington's Pacific coast. Historical abundance was very large, based on peak harvest values, and minimum viable spawning abundance goal for recovery is 35,500. Lowest abundances likely occurred in the 1960's and 1970's. Abundance estimates have been highly variable and uncertain, but methodologies have improved and average annual abundance of returning adults for a recent ten-year period was over 2,500. Current abundance is very low compared to historical levels.

**Habitat**

Ozette Lake is primary habitat for adults and juveniles. Adults hold in lake and spawn on lakeshore beaches, particularly Allen's Beach and Olsen's Beach. Spawning substrates vary from cobble/large gravel to coarse sand and silt, and groundwater upwelling sites appear to be favored spawning sites. Spawners also use tributaries to the lake (e.g., Umbrella Creek, Big River, Crooked Creek) and spawn in gravel riffles and glides and less commonly in pools and side channels. Juvenile reside and feed in the lake throughout their freshwater rearing stage. Migration distances to and from ocean through Ozette River are relatively short. Ocean rearing areas are not well-known, but nearshore and offshore North Pacific waters are likely used.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Haggerty, M. J., A. C. Ritchie, J. G. Shellberg, M. J. Crewson, and J. Jalonen. 2009. Lake Ozette Sockeye Limiting Factors Analysis. Prepared for Makah Indian Tribe and NOAA Fisheries in cooperation with Lake Ozette Sockeye Steering Committee, Port Angeles, WA. 565pp.

### Ozette Sockeye ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | No cities or towns impacts, but land use or other factors may be affecting quantity and quality of spawning habitats, such as lake beaches. | Research, survey or monitoring - habitat. | | External |
| 2 | Resource information collection needs | Continue adult and juvenile monitoring. | Research, survey or monitoring - fish and wildlife populations. | | External |
| 3 | Agriculture and aquaculture side effects | Management and monitoring of hatchery restoration program needs to be maintained. | Hatcheries (restoration). | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## LOWER COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 14*)

**Conservation Status and Concern**

Most populations are rated at high or very high extinction risk, and dams block several large areas of historic range. Habitat degradation and hatchery-related impacts are other limiting factors.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: NOAA

Adults in this DPS exhibit winter and summer adult return timing. Winter-run steelhead in mature condition may begin entering natal rivers in early December; spawning occurs typically from early March to early June, with peak in late April/early May. Summer-run steelhead in immature condition begin entering natal rivers in early May and entry extends to October; they mature in freshwater and spawn in following calendar year from January to June, with peak in late February to early April. Adults usually survive spawning and migrate to sea. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 4 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from April to June, with peak in May; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in central North Pacific Ocean or Gulf of Alaska; rearing typically occurs for 1 to 3 years, with 2 years the most common. Total age at first return to spawn is usually 4 to 6 years.

**Distribution and Abundance**

This DPS includes steelhead in Washington and Oregon Columbia River tributaries from Cowlitz River up to Hood River. In Washington, there are 14 historical winter-run and five historical summer-run populations. Steelhead from four Washington hatchery propagation programs are included in DPS, but hatchery steelhead from non-native and non-local stocks are not. Dams in several rivers have significantly reduced or eliminated historical distribution. Other man-made barriers and habitat alterations further reduce distribution. Current abundance is low compared to historic. Recent analyses indicated that in Washington, only the Wind River summer-run population was considered viable, and most others were at very high or high risk levels.

**Habitat**

Adults use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian

vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is migration corridor. Central North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

**Lower Columbia Steelhead DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often unknown, and thus it is uncertain if management goals are being met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Resource information collection needs | Monitoring needed that will ascertain proportion of hatchery-origin spawners in annual spawning escapements. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MIDDLE COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 17*)

**Conservation Status and Concern**

Many populations are rated at high extinction risk. Dams impede passage and reduce or modify access to large areas of historic range, and other habitat degradation limits distribution and productivity.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Intermediate/stable | Moderate |

**Biology and Life History**

Photo: NOAA

Most adults exhibit summer return timing, but winter return timing occurs in several populations. Summer-run steelhead in immature condition begin entering freshwater in late spring, and travel to and enter natal tributaries through summer and fall; they mature in freshwater and spawn in following calendar year usually from early March to early June. Winter-run steelhead enter freshwater in mature condition and may enter natal rivers by early December; their spawn timing may coincide with that of summer-run steelhead. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 5 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March to June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years, with 2 the most common. Age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**

Steelhead in this DPS occur in Washington and Oregon Columbia River tributaries upstream and exclusive of Wind River (Washington) and Hood River (Oregon), and downstream of Priest Rapids Dam, but excluding Snake River basin. In Washington, extant populations occur in Yakima, Touchet, Walla Walla, and Klickitat rivers and Rock Creek; a remnant White Salmon River population may recover due to dam removal. Dams in several rivers have significantly reduced or eliminated historical distribution. Distribution also is reduced by other man-made passage barriers and habitat alterations from agriculture and other development. Abundance has increased in some areas (Yakima Basin and Walla Walla River) but is low in others. Recent analyses rated a few populations as viable, but the DPS was rated as not viable overall.

**Habitat**

Adults use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and

temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is migration corridor and is greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

### Middle Columbia Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## PUGET SOUND STEELHEAD DPS (*Oncorhynchus mykiss pop. 37*)

**Conservation Status and Concern**

In 2011, most populations showed declining growth rates and extinction risks were relatively high overall, especially for central/south Puget Sound populations. Habitat degradation and poor early marine survival may be impeding productivity.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G5T2Q | SNR | Low/declining | Moderate-high |

**Biology and Life History**

Photo: NOAA

Adults exhibit winter and summer return timing. Winter-run are most common. Winter-run adults in mature condition may begin entering rivers in late November; spawning may occur from February to June with peak spawning in April or May. Summer-run adults return to rivers from May to October and mature in freshwater, with spawning occurring in following calendar year from January to May. Some populations contain adults of both return- types, and which likely overlap in spawn-timing. Other exclusively summer-run populations occur upstream of falls or cascades that exclude fish returning in winter due to flows. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 3 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately in April and May; some mature in freshwater without going to sea, more commonly in males than females. Juvenile mortality in Puget Sound may be relatively high. Ocean migration paths are not well-documented but sub-adults may rear in central North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years, with 2 years the most common.

**Distribution and Abundance**

This DPS includes steelhead in Washington watersheds draining to Puget Sound, Hood Canal, and the Strait of Juan de Fuca west to and including Elwha River. It includes 32 historical populations. Steelhead in several hatchery programs based on local wild broodstock are included in the DPS, but hatchery steelhead from non-native and non-local stocks are not. Dams in several rivers significantly reduced or eliminated historical distribution, and other man-made barriers (e.g. culverts) further reduce distribution. Current abundance is at very low level compared to historic estimates. Summer-run populations are generally small due to limited habitat and abundance trends are not well-monitored.

**Habitat**

Adult steelhead use wide variety of freshwater habitats, spawning in river mainstems and large and small tributaries. They migrate relatively far upstream compared to other salmonids and access is aided by flow conditions during their return timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed and use differing habitats in response to seasonal flow and temperature

conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Central North Pacific Ocean and Gulf of Alaska are likely marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J. M., J. J. Hard, E. J. Connor, R. A. Hayman, R. G. Kope, G. Lucchetti, A. R. Marshall, G. R. Pess, and B. E. Thompson. 2015. Identifying historical populations of steelhead within the Puget Sound distinct population segment. U.S. Dept. Commerce, NOAA Tech. Memo. NMFSNWFSC-128.

**Puget Sound Steelhead DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, estuarine, and nearshore-marine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine and nearshore marine habitats and processes. | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in some localities. | Current insufficient | External |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Climate change and severe weather | River scour and excessive sedimentation are threats from high flows and bank/hillsides erosion. | Restoration of forests and adequate forest management to protect channels, stream banks, and floodplains, and reduce effects of heavy rains and high flows. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## SNAKE RIVER BASIN STEELHEAD DPS (*Oncorhynchus mykiss pop. 13*)

**Conservation Status and Concern**

Extant populations are at moderate to high extinction risk. Dams impede passage, reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2T3Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: NOAA

Adults in this DPS exhibit summer return-timing. They enter freshwater in immature condition in late spring, and travel to and enter natal tributaries through summer, fall, and in following spring if they hold through winter in mainstem reservoirs. They mature in freshwater and spawn from February to May in calendar year following Columbia R. entry. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles may rear in freshwater for 1 to 3 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March through June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years. Age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**

Steelhead in this DPS occur in Snake River tributaries in Washington, Oregon, and Idaho. Of 24 extant populations, two are entirely in Washington and two are in watersheds shared by Washington and Oregon. Historical populations likely occurred upstream of impassable Hells Canyon Dam. Asotin River abundance has been stable, but Tucannon River wild-born fish abundance has been low, and population was rated at high risk. Tucannon steelhead monitoring has revealed high proportions of non-local hatchery-origin and non-local wild-born adults entering river. If these remain and spawn, they may affect abundance and productivity of native population. Also, many Tucannon steelhead were found to bypass river during migration, hold in Snake River upstream of Lower Granite Dam, and a proportion did not return downstream (over two dams) to natal river. Populations partially in Washington were at viable or stable status.

**Habitat**

Adult steelhead use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater

temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia and Snake rivers are migration corridors (long distances), and are greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Bumgarner, J. D., and J. T. Dedloff. 2011. Lyons Ferry complex hatchery evaluation: summer steelhead annual report 2008 and 2009 run year. Washington Department of Fish and Wildlife, Olympia, WA.

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281 pp.

**Snake River Basin Steelhead DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## UPPER COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 12*)

**Conservation Status and Concern**

Extant populations are rated at high extinction risk. Dams impede passage and reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/increasing | Moderate-high |

**Biology and Life History**

Photo: NOAA

Steelhead in this DPS exhibit summer adult return timing. They enter freshwater in immature condition in late spring, and travel to and enter natal tributaries through summer, fall, and in following spring, if they hold through winter in mainstem reservoirs. They mature in freshwater and spawn from early March to mid-July in calendar year following Columbia River entry. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles may rear in freshwater for 1 to 5 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March through June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years. Total age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**

Steelhead in this DPS occur in Columbia River tributaries upstream and exclusive of Yakima River to the U.S./Canada border. Several tributaries upstream of impassable Chief Joseph and Grand Coulee dams could have historically supported additional populations. Steelhead in six artificial propagation programs are included in DPS. Dams, other man-made passage barriers and habitat alterations from land uses significantly reduced, modified or eliminated historical distribution. Barriers and land use impacts (e.g., irrigation) are being corrected in several rivers following Recovery Plan. Although total annual spawner abundance generally has increased in last 10 years, proportions of wild-born adults remain well below recovery goals. The four extant populations were last rated at high extinction risk.

**Habitat**

Adult steelhead use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is

migration corridor (long distance) and is greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

**Upper Columbia Steelhead DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Add or improve fish passage facilities in multiple localities. | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BULL TROUT – COASTAL RECOVERY UNIT (*Salvelinus confluentus pop. 3*)

**Conservation Status and Concern**

Many of the Washington core area populations have unknown status. Bull Trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fish species.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G4T2Q | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: Roger Tabor, USFWS

Bull Trout in this DPS exhibit migratory (anadromous and amphidromous) and resident (adfluvial and fluvial) life history forms. They spawn in headwater streams and rivers from late summer to late fall, with falling water temperatures between 41 to 48$^{o}$ F., and may spawn each year or in alternate years. Eggs hatch in late winter or early spring. Fry emerge from gravel in April or May. Most information indicates that sexual maturity is attained in 4 to 7 years. They require colder waters than other trout species. Small Bull Trout eat terrestrial and aquatic insects, and shift to preying on fish as they grow larger. Large Bull Trout are primarily fish predators. Resident and migratory forms may be found together, and either form may produce offspring with either life history strategy.

**Distribution and Abundance**

Bull Trout in this Recovery Unit occur in Washington and Oregon watersheds west of the Cascade Mountains crest. In Washington, there are 16 core areas (habitat/population units) designated that include multiple populations. One historic core area, White Salmon River, was designated. Most core areas are in Puget Sound and Olympic Peninsula drainages, and two are in Columbia River drainages. Four core areas, Lower Skagit, Upper Skagit, Quinault River, and Lewis River, have been identified as current strongholds and likely have most stable and abundant populations in Recovery Unit. Bull Trout are reported as extirpated from White Salmon, lower Nisqually, and Satsop rivers, but these may not be only Washington extirpated localities in this Unit. Only a few populations are regularly monitored to estimate spawner abundance.

**Habitat**

Habitat includes deep pools in cold rivers and large tributary streams, often in moderate to fast currents, and large, cold lakes and reservoirs. Conditions that favor population persistence include stable channels, relatively stable stream flow, low levels of fine substrate sediments, high channel complexity with various cover types, and temperatures not exceeding about 59$^{o}$ F. Suitable migratory corridors between seasonal habitats and for genetic exchange among populations are needed. Spawning usually occurs in gravel riffles of small tributary streams, including lake inlet streams, with sites often associated with springs and upwelling groundwater. Optimum temperatures for incubation are about 36 to 39$^{o}$ F., and for juvenile rearing, about 45 to 46$^{o}$ F. Abundance of large woody debris and rubble substrate are important for rearing habitat.

**References**

USFWS. 2014. Revised draft recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xiii + 151pp.

WDFW. 2004. Washington State Salmonid Stock Inventory- Bull Trout/Dolly Varden. Washington Department of Fish and Wildlife, Olympia, WA. 449pp.

**Bull Trout - Coastal Recovery Unit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Spawning and resident habitat has been destroyed or is threatened by urbanization, fisheries management activities, agriculture practices, mining, residential development, livestock grazing, dams and logging practices. | Even though many protective measures have taken place, currently-used spawning and resident habitat needs to be protected from degradation. | Current sufficient | Both |
| 2 | Invasive and other problematic species and genes | Introgression with hatchery-released eastern brook trout is a primary threat to Bull Trout in some waters. | Hatchery stocking of brook trout in drainages where Bull Trout are known to reside has been curtailed. Reducing existing numbers of brook trout where applicable/possible would be prudent. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Not 'accidental mortality' but intentional poaching of vulnerable fish during spawning season and other times of the year. | Increase law enforcement patrols of Bull Trout habitat during spawning season and close motor vehicle access to sensitive areas. | Current insufficient | Both |
| 4 | Climate change and severe weather | Potential climate change effects include increased water temperatures, which may have negative temporal and spatial impacts. | Restoration of forests and adequate forest management to protect riparian cover and restore landscape-level hydrology. | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## BULL TROUT – MID-COLUMBIA RECOVERY UNIT (*Salvelinus confluentus pop. 2*)

**Conservation Status and Concern**

Many of the Washington core area populations have unknown status. Bull Trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fishes.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G4T2Q | SNR | Unknown/unknown | Moderate |

**Biology and Life History**

Photo: Roger Tabor, USFWS

Bull Trout in this DPS exhibit resident, adfluvial and fluvial life history forms. They spawn in headwater streams and rivers from late summer to late fall, with falling water temperatures between 41 to 48$^{o}$ F., and may spawn each year or in alternate years. Eggs hatch in late winter or early spring. Fry emerge from gravel in April or May. Most information indicates that sexual maturity is attained in 4 to 7 years. They require colder waters than other trout species. Small Bull Trout eat terrestrial and aquatic insects, and shift to preying on fish as they grow larger. Large Bull Trout are primarily fish predators. Resident and riverine migratory forms may co-occur, and each form produces offspring with either life history strategy.

**Distribution and Abundance**

Bull Trout in this Recovery Unit occur in Washington, Oregon and Idaho watersheds of the Columbia Basin east of the Cascade Mountains crest. In Washington, there are seven core areas (habitat/population units) designated, and Washington shares two other core areas with Oregon. Core areas may include multiple populations. The Okanogan River is recognized as foraging, migrating, and overwintering habitat. Bull Trout have been extirpated from Lake Chelan. The area upstream from Chief Joseph Dam is currently unoccupied by Bull Trout. Asotin Creek core area was as rated one of the least robust (most threatened). Some populations are regularly monitored, especially in the Yakima River core area, for spawner abundance, but total population abundance estimates are not made.

**Habitat**

Habitat includes deep pools in cold rivers and large tributary streams, often in moderate to fast currents, and large, cold lakes and reservoirs. Conditions that favor population persistence include stable channels, relatively stable stream flow, low levels of fine substrate sediments, high channel complexity with various cover types, and temperatures not exceeding about 59$^{o}$ F. Suitable migratory corridors between seasonal habitats and for genetic exchange among populations are needed. Spawning usually occurs in gravel riffles of small tributary streams, including lake inlet streams, with sites often associated with springs and upwelling groundwater. Optimum temperatures for incubation are about 36 to 39$^{o}$ F., and for juvenile rearing, about 45 to 46$^{o}$ F. Abundance of large woody debris and rubble substrate are important for rearing habitat.

**References**

Scholz, A. T. and H. J. McLellan. 2009. Field Guide to the Fishes of Eastern Washington. Eagle Printing, Cheney, Washington. 310pp.

USFWS. 2014. Revised draft recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xiii + 151pp.

USFWS. 2012. Species Fact Sheet, Bull Trout, *Salvelinus confluentus*. 4pp.

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**Bull Trout - Mid-Columbia Recovery Unit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Spawning habitat has been destroyed or is threatened by development, mining and logging practices. | Acquisition of cold headwater spawning habitat could be one solution to protecting it. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Spawning habitat and spawning fish have been damaged/poached-killed by individuals that have easy (motor vehicle) access to the stream's edge. | Increase law enforcement patrols of Bull Trout habitat during spawning season and close motor vehicle access to sensitive areas. | Current insufficient | Both |
| 3 | Invasive and other problematic species and genes | Introgression with hatchery-released eastern brook trout and brown trout is a primary threat to Bull Trout in some waters. | Hatchery stocking of brook trout and brown trout in drainages where Bull Trout are known to reside has been curtailed. Reducing existing numbers of these nonnatives where applicable/possible would be prudent. | Current insufficient | Both |
| 4 | Climate change and severe weather | Potential climate change effects include increased water temperatures, which may have negative temporal and spatial impacts. | Restoration of forests and adequate forest management to protect riparian cover and restore landscape-level hydrology. | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## INLAND REDBAND TROUT (*Oncorhynchus mykiss gairdneri*)

**Conservation Status and Concern**

Species is widespread, but some populations are at risk from non-native hatchery trout competition and interbreeding. Water quality issues threaten most locations, and barriers fragment populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5T4 | SMR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: Courtesy USFWS

Inland Redband Trout have three history forms; resident, fluvial, and adfluvial. The resident form tends to live out its life in small tributaries and headwater streams. The fluvial form lives most of its life cycle in large rivers and streams before returning to its natal small tributary or headwater stream to spawn. The adfluvial form spends most of its life cycle in a lake or reservoir before returning to its natal headwater stream or tributary to spawn. One to three years after hatching, the juveniles will migrate to the lake or reservoir to mature. Fluvial Inland Redband Trout will migrate to overwintering areas within their streams in the fall. Spawning normally occurs between February and June, depending on the water temperature and location. Diet consists of zooplankton, benthic macroinvertebrates, fish eggs, and occasionally other fishes, depending on life history form and life stage.

**Distribution and Abundance**

Inland Redband Trout historically occurred in the mid- and upper-Columbia River drainages east of the Cascade Mountains crest from above Celilo Falls (now submerged) to barrier falls on the Snake, Spokane and Pend Oreille rivers. It has been reported that current distribution in Washington is approximately 11 percent of the former range. Although population sizes are unknown for most of their Washington distribution, they are presumed stable. Several populations have been identified in northeastern Washington but a comprehensive inventory has not been completed.

**Habitat**

Inland Redband Trout prefer the clear, clean, cold water of headwater streams, creeks, small to large rivers, and lakes with lots of dissolved oxygen. Prime habitat consists of an array of riffles, pools, submerged wood, boulders, undercut banks, and aquatic vegetation. Winter habitat includes deep pools with extensive amounts of cover in third-order mountain streams. Summer surveys indicated that low-gradient, medium-elevation reaches with an abundance of complex pools are critical areas for production.

**References**

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6, Bethesda, MD. 275pp.

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Muhlfeld, C. C., D. H. Bennett, and B. Marotz. 2001. Fall and winter habitat use by Columbia River redband trout in a small stream in Montana. N. Amer. Jour. Fisheries Management 21:170-177.

Scholz, A. T. and H. J. McLellan. 2009. Field Guide to the Fishes of Eastern Washington. Eagle Printing, Cheney, WA. 310pp.
Staley, K and J. Mueller. 2000. Rainbow trout (*Oncorhynchus mykiss)*. Fish and Wildlife Habitat Management Leaflet. Number 13.
Wydoski, R. S. and R. R. Whitney 2003. Inland Fishes of Washington, second edition. University of Washington Press, Seattle, WA. 322 pp.

**Inland Redband Trout: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Although there are distribution data available, more are needed to accurately assess current status. Western Native Trout Initiative (WNTI) holds the communal database. | Continued survey data and genetic samples need to be collected. | Current insufficient | Both |
| 2 | Coordination/ Administration Needs | Complacency with both the current understanding of redband trout and the coordination of all agencies collecting data on redband trout could be considered a threat. | Continued and expanded coordination between agencies and tribes that collect redband trout data. | Current insufficient | Both |
| 3 | Invasive and other problematic species and genes | Introgression with hatchery-released non-native rainbow trout is a primary threat to Inland Redband Trout genetic integrity. | Stop hatchery stocking in waters where Inland Redband Trout are known to reside. | Current insufficient | Both |
| 4 | Agriculture and aquaculture side effects | Habitat degradation due to farming practices and crop production. | Farmer-targeted outreach to see if new crop culture practices could help reduce impact to fish populations. | Current insufficient | Both |
| 5 | Agriculture and aquaculture side effects | Habitat degradation due to ranching and stock-grazing practices. | Work with ranchers to fence riparian areas to prevent stock animals and waste from entering streams. | Current insufficient | Both |
| 6 | Energy development and distribution | Habitat loss due to dam construction. | Dam removal is unlikely. We identified the problem but there might not be a solution to this one. | Current insufficient | Both |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Agriculture and aquaculture side effects | Habitat degradation due to farming practices and crop production. | Use existing plant culture practices that reduce impact to local fish populations. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTSLOPE CUTTHROAT TROUT (*Oncorhynchus clarkii lewisi*)

**Conservation Status and Concern**

Westslope Cutthroat Trout is stable and abundant in its range, but faces threats to its habitat and threats from genetic introgression.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | None | Yes | G4T3 | SNR | Medium/stable | Low-moderate |

**Biology and Life History**

Photo: Courtesy USGS

Westslope Cutthroat Trout have three life-history forms- adfluvial, fluvial, and resident, and all forms may occur within a single basin. Adfluvial fish live in lakes and spawn in its tributaries. They will occupy all lake habitats if no other trout species are present, otherwise, they segregate in nearshore, littoral areas. Fluvial fish reside in rivers and migrate to tributaries to spawn. Resident fish spend entire life in tributaries. Spawning occurs mainly in small headwater tributaries from March to July at water temperatures near 50°F. Fish tend to spawn in their natal stream. Fluvial and adfluvial forms usually return to rivers or lakes, but some remain in tributaries during summer. Juveniles begin to mature at age 3 years, but usually spawn for first time at age 4 or 5 years. Maturing adfluvial fish move to vicinity of tributaries in fall and winter, and begin to migrate upstream in spring. Adults and juveniles are opportunistic feeders, but primarily forage on insects and invertebrates.

**Distribution and Abundance**

In Washington, this species historically occurred in Lake Chelan and Methow River basins and in headwaters of Pend Oreille River, and was abundant in Lake Chelan Basin and Pend Oreille River. Naturally self-sustaining populations were found in almost every eastern-draining Cascade Mountain Columbia River subbasin (e.g., Yakima, Wenatchee, and Entiat) above 3,000 feet during 1990s surveys. Some of these may be due to stocking of hatchery fish into barren alpine lakes and streams. In western Washington, they have been reported in a few western Cascade Mountains drainages, such as tributaries to Skagit River and North Fork Skykomish River, South Fork Tolt River, and tributaries in Cowlitz Basin, but it is thought these resulted from releases of an eastern Washington hatchery stock. This species is abundant and stable in Washington.

**Habitat**

Habitats include small mountain streams, mainstem rivers, and large natural lakes. In rivers, adults prefer large pools and slow velocity areas. Stream reaches with numerous pools and some form of cover generally have highest densities. In lakes they often occur near shoreline areas. Preferred spawning habitat is small gravel substrates and mean water depths from 6.7 to 7.9 inches. Many fry disperse downstream after emergence. Juveniles of migratory populations may spend 1 to 4 years in natal streams, then move to a mainstem river or lake where they remain until they spawn. Juveniles tend to overwinter in interstitial spaces in stream substrates. Larger individuals congregate in deeper pools in winter. Resident fish tend to inhabit tributary shoreline areas in summer and overwinter in pools. Cool, clean, well-oxygenated water is essential.

**References**

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. 275pp.

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Wydoski, R. S. and R. R. Whitney. 2003. Inland Fishes of Washington, second edition, University of Washington Press, Seattle, WA. 322pp.

### Westslope Cutthroat Trout: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Coordination/ administration needs | Complacency with both current understanding of species, and the coordination of all agencies collecting data on it could be considered a threat. | Continue to expand the distribution, habitat and genetic database for this species, with all interested agencies and tribes. | Current insufficient | Both |
| 2 | Invasive and other problematic species and genes | Even though many populations are stable, introgression with hatchery-released fish is a primary threat to species. | Stop hatchery stocking in waters where species is known to reside. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | As with the other species, habitat fragmentation and degradation, due to various types of development is a constant threat to Westslope Cutthroat Trout. | Continued stewardship of spawning and residential habitat is needed to maintain current population rigor. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# FRESHWATER FISH

## BURBOT (*Lota lota*)

**Conservation Status and Concern**

Burbot are restricted to only 11 deep, cold-water lakes in Washington. Little is known about abundance, age structure, or productivity of any of the populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3 | Unknown/unknown | Moderate |

**Biology and Life History**

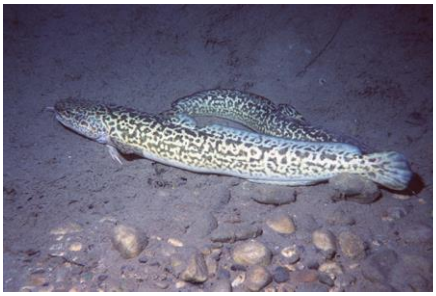
Photo: E. Keeley

Burbot is the only member of codfish family (*Gadidae*) inhabiting freshwater. Spawning occurs in late winter/early spring in Washington lakes when water temperature is about 35°F. Individuals spawn annually or in alternate years. Eggs hatch in about a month. Young eat mainly immature aquatic insects, crayfish, mollusks, and other deepwater invertebrates. Larger individuals feed mostly on fishes. They usually become sexually mature in 3 to 4 years (males) or 4 to 5 years (females). Burbot are large with maximum length up to 33 inches, and maximum weight up to 33 pounds. The oldest Burbot recorded in Washington (gill net caught in Keechelus Lake, upper Yakima Basin) was age 19 years and was 29 inches long. Burbot over age 10 are common in Washington lakes. Little is known about population-specific abundance, age structure, or productivity.

**Distribution and Abundance**

Burbot are restricted to only 11 deep, cold-water lakes in Washington. Six lakes/reservoirs are in northern Columbia Basin (Osoyoos, Palmer, Chelan, Rufus Woods, Banks, and Roosevelt). Three lakes/reservoirs constructed on ancestral lakes are in upper Yakima Basin (Keechelus, Kachess and Cle Elum), and two lakes are in Pend Oreille region (Sullivan, Bead). No Burbot have been documented in western Washington. Of the eleven Washington lake populations evaluated in 1997, only one (Lake Roosevelt) was rated as "healthy", nine were rated as "unknown" status (relative to abundance and productivity), and one (Banks Lake) was rated "critical". This assessment 17 years ago did not provide adequate population trend data, or other data (size/age structure, productivity) needed for fishery management.

**Habitat**

In Washington, Burbot are found in deep (200 feet and greater), cold waters of lakes, reservoirs, and large rivers. In summer, stays close to the bottom in deep, cold waters, but may move into shallower water at night. Moves into shallow water in the winter when lakes are homothermous. In spawning, Burbot broadcast eggs usually over sand or gravel (sometimes silt) substrates in up to about 10 feet of water.

**References**

Bonar, S. A., L. G. Brown, P. E. Mongillo and K. Williams. 1997. Status of Burbot in Washington State. Wash. Dept. of Fish and Wildlife Research Report. 51pp.

NatureServe Explorer http://explorer.natureserve.org

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Burbot: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Inadequate data for population trend, size range, age structure, and productivity. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Reservoir water and habitat management effects on Burbot are unknown. | Research whether Burbot are entrained and killed by dam and reservoir facilities or management of those facilities and determine the effect of lack of fish passage on Burbot. | | External |
| 3 | Overharvesting of biological resources | Burbot are harvested but no harvest assessment of impacts to populations are done. | Research, survey or monitoring - utilization. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## LAKE CHUB (*Couesius plumbeus*)

**Conservation Status and Concern**

The status of this species is unknown and its major threat is habitat alteration.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Unknown/unknown | Moderate |

**Biology and Life History**

The Lake Chub spawns in spring and summer. Eggs hatch in about 10 days. They become sexually mature in their third or fourth year. They sometimes occur in large schools. This species may migrate up to 1 mile between separate spawning and non-spawning habitats. Lake Chub probably do not live more than 5 years and may grow as large as 6 inches.

Photo: K. P. Schmidt, National Park Service

**Distribution and Abundance**

In Washington, Lake Chub are found in the Columbia River system. They have been found in Cedar Lake (Stevens County) and the North Fork of Beaver Creek (Okanogan County). There was a documented occurrence west of the Cascade mountains in Twin Lake (Snohomish County) in the 1950s, but it is has likely been extirpated. Its distribution appears to be sparse in Washington and its status is unknown.

**Habitat**

This species occurs in varied habitats, including standing or flowing water, and large or small bodies of water. It is most common in gravel-bottomed pools and stream reaches, and along rocky lake margins. It is more common in lakes in the southern part of the range, mostly in rivers in the north (but in lakes if available). Often it occurs in shallows but may move into deeper parts of lakes in summer. Spawning occurs in river shallows, along rocky shores, in shoals of lakes.

**References**


Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison. 1,052 pp.

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Scott, W. G., and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. 966pp.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Lake Chub: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## TUI CHUB (*Siphateles bicolor*)

**Conservation Status and Concern**

This species is confined to a small part of the Columbia Basin and its biggest threat is predation by non-native predators.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G4 | S2S3 | Unknown/unknown | Low-moderate |

**Biology and Life History**

Photo: USDA Forest Service

Adult fish of all ages and sizes school together, while juveniles of same year class often school together. They inhabit lakes and slow-moving streams. They migrate to shallow water in the spring, but stay in deeper water in winter. Tui Chub first spawn at age 3 years and spawning takes place during late April to late June in areas with abundant aquatic vegetation. Multiple spawning by one female may be common. Eggs hatch in 10 to 12 days. Juveniles feed first on diatoms, rotifers, desmids, and other plankton, then transition to larger zooplankton. Adults feed on plankton, insects, crustaceans, and fish larvae and fry (including their own). In streams they will prey on various benthic organisms. Young fish are prey of large trout and introduced warm-water fish species.

**Distribution and Abundance**

Tui Chub are native to the Columbia Basin in central Washington, which is northernmost part of the species' range. In Washington, Tui Chub are confined to reservoirs, ponds, potholes, and warm, slow-moving reaches of lower Crab Creek, an upper Columbia River tributary. They are common to abundant in several Adams County interconnected lakes (McMannaman, Morgan, Half Moon, Hutchinson, and Shiner).

**Habitat**

This species usually occurs in weedy shallows of lakes or in mud- or sand-bottomed pools of slow-moving headwaters, creeks, and small to medium rivers. In lakes, Tui Chub spend winter in deep water, and move to shallow water in spring. In summer, this chub also occurs in deep water and in surface waters over deep water. Spawning usually occurs in shallow water where eggs settle to the bottom or adhere to aquatic vegetation. Young remain close to shore near heavy vegetation for most of summer.

**References**


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Sigler, W. F., and J. W. Sigler. 1987. Fishes of the Great Basin: A natural history. University of Nevada Press, Reno, NV. 425pp.

Wydoski, R. S., and R. R. Whitney. 2003. Inland fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Tui Chub: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Even though Tui Chub is known to overpopulate in some cases, lake rehabilitations have lowered numbers in Hutchinson and Shiner Lakes. | Need assessment surveys near Crab Creek and discontinue rehabilitations in waters where they are found. | Current insufficient | WDFW |
| 2 | Invasive and other problematic species and genes | Because of limited distribution, predation by non-native fish could have a significant impact in Washington. | It is difficult to control predation. Action unknown at this time. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## LEOPARD DACE (*Rhinichthys falcatus*)

**Conservation Status and Concern**

The status of this species is unknown and it faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2S3 | Unknown/unknown | Moderate-high |

**Biology and Life History**

Leopard Dace spawn between May and July. Several males may spawn with one female. The average life span is probably 3 to 4 years, but could be as long as 7 years. The spawning habitat is probably similar to that of other dace that spawn in stream riffles. Young-of-the year feed on aquatic insect larvae. Yearlings feed on aquatic insects during the summer and in the fall switch to terrestrial insects. Adults feed on aquatic insect larvae, terrestrial insects, and earthworms.

Photo: from Wydoski and Whitney 2003

**Distribution and Abundance**

Population size and status are unknown. Distribution is spotty within the Columbia River Basin, and in Washington it is found in lower, mid, and upper Columbia River mainstem and tributaries, such as Yakima and Similkameen rivers, and in Snake River.

**Habitat**

Leopard Dace are usually found in streams, but can also occur in lakes. In streams, it prefers slow to moderate current and is associated with stone substrate covered by fine sediments. In creeks and small to medium rivers, the preferred habitat is flowing pools and gravel runs. They are usually found in slow-moving current, but in greater currents than used by Umatilla Dace, and in slower, deeper water than used by longnose dace. In lakes, Leopard Dace prefer rocky margins.

**References**

Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes. Houghton Mifflin Co., Boston, MA. 432pp.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Leopard Dace: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## UMATILLA DACE (*Rhinichthys umatilla*)

**Conservation Status and Concern**

This species' status is unknown and it faces threats from human development and habitat alterations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2 | Unknown/unknown | Moderate |

**Biology and Life History**

Spawning probably takes place in early to mid-July. Food preferences are unknown, but presumed to be similar to other dace that feed primarily on insect larvae. The closely-related *R. osculus* is a benthic feeder and its young are primarily planktivores, while adults feed mainly on aquatic insects, fresh-water shrimp, plant material and zooplankton. Maximum size Umatilla dace can reach is about is 3 inches, and average life span is probably 3 to 4 years, but could be as long as 8 years.

Photo: Paul Mongillo, WDFW

**Distribution and Abundance**

This species occurs in Columbia Basin, east of Cascade Mountains crest. In Washington, it has been reported in the Columbia, Yakima, Okanogan, Similkameen, Kettle, Colville, and Snake rivers, and also may occur in the Methow and Wenatchee rivers. This species has experienced extensive habitat loss due to hydroelectric dams.

**Habitat**

Umatilla Dace are benthic fish that occur in relatively productive, lower elevation streams. They seem to prefer cover provided by cobbles and larger stones where current is fast enough to prevent siltation. They are most often captured along river banks at depths less than 3 feet, but larger fish tend to occupy deeper habitats. The species is absent from colder, mountain tributaries. They have been found in reservoirs where there is a rocky bottom and a noticeable current. Like Leopard Dace, Umatilla Dace usually occupy habitats with slower water velocity than those used by longnose dace, and Umatilla Dace adults use lower water velocities habitats than those used by Leopard Dace.

**References**


Hass, G. R. 1999. Personal communication. University of British Columbia, Vancouver. Cited in Wydoski and Whitney 2003.

Hughes, G. W., and A. E. Peden. 1989. Status of the Umatilla Dace, *Rhinichthys umatilla*, in Canada. Canadian Field-Naturalist 103:193-200.

Peden, A. E., and G. W. Hughes. 1988. Sympatry in four species of *Rhinichthys* (Pisces), including the first documented occurrences of *R. umatilla* in the Canadian drainages of the Columbia River. Canadian Journal of Zoology 66:1846-1856.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Umatilla Dace: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Need more assessment surveys to determine current distribution and status and whether it merits a change in listed status. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Human-altered habitat has had a negative impact. Needs flowing water sufficient to maintain interspaces in rubble/cobble. | Need more assessment surveys to determine current distribution and type of habitat usage in Washington. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## OLYMPIC MUDMINNOW (*Novumbra hubbsi)*

**Conservation Status and Concern**

Populations of this endemic species are confined to a very small lowland portion of western Washington and its biggest threat is loss of habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Sensitive | Yes | G3 | S2S3 | Unknown/unknown | Moderate |

**Biology and Life History**

Olympic Mudminnows are small, average length approximately 2.1 inches, and are not selective feeders, consuming annelids, crustaceans, insects, and mollusks. Spawning begins in late November, subsides during the winter months, then resumes in March and lasts until mid-June. Spawning sites are in shallow, low flow areas such as flooded areas adjacent to streams. Males maintain breeding territories. Eggs are adhesive and are deposited on aquatic vegetation; no parental care is given. Fry attach themselves to vegetation, using "gluing" head glands.

Photo: Julie Tyson, WDFW

**Distribution and Abundance**

The Olympic Mudminnow occurs only in Washington and its current range includes the southern and western lowlands of the Olympic Peninsula, Chehalis River Basin, lower Deschutes River drainage, and south Puget Sound west of the Nisqually River. Populations have also been observed in King and Snohomish counties within the Cherry Creek drainage, Peoples Creek drainage, and Issaquah Creek.

**Habitat**

This species has three main habitat requirements: water with little to no flow, several inches of soft mud substrate, and abundant aquatic vegetation. Its preferred habitat includes quiet waters with mud or dark bottoms, usually well-vegetated areas and areas under overhanging banks, especially in marshy streams and brownish water of bogs and swamps. They can also be found in low-lying marshes, roadside ditches, and vegetation-choked streams at lower elevations (sea level to 459 feet), but are intolerant of saltwater. This species does not occur in otherwise suitable areas that have introduced spiny-rayed fishes.

**References**


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**Olympic Mudminnow: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Classified as a "Sensitive Species" in Washington because of its restricted range, endemic to Washington and its habitat, vulnerable to destruction or negative change. | Continued surveys to confirm distribution and habitat use. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Due to the amount of time passed since regular surveys, updated surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | Over ten years since the last surveys to determine distribution, status information, and type of habitat use. | More field surveys are needed to determine current distribution, habitat use and status. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MARGINED SCULPIN (*Cottus marginatus*)

**Conservation Status and Concern**
This species is confined to three rivers in southeastern Washington and faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G3 | S1? | Medium/unknown | Moderate |

**Biology and Life History**
Margined Sculpin is a benthic stream dwelling species. Spawning takes place in May to June. Eggs are deposited under rocks and the males actively guard the nest. Adults may reach about 2.5 inches in length. Food habits are unknown, but most sculpins feed on a variety of invertebrates, including aquatic invertebrates, terrestrial insects, and earthworms, and on young fish and fish eggs.

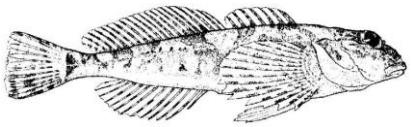

Image: WDFW

**Distribution and Abundance**
This species is endemic to Oregon and Washington, and occurs in headwater tributaries of Columbia Basin drainages in the Blue Mountains (northeastern Oregon and southeastern Washington). In Washington it occurs in headwaters of the Walla Walla, Touchet, and Tucannon rivers.

**Habitat**
Margined Sculpin primarily inhabit pools and slow-moving glides in headwater tributaries where water temperatures normally are less than 66$^{o}$F. Adults are usually found in deeper and faster water than juveniles. They are generally found in habitats with small gravel and silt substrates and avoid larger substrates (large gravel, cobble, boulders). However, this sculpin appears adaptable to a wide variety of currents and substrates. In areas where it is not competing with other sculpin species, it is found typically in moderate to rapid current on a rubble or gravel substrate.

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### Margined Sculpin: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "Sensitive Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: likely declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | Because of its very limited distribution in SE Washington, data on current population status, distribution and type of habitat use are lacking. | Field surveys are needed to determine current distribution, status, and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MOUNTAIN SUCKER (*Catostomus platyrhynchus*)

**Conservation Status and Concern**
The status of this species is unknown and it faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Unknown/unknown | Low-moderate |

**Biology and Life History**
Mountain Suckers are mostly riverine and spawn in riffles below pools in late spring-early summer when the water temperature is 52 to 66°F. Limited upstream spawning migrations may occur. Their diet is almost entirely algae and diatoms and they scrape food from rocks with their cartilaginous lower jaws. They, especially juveniles, also consume some invertebrates. They form schools, sometimes with other sucker species. Mountain Suckers are small and may reach a total maximum length of 9 inches.

Photo: from Wydoski and Whitney 2003

**Distribution and Abundance**
In Washington, this species is restricted to the Columbia River system. Mountain Suckers have been found in the Hanford Reach of Columbia River mainstem, and in Cowlitz, Yakima, Wenatchee, Palouse and Snake rivers. Population size and status are unknown.

**Habitat**
Mountain Suckers utilize river and stream areas of slow to moderate current and pools. Spawning occurs over gravel riffles. This sucker appears to prefer clear, cold creeks and small to medium rivers with clean rubble, gravel or sand substrate. It may favor pool-like habitats in some areas, and faster water in other regions. They are rarely found in lakes. Young fish usually inhabit slower moving waters in side channels, or weedy backwaters. In some areas, juveniles tend to occur closer to reservoirs than do adults. The species is most abundant where there is some form of cover in the water (used as daytime refuge). This sucker's presence may be a sensitive indicator of native fish and invertebrate assemblages.

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**Mountain Sucker: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining and to confirm current distribution. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## SALISH SUCKER (*Catostomus sp. 4*)

**Conservation Status and Concern**

This species is only found in western Washington and faces threats from loss of habitat and degradation to water quality.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G1 | S1 | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: Paul Mongillo, WDFW

Salish Suckers begin spawning in March or April, depending on the water temperature, and spawning can be prolonged until late August. Individuals first spawn at the end of their second year. This species is similar to other species of suckers in that it is a broadcast spawner and it deposits its eggs in riffles. Its life span is only 4 to 5 years in British Columbia, but older individuals are known from Washington. In British Columbia, the species typically co-occurs with juvenile coho salmon, cutthroat trout, and prickly sculpin. All of these species are capable of being significant predators of young Salish Suckers. Little is known about their diet, especially diet of juveniles. However, they probably have a diet similar to longnose suckers, which consists of a variety of benthic-dwelling aquatic invertebrates and occasionally fish eggs.

**Distribution and Abundance**

Salish Suckers are currently found only in western Washington and a few streams in British Columbia's lower Frazer Valley. In Washington, they have been found in six watersheds draining to Puget Sound (including Hood Canal), from Nooksack River to Lake Cushman in North Fork Skokomish River. Localities they have been reported in include several Nooksack Basin lowland creeks, Whatcom Lake, Skagit Basin including Sauk and Suiattle rivers, Stillaguamish Basin, including Twin, Chitwood, and Trout lakes, Deep Creek in Snohomish Basin, Green River, and Lake Cushman. Population size and status are unknown.

**Habitat**

Salish Suckers are benthic dwellers, and mainly found in lowland streams and associated ponds, and in off-channel sloughs and marshes of big rivers, as well as in lakes. They inhabit a variety of water velocities over silt and sand substrates, often in areas with instream vegetation and over-hanging riparian vegetation. They have a preference for slow-moving water in streams and most likely seek off-channel habitats during high stream-flows in winter and spring.

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**Salish Sucker: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Studies show fencing off streams will protect habitat from grazing animals. | B.C. studies show habitat enhancement, fencing and riparian plantings would be helpful. | Current insufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Data show loss of habitat is causing population declines. | B.C. studies show habitat enhancement, fencing and riparian plantings would be helpful. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PYGMY WHITEFISH (*Prosopium coulteri*)

**Conservation Status and Concern**

Pygmy Whitefish status in Washington is unknown and it faces threats to habitat and water quality.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G5 | S1S2 | Unknown/unknown | Low-moderate |

**Biology and Life History**

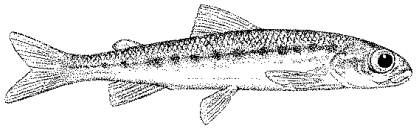

Image: WDFW

Slow growth, low fecundity and short life cycle characterize Pygmy Whitefish. They frequently are found in large schools of several thousand fish in both rivers and lakes. They spawn at night from late summer to early winter depending on the geographic location and elevation. Spawning occurs in stream riffles or along lake shorelines. Female fecundity ranges from 200 to 1,000 eggs. Average life span is 4 to 7 years, and size is usually less than 6 inches long. In general, males mature earlier and die earlier than females. Diet is primarily zooplankton, but may include macroinvertebrates, crustaceans and fish eggs. This species is considered a glacial relict, is one of the most primitive of coregonines, and has greatest discontinuous range of any North American freshwater fish.

**Distribution and Abundance**

Washington is at the southern end of Pygmy Whitefish's range. Historically they were known to have occurred in 15 Washington lakes. They currently inhabit nine lakes: Lake Chelan (Chelan County), Crescent Lake (Clallam County), Lake Chester Morse (King County), Lake Cle Elum, Lake Kachess, and Keechelus Lake (Kittitas County), Lake Osoyoos (Okanogan County), and Bead Lake and Lake Sullivan (Pend Oreille County). The six lakes they have been extirpated from are: North Twin Lake (Ferry County), Buffalo Lake (Okanogan County), Diamond Lake, Horseshoe Lake, and Marshall Lake (Pend Oreille County), and Little Pend Oreille Lakes (Stevens County). Population sizes and trends are unknown. They may co-occur with other whitefish species.

**Habitat**

Pygmy Whitefish normally occupy deep, unproductive lakes where the water temperatures are 50°F or lower, but there have been a few cases where this species was found in small shallow and more productive lakes, and they can also be found in streams. Common in lakes and flowing waters of clear or silted rivers in mountain areas; in western lakes, occurs in waters usually less than 20 feet deep, not changing depth seasonally. Spawners use coarse gravel substrates in shallow areas of streams or lakes.

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**Pygmy Whitefish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Classified as a "Sensitive Species" in Washington. | Periodic surveys to monitor status: increasing or declining. | Current sufficient | WDFW |
| 2 | Invasive and other problematic species and genes | It is likely that non-native fish are partially responsible for decline in numbers. | Collection of diet data from other species would help confirm or deny predation on species. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCES

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## SECTION B: Explanation of Terms

**Conservation Status Table**

**Federal Status**
Refers to legal designations under the Federal Endangered Species Act (listed as Endangered, Threatened, or Candidate species, or designated as a Sensitive species).

**State Status**
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Other designations include Candidate and Monitor.

**PHS (Priority Habitats and Species Program)**
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

**Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** or = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.

**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:
**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:

**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

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