STEELHEAD TROUT

Oncorhyncus mykiss

Sometimes known as Rainbow Trout

SUMMARY

Sea-going members of the rainbow trout species, Steelhead Trout return to natal hatching grounds to spawn, with a small percentage surviving to reproduce more than once. Wild Steelhead populations have declined significantly due to overfishing and habitat loss. Commercial fishing for Steelhead Trout in the U.S. has been restricted to Native American tribes for decades. Hatcheries supply the majority of the Steelhead these fishers catch. Chef Barton Seaver says, “It's very easy to trade any of the Alaskan Salmon for Steelhead. All have the same characteristic rosy-orange flesh and unique salmon flavor. My favorite is probably Sockeye in that it matches the Steelhead in terms of the gamey intense flavor that people love.”

Criterion	**Points**
Life History	2.25
Abundance	0.50
Habitat Quality and Fishing Gear Impacts	1.50
Management	1.75
Bycatch	2.00
Final Score	**1.60**
Color	

Final Score	**Color**
2.40 - 4.00	
1.60 - 2.39	
0.00 - 1.59	

LIFE HISTORY

Core Points (only one selection allowed)

If a value for intrinsic rate of increase ('r') is known, assign the score below based on this value. If no r-value is available, assign the score below for the correct age at 50% maturity for females if specified, or for the correct value of growth rate ('k'). If no estimates of r, age at 50% maturity, or k are available, assign the score below based on maximum age.

1.00 Intrinsic rate of increase <0.05; OR age at 50% maturity >10 years; OR growth rate <0.15; OR maximum age >30 years.

2.00 Intrinsic rate of increase = 0.05-0.15; OR age at 50% maturity = 5-10 years; OR a growth rate = 0.16–0.30; OR maximum age = 11-30 years.

3.00 Intrinsic rate of increase >0.16; OR age at 50% maturity = 1-5 years; OR growth rate >0.30; OR maximum age <11 years.

Intrinsic rate of increase, age at 50% maturity, and maximum age are unknown. Steelhead Trout have a complicated life history, and researchers have been unable to determine these important life history parameters. Like salmon, Steelhead are anadromous: they hatch in freshwater, spend part of their life in the ocean, and return to their natal rivers to spawn. Unlike salmon, however, a small number of Steelhead survive after spawning, go back to sea, and may spawn repeatedly.

Steelhead Trout spend 1 to 3 years after hatching in freshwater, then migrate to sea. They live up to 3 years in the ocean, and then return to freshwater to spawn (WDRW and ODFW 2002; NFSC and SFSC 2003). Steelhead in Alaska and British Columbia typically spawn by age 5. Steelhead in Washington, Oregon and Northern California spawn by age 4, and Steelhead in Central and Southern California spawn by age 3 (NFSC 1996). Since Steelhead mature and spawn by the time they are 5 years old, we awarded the high score of 3.00 points here.

Points of Adjustment (multiple selections allowed)

-0.25 Species has special behaviors that make it especially vulnerable to fishing pressure (e.g., spawning aggregations; site fidelity; segregation by sex; migratory bottlenecks; unusual attraction to gear; etc.).

Steelhead Trout exhibit strong site fidelity by returning to spawn in their natal rivers following one or more years at sea (Davis et al. 2003; HSRG 2004). This behavior makes Steelhead vulnerable, because there is a risk of eliminating entire, distinct spawning populations with heavy, directed fishing pressure.

Steelhead Trout do have some reproductive behaviors, however, that may make them less vulnerable to fishing pressure. Some Steelhead survive after spawning and may spawn repeatedly. But this number is likely low: in recent years, less than 5% of Steelhead that return to the Columbia River to spawn are repeat spawners. This percentage may be artificially low, however, given the large number of dams and reservoirs that Steelhead must negotiate (WDFW and ODFW 2002).

Additionally, recent evidence suggests that large numbers of Steelhead Trout may remain in freshwater after hatching and spawn before migrating to the ocean. Although this strategy may increase the reproductive success of these Steelhead relative to other salmon species, as well as to other Steelhead, they may be subject to greater recreational fishing pressure in freshwater (Michael, pers. comm., 2006).

Since Steelhead Trout exhibit strong site fidelity, repeat spawning is rare, and little is known about the pressures faced by Steelhead that spawn before heading to the ocean, we chose to subtract here.

-0.25 Species has a strategy for sexual development that makes it especially vulnerable to fishing pressure (e.g., age at 50% maturity >20 years; sequential hermaphrodites; extremely low fecundity).

-0.25 Species has a small or restricted range (e.g., endemism; numerous evolutionarily significant units; restricted to one coastline; e.g., American lobster; striped bass; endemic reef fishes).

Steelhead Trout are sea-going Rainbow Trout and are not recognized as a separate species. They are native to marine and freshwater habitats along the U.S. West Coast from California to the Alaska Peninsula, and their range stretches to the Sea of Okhotsk and the Kamchatka Peninsula in Russia (HSSP 2006).

Rainbow Trout are one of the most widely introduced fish species in the world. Native to North America, from Alaska to the Baja Peninsula, Rainbow Trout have been introduced to freshwater systems in over 45 countries and to every continent except Antarctica (ISSG 2005).

Since this ranking concerns Steelhead Trout and not Rainbow Trout, we chose to subtract for this factor.

-0.25 Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Nino; decadal oscillations).

Naturally shifting oceanic and atmospheric conditions in the North Pacific Ocean affect ocean productivity. Variations in Steelhead Trout abundance have been associated with these broad-scale changes in productivity (USFWS 1999; WDFW and ODFW 2002; NFSC and SFSC 2003).

The Pacific Decadal Oscillation (PDO) causes the North Pacific Ocean to cycle between warmer, less productive conditions and cooler, more productive conditions. Since 1977, marine productivity has been unfavorable for most Steelhead and salmon populations in the Pacific Northwest; while, in contrast, many salmonid populations in Alaska have reached record abundance levels (USFWS 1999; WDFW and ODFW 2002; NFSC and SFSC 2003). Years of drought associated with the PDO in the late 1980s and early 1990s resulted in unfavorable freshwater habitats throughout the Pacific Northwest, which scientists believe led to declines in Steelhead populations (USFWS 1999).

+0.25 Species does not have special behaviors that increase ease or population consequences of capture OR has special behaviors that make it less vulnerable to fishing pressure (e.g., species is widely dispersed during spawning).

+0.25 Species has a strategy for sexual development that makes it especially resilient to fishing pressure (e.g., age at 50% maturity <1 year; extremely high fecundity).

+0.25 Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).

+0.25 Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).

2.25 Points for Life History

ABUNDANCE

Core Points (only one selection allowed)

Compared to natural or un-fished level, the species population is:

1.00 Low: Abundance or biomass is <75% of BMSY or similar proxy (e.g., spawning potential ratio).

Though a limited number of Steelhead Trout populations remain healthy (Michaels, pers. comm., 2006), dramatic declines have occurred in most Steelhead Trout populations. Each population (i.e., group of Steelhead that returns to their natal stream to spawn) of Steelhead is called an Evolutionarily Significant Unit (ESU). This term refers to fact that each spawning group is a distinct population and reproductively isolated from other spawning groups (NOAA 1991). Currently, the U.S. National Marine Fisheries Service (NMFS) lists 10 Steelhead ESUs as either Threatened or Endangered under the Endangered Species Act (ESA; NOAA 2006). NMFS is also reviewing the status of

Steelhead ESUs in Puget Sound for listing under the ESA (NWR 2005; Waknitz, pers. comm., 2006).

Hatchery programs were initiated in the 1960's to supplement declining natural populations of Steelhead Trout with hatchery-raised individuals. In the early 2000s, 75 to 90% of the Steelhead returning each year to the Columbia River to spawn originated in hatcheries (WDFW and ODFW 2002). There are concerns that hatchery populations may negatively impact wild populations of Steelhead. Studies in the Clackamas Basin have found that hatchery-raised Steelhead produce only about one-third the offspring per parent that wild Steelhead produce. Steelhead in the Clackamas Basin in Oregon constitute 60 to 82% of the spawning population. Interbreeding between hatchery-raised and wild Steelhead is minor, so genetic dilution of the already-threatened ESUs in this river basin is not a pressing threat. Instead the threat lies in that hatchery-raised Steelhead compete with the more reproductively robust wild Steelhead for spawning and rearing habitat (Kostow et al. 2003). In Forks Creek, WA, wild Steelhead produced 9 and 42 times as many adult offspring as did hatchery-raised Steelhead during 1996 and 1997, respectively. Although the degree of hybridization and the reproductive success of hybrids are currently unknown in this river basin, hybridization between wild and hatchery-raised Steelhead could potentially reduce the reproductive success of wild populations (McLean et al. 2003).

Despite efforts to recover Steelhead Trout populations with hatchery programs, Steelhead populations remain at low abundances throughout the species' range. Therefore, we chose to award the low score of 1.00 point here.

2.00 Medium: Abundance or biomass is 75-125% of BMSY or similar proxy; OR population is approaching or recovering from an overfished condition; OR adequate information on abundance or biomass is not available.

3.00 High: Abundance or biomass is >125% of BMSY or similar proxy.

Points of Adjustment (multiple selections allowed)

-0.25 The population is declining over a generational time scale (as indicated by biomass estimates or standardized CPUE).

Although some populations of Steelhead Trout remain in healthy condition (Michael, pers. comm., 2006), most Steelhead Trout populations are in decline. In the Columbia River, where a Native American commercial fishery exists, the winter run of Steelhead declined in the early 2000s (WDFW and ODFW 2002). Conversely, the abundance of summer-run Steelhead, which are mostly hatchery-raised fish, recently increased (WDFW and ODFW 2002).

Puget Sound Steelhead populations are declining (NOAA 2006; Wright, pers. comm., 2006). And, in the Lake Washington-Lake Sammamish system, Steelhead have become

functionally extinct (i.e., there are so few of them left, they no longer fill their niche in the ecosystem; Wright, pers. comm., 2006).

-0.25 Age, size or sex distribution is skewed relative to the natural condition (e.g., truncated size/age structure or anomalous sex distribution).

-0.25 Species is listed as "overfished" OR species is listed as "depleted", "endangered", or "threatened" by recognized national or international bodies.

The U.S. National Marine Fisheries Service lists 10 populations of West Coast Steelhead Trout as Endangered or Threatened under the Endangered Species Act. Additionally, Steelhead Trout populations in Puget Sound are currently undergoing consideration for listing (NOAA 2006; NOAA 2005a).

-0.25 Current levels of abundance are likely to jeopardize the availability of food for other species or cause substantial change in the structure of the associated food web.

+0.25 The population is increasing over a generational time scale (as indicated by biomass estimates or standardized CPUE).

+0.25 Age, size or sex distribution is functionally normal.

+0.25 Species is close to virgin biomass.

+0.25 Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.

0.50 Points for Abundance

HABITAT QUALITY AND FISHING GEAR IMPACTS

Core Points (only one selection allowed)

Select the option that most accurately describes the effect of the fishing method upon the habitat that it affects

1.00 The fishing method causes great damage to physical and biogenic habitats (e.g., cyanide; blasting; bottom trawling; dredging).

2.00 The fishing method does moderate damage to physical and biogenic habitats (e.g., bottom gillnets; traps and pots; bottom longlines).

Commercial fishing for Steelhead Trout are limited to Native American tribal fishers, who use drift and set gillnets and hook-and-line gears (Lampsakis 2005). Fishers using set gillnets, and, to a lesser extent, drift gillnets, catch the majority of Steelhead in the lower portions of rivers and estuaries (Wright, pers. comm., 2006). While drift gillnets and hook-and-line gear does little damage to the surrounding environment, set gillnets may damage benthic habitats by uprooting and breaking aquatic vegetation (Morgan and Chuenpagdee 2003).

3.00 The fishing method does little damage to physical or biogenic habitats (e.g., hand picking; hand raking; hook and line; pelagic long lines; mid-water trawl or gillnet; purse seines).

Points of Adjustment (multiple selections allowed)

-0.25 Habitat for this species is so compromised from non-fishery impacts that the ability of the habitat to support this species is substantially reduced (e.g., dams; pollution; coastal development).

Dam construction, agricultural activities, and urbanization continue to compromise critical Steelhead Trout habitat and contribute to the species' decline. Hydroelectric dams on the Columbia and Snake Rivers limit fish passage and significantly reduce water flow levels. By limiting access to spawning grounds, dams have caused reduced reproductive success of Steelhead. Dams have also increased mortality of Steelhead in river systems by creating reservoirs with elevated water temperatures and increased abundance of predators (EPA 2000; WDFW and ODFW 2002).

Although projects are underway to improve the passability of dams and restore Steelhead Trout habitat, compliance is controversial, and stakeholders are involved in litigation (NOAA 2005b).

-0.25 Critical habitat areas (e.g., spawning areas) for this species are not protected by management using time/area closures, marine reserves, etc.

The U.S. Endangered Species Act (ESA) requires that fishery and wildlife managers develop recovery plans for all species listed as Endangered or Threatened. Although many populations of Steelhead Trout have been listed under the ESA since 1991, none have recovered. The U.S. National Marine Fisheries Service recently designated critical habitat areas in Washington, Oregon, Idaho and California for all populations of Steelhead listed as Endangered or Threatened; however, protection of these areas has yet to be implemented (NOAA 2005c).

-0.25 No efforts are being made to minimize damage from existing gear types OR new or modified gear is increasing habitat damage (e.g., fitting trawls with roller rigs or rockhopping gear; more robust gear for deep-sea fisheries).

-0.25 If gear impacts are substantial, resilience of affected habitats is very slow (e.g., deep water corals; rocky bottoms).

+0.25 Habitat for this species remains robust and viable and is capable of supporting this species.

+0.25 Critical habitat areas (e.g., spawning areas) for this species are protected by management using time/area closures, marine reserves, etc.

+0.25 Gear innovations are being implemented over a majority of the fishing area to minimize damage from gear types OR no innovations necessary because gear effects are minimal.

+0.25 If gear impacts are substantial, resilience of affected habitats is fast (e.g., mud or sandy bottoms) OR gear effects are minimal.

1.50 Points for Habitat Quality and Fishing Gear Impacts

MANAGEMENT

Core Points (only one selection allowed)

Select the option that most accurately describes the current management of the fisheries of this species.

1.00 Regulations are ineffective (e.g., illegal fishing or overfishing is occurring) OR the fishery is unregulated (i.e., no control rules are in effect).

2.00 Management measures are in place over a major portion over the species' range but implementation has not met conservation goals OR management measures are in place but have not been in place long enough to determine if they are likely to achieve conservation and sustainability goals.

Several agencies manage fisheries for Steelhead Trout. The Pacific Fishery Management Council (PFMC) regulates fisheries in the U.S.'s Exclusive Economic Zone (3 to 200 miles offshore) off the U.S. West Coast. State agencies manage Steelhead fisheries in inland waters such as rivers and lakes and in coastal waters (up to 3 miles offshore). The PFMC prohibits commercial fishing for Steelhead in federal waters, with one exception. Native American fishers maintain sovereign rights to the commercial Steelhead fishery by treaty (WDFW and ODFW 2002; PFMC 2003; Waknitz, pers. comm., 2006). The PFMC uses the 2000 Fall Management Agreement to regulate these small Steelhead fisheries. Tribal representatives participate in PFMC meetings and sit on its technical committees (WDFW 2001). The PFMC requires Native American fishers participating in the commercial fishery to maintain logbooks and record daily catches (Lampsakis 2005).

A substantial amount of Steelhead Trout caught by Native American fisheries is hatchery-raised. In Washington State, managers control the amount of wild Steelhead the fishery catches by timing the commercial season, which runs from late November through late February, to coincide with the return of hatchery-raised Steelhead to spawn. Hatchery-raised Steelhead return to the rivers from November through January, while wild Steelhead generally return to spawn from late January through May. On the Columbia River, wild Steelhead and hatchery-raised Steelhead constitute 15% and 85%, respectively, of the annual Native American Steelhead catch (WDFW and ODFW 2002; Waknitz, pers. comm., 2006).

In Alaska, there are no directed commercial fisheries for Steelhead Trout. However, federal regulations do permit subsistence fishers to catch and keep limited numbers of Steelhead (USFWS 2003; Turek, pers. comm., 2006). In 2002, the Department of Fisheries and Oceans Canada's Pacific Region Salmon Integrated Fisheries Management Plan prohibited commercial fishing of Steelhead in Canadian waters (NCSA 2006).

Recreational catches of Steelhead Trout in the U.S. are limited to hatchery-reared Steelhead only, identified by fin clipping; all wild or unmarked fish must be released and returned (WDFW and ODFW 2002).

Despite drastic measures by fishery managers to limit fishing pressure, Steelhead Trout populations remain severely depleted. For this reason we chose to award a score of 2.00 here.

3.00 Substantial management measures are in place over a large portion of the species range and have demonstrated success in achieving conservation and sustainability goals.

Points of Adjustment (multiple selections allowed)

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.

The National Marine Fisheries Service's Biological Review Team monitors Steelhead Trout populations in California, Oregon and Washington and meets regularly to discuss the biology, abundance and ecology of West Coast Steelhead (NFSC and SFSC 2003).

Tribal and state biologists monitor wild and hatchery-raised Steelhead Trout abundance during their spawning migrations back to their native rivers and hatcheries (WSFW 2001). Since 1984, they have monitored the age distribution and ratio of wild vs. hatchery-raised fish in the annual Native American commercial catch (WDFW and ODFW 2002). In 1992, state and tribal biologists in Washington established the Salmon Stock Inventory (SaSI), which compiles data and identifies the status of salmon and Steelhead populations. The SaSi provides a system to monitor population and habitat status (WSFW 2001). Also, the Alaska Board of Fisheries conducts annual surveys to document the spawning populations of Steelhead within its borders (ADFG 2006).

These apparently intensive monitoring schemes, however, prove inadequate due to the complex life history of Steelhead Trout. For most populations, basic measures of abundance, reproduction, and the contribution of hatchery-raised individuals to spawning events continue to elude scientists (Michael, pers. comm., 2006). Given the lack of understanding about the status of many Steelhead populations, we chose to subtract for this factor.

-0.25 Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

-0.25 This species is overfished and no recovery plan or an ineffective recovery plan is in place.

The Endangered Species Act requires federal agencies to develop and implement recovery plans for all species listed as either Threatened or Endangered. Populations of Several populations of Steelhead Trout have been listed as Threatened or Endangered since 1991, and despite closure of commercial fishing for Steelhead for decades, populations have still not recovered.

In July 2005, the National Marine Fishery Service announced its intent to develop

recovery plans for 16 of the listed populations of Pacific salmon and Steelhead in the Northwest and is working with federal, state, local and tribal agencies to produce draft recovery plans (EPA 2005).

Given the ineffective and belated nature of these measures, we chose to subtract for this factor.

-0.25 Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

+0.25 There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

+0.25 Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

+0.25 This species is overfished and there is a recovery plan (including benchmarks, timetables and methods to evaluate success) in place that is showing signs of success OR recovery plan is not needed.

+0.25 Management has taken action to control excess capacity or reduce subsidies that result in excess capacity OR no measures are necessary because fishery is not overcapitalized.

Following precipitous declines of Steelhead Trout throughout the U.S. Pacific Northwest, Washington and Oregon enacted an emergency buy-back program in the mid 1980s, whereby the government bought back and retired commercial fishing licenses for Steelhead (WDFW and ODFW 2002). Since 1975, the Pacific Fishery Management Council and state agencies have restricted fishing of Steelhead Trout to recreational and Native American commercial fishers.

1.75 Points for Management

BYCATCH

Core Points (only one selection allowed)

Select the option that most accurately describes the current level of bycatch and the consequences that result from fishing this species. The term, "bycatch" used in this document excludes incidental catch of a species for which an adequate management framework exists. The terms, "endangered, threatened, or protected," used in this document refer to species status that is determined by national legislation such as the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act (or another nation's equivalent), the IUCN Red List, or a credible scientific body such as the American Fisheries Society.

1.00 Bycatch in this fishery is high (>100% of targeted landings), OR regularly includes a "threatened, endangered or protected species."

2.00 Bycatch in this fishery is moderate (10-99% of targeted landings) AND does not regularly include "threatened, endangered or protected species" OR level of bycatch is unknown.

The level of bycatch in targeted Steelhead Trout fisheries is unknown but generally thought to be low (Waknitz, pers. comm., 2006). There is unintended catch of chum and coho Salmon in the Native American Steelhead fisheries in the Puget Sound and along the Washington coast. But, fishers generally retain incidentally captured salmon for consumption, sale, and ceremonial use (Wright, pers. comm., 2006; Lampsakis 2005).

In fisheries that target hatchery-raised Steelhead Trout, the incidental capture of wild Steelhead is a concern. In Washington, managers time the fishing season to coincide with the return of hatchery-raised Steelhead to the rivers in November through April. In doing so, they seek to shift fishing pressure from wild Steelhead populations, some of which are Threatened or Endangered, to hatchery-raised Steelhead, which spawn later in the year (WDFW and ODFW 2002; NFSC and SFSC 2003). Despite these efforts, however, fishers do catch some wild Steelhead. Commercial Steelhead fishers in Washington may only retain hatchery-raised Steelhead and must release all wild Steelhead, whether dead or alive (Michael, pers. comm., 2006). However, captured fish are generally dead by the time fishers retrieve the nets (Michael, pers. comm., 2006; Wright, pers. comm., 2006).

In conclusion, the overall level of bycatch in commercial Steelhead Trout fisheries is unknown, but likely low. But, the incidental capture of salmon and wild Steelhead is likely fatal. We therefore chose to award the medium score of 2.00 points here.

3.00 Bycatch in this fishery is low (<10% of targeted landings) and does not regularly include "threatened, endangered or protected species."

Points of Adjustment (multiple selections allowed)

-0.25 **Bycatch in this fishery is a contributing factor to the decline of "threatened, endangered, or protected species" and no effective measures are being taken to reduce it.**

Currently, the National Marine Fisheries Service lists 10 Evolutionary Significant Units (ESUs) of West Coast salmon (excluding Steelhead) as either Threatened or Endangered. The listing includes populations of chum, coho, sockeye, and chinook salmon (NOAA 2005a). Regulations generally require Native American commercial Steelhead Trout fishers to release protected salmon species when they catch them (Lampsakis 2005). However, they typically fish with gillnets, which usually kill fish before they can be released (Michael, pers. comm., 2006; Wright, pers. comm., 2006).

Commercial Steelhead Trout fisheries are very limited, however. Since there is no indication that interactions with Steelhead Trout fisheries contribute to the decline of protected salmon populations, we chose not to subtract here.

-0.25 Bycatch of targeted or non-targeted species (e.g., undersize individuals) in this fishery is high and no measures are being taken to reduce it.

-0.25 **Bycatch of this species (e.g., undersize individuals) in other fisheries is high OR bycatch of this species in other fisheries inhibits its recovery, and no measures are being taken to reduce it.**

Fisheries targeting Pacific salmon catch Steelhead Trout as bycatch (Michael, pers. comm., 2006; Wright, pers. comm., 2006). However, federal restrictions on season and mesh size in salmon fisheries limit their impact on Steelhead populations (WDFW and ODFW 2002; Thomas 2004). For example, the National Marine Fisheries Service allows commercial and sport chinook fisheries in the Columbia River to capture no more than 2% of winter-run Steelhead annually (Thomas 2004).

Native American gillnet fishers targeting Pacific salmon in the Columbia River incidentally capture hatchery-raised, summer-run Steelhead each year (Wright, pers. comm., 2006), although the overall impact on Steelhead populations is unclear (Michael, pers. comm., 2006).

Bycatch of Steelhead in other fisheries is low (PFMC 2003; Waknitz, pers comm., 2006). Since there is bycatch of Steelhead in other fisheries, but it seems largely limited to hatchery-raised Steelhead, we chose to not subtract here.

-0.25 The continued removal of the bycatch species contributes to its decline.

+0.25 Measures taken over a major portion of the species range have been shown to reduce bycatch of "threatened, endangered, or protected species" or bycatch rates are no longer deemed to affect the abundance of the "protected" bycatch species OR no measures needed because fishery is highly selective (e.g., harpoon; spear).

+0.25 There is bycatch of targeted (e.g., undersize individuals) or non-targeted species in this fishery and measures (e.g., gear modifications) have been implemented that have been shown to reduce bycatch over a large portion of the species range OR no measures are needed because fishery is highly selective (e.g., harpoon; spear).

+0.25 Bycatch of this species in other fisheries is low OR bycatch of this species in other fisheries inhibits its recovery, but effective measures are being taken to reduce it over a large portion of the range.

+0.25 The continued removal of the bycatch species in the targeted fishery has had or will likely have little or no impact on populations of the bycatch species OR there are no significant bycatch concerns because the fishery is highly selective (e.g., harpoon; spear).

2.00 Points for Bycatch

REFERENCES

Alaska Department of Fish and Game (ADFG). 2006. Steelhead Abundance Index. Available at: www.sf.adfg.state.ak.us/region1/trout/steelhead.cfm

Davis, G., M. Nichols and M. Spear. 2003. Interim Report SP-F10, Task 3B: Oroville Facilities Relicensing. State of California Department of Water Resources.

High Seas Salmon Program (HSSP). 2006. Known Ocean Ranges of Pacific Salmon and Steelhead from High Seas Tagging Research. Available at: http://www.fish.washington.edu/research/highseas/known_range.html

Invasive Species Specialist Group (ISSG). 2005. Global Invasive Species Database: *Oncorhynchus mykiss*. Available at: http://www.issg.org/database/species/ecology.asp?si=103&&fr=1&sts=

Kostow, K., A. Marshall and S.R. Phelps. 2003. Naturally Spawning Hatchery Steelhead Contribution to Smolt Production but Experience Low Reproductive Success. Trans. Am. Fish Society; 132:780-790

Lampsakis, N. 2005. Point No Point Treaty Council In-Common Winter Steelhead Regulations #F05-050.

McLean, J., P. Bentzen, and T. Quinn. 2003. Differential Reproductive Success of Sympatric, Naturally Spawning Hatchery and Wild Steelhead Trout (*Oncorhynchus mykiss*) through the Adult Stage. Canadian Journal of Fisheries and Aquatic Sciences; Vol. 60:433-440

Michael, H. 2006. Personal Communication. Fisheries Biologist. Washington Department of Fish and Wildlife.

Morgan, L. and R. Chuenpagdee. 2003. Shifting Gears: Addressing the Collateral Impacts of Fishing Methods in U.S. Waters. Pew Science Series.

National Oceanographic and Atmospheric Administration (NOAA). 2006. Steelhead Endangered Species Act Listings. Available at: http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Alsea-Response/Steelhead-ESA-Listings.cfm

NOAA. 2005a. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs. Available at: http://a257.g.akamaitech.net/7/257/2422/01jan20051800/edocket.access.gpo.gov/gov/2005/pdf/052351.pdf#search='Final%20Listing%20Determinations%20for%2016%20ESUs%20of%20West%20Coast%20Salmon%2C%20and%20Final%204%28d%29%20Protective%20Regulations%20for%20Threatened%20Salmonid%20ESUs'

NOAAc. 2005b. Salmon and Hydropower. Available at: www.nwr.noaa.gov/Salmon-Hyrdo power/index.cfm

NOAA. 2005c. Final Critical Habitat Designations in Washington, Oregon, Idaho and California for Endangered and Threatened Pacific Salmon and Steelhead

NOAA. 1991. Definition of Species Under the Endangered Species Act: Application to Pacific Salmon. Available at: http://www.nwfsc.noaa.gov/publications/techmemos/tm194/waples.htm

North Coast Steelhead Alliance (NCSA). 2006. Backgrounder. Available at: www.ncsteelhead alliance.ca/docs/kdm_salmon_fisheries_web.pdf

Northwest Regional Office of National Marine Fisheries Service (NWR). 2005. Steelhead Endangered Species Act Listings. Available at: www.nwr.noaa.gov/ESA-Salmon-Listings

Northwest Fisheries Science Center and Southwest Fisheries Science Center (NFSC and SFSC). 2003. Updated Status of Federally Listed ESU's of West Coast Salmon and Steelhead

PFMC. 2003. Pacific Coast Salmon Plan. Available at: www.pcouncil.org/salmon/salfmp.html

Turek, M. 2006. Personal Communication. Alaska Department of Fish and Game

United States Fish and Wildlife Service (USFWS). 2003. Subsistence Management Regulations for Public Lands in Alaska. Available at: http://a257.g.akamaitech.net/7/257/2422/01dec20031500/edocket.access.gpo.gov

USFWS. 1999. Federal Register 64 (57). Available at: www.fws.gov/endangered/federalregister/1999/f99032sb.pdf#search='steelhead%20imports'

U.S. Environmental Protection Agency (EPA). 2005. Endangered and Threatened Species: Recovery Plan Preparation for 16 Evolutionarily Significant Units (ESUs) of Pacific Salmon and Steelhead. Available at:http://www.epa.gov/fedrgstr/EPA-SPECIES/2005/July/Day-07/e13394.htm

U.S. Environmental Protection Agency (EPA). 2000. Endangered and Threatened species: Proposed Range Extension for Endangered Steelhead in Southern