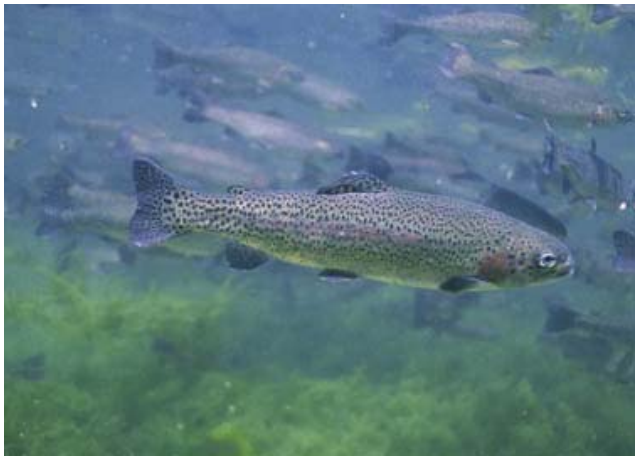
STEELHEAD

Oncorhynchus mykiss Walbaum, 1792
(Salmonidae)

Global rank G5 (09Dec1996)
State rank S4 (01May2006)
State rank reasons
Widely distributed in coastal Southeast and Southcentral Alaska, with abundance centralized in Southeast. Suspected population decline, particularly in Southeast stocks, due to overharvest in sport fisheries. Small populations susceptible to overexploitation through sport and subsistence fisheries, bycatch in commercial fisheries and habitat degradation.



Taxonomy
A highly variable species. Formerly known as *Salmo gairdneri*, but this taxon is closely related to Pacific salmon and is conspecific with Asiatic steelhead (*Oncorhynchus mykiss*). For a complete taxonomic history, see Smith and Stearley (1989), Robins et al. (1991), and Behnke (1992).

Behnke (1992) included in *O. mykiss* three major groups: (1) the redband trout of the Columbia River basin east of the Cascade Mountains, and in upper Fraser River basin and the Athabasca headwaters of the Mackenzie River basin (subspecies *gairdneri*); (2) the redband trout of the Sacramento River basin, which he regarded as comprising two Kern River drainage subspecies (*aguabonita* and *gilberti*), plus the McCloud River subspecies (provisionally denoted as subspecies *stonei*); and (3) the coastal rainbow trout (nominal subspecies *irideus* of North America and *mykiss* of eastern Asia, though no known taxonomic characters separate *mykiss* from *irideus*). The form present in Alaska is *O. mykiss irideus* (Mecklenburg et al. 2002).

Oncorhynchus mykiss freely interbreeds with cutthroat trout (*O. clarki*) and Gila trout (*O. gilae*), producing fertile offspring (Sublette et al. 1990).

General description
Juveniles: Juveniles are difficult to distinguish from resident freshwater rainbow trout, as their coloration is extremely variable: top of head, back and upper sides may be dark blue to greenish or brown. Lower sides and belly silvery white to grayish (Morrow 1980). Heavily spotted with irregularly-shaped spots both above and below lateral line including dorsal and caudal fins. Rose-red, lateral line band. Parr marks rounded; dorsal and ventral supplemental rows reduced or absent (Behnke 1992). Differentiated from cutthroat trout by red slash on bottom of the jaw and lack of hyoid teeth (Pollard et al. 1997).

Adults: Adults are streamlined and slender. Upper sides shiny, gunmetal blue and silvery white below lateral line. Spotting similar to juveniles. Spawning fish develop more pronounced reddish lateral line, upper sides become olive to black and lower sides turn dusky gray.
Length (cm) 60-80 (average, females slightly larger than males)
Weight (kg) 2.7-4.0 (Alaska average), max. recorded 19.1

Reproduction
Spawns late April-early June. Female fecundity varies with size and condition; averages around 5,000 eggs (ADFG 1985). Usually survives spawning but repeat spawning is rare (Mecklenburg et al. 2002). Eggs incubate 1.5–4 months before hatching (varies with temperature); fry emerge from gravel at around 30 mm length. Juveniles spend 1–4 years in fresh water before migrating to the ocean as smolts; return to natal stream after 1–4 years at sea (typically 2). Smoltification usually occurs at 3 or 4 years of age and 140–160 mm in length.

Ecology
The steelhead is the anadromous life form of the coastal rainbow trout. Known to hybridize with cutthroat trout where ranges overlap. Designated into runs by the time of year they return to fresh water (e.g., fish that enter fresh water in March are spring run). In Southeast Alaska, the majority

of runs are spring with a few fall. Other regions of Alaska are dominated by fall-run steelhead.

Economic
An important sport fish. Various populations worldwide have been cultured and introduced due to unique qualities such as fast growth, disease resistance, and high catchability (Sublette et al. 1990). Introduction of this species has caused contraction of range of native brook trout in southern Appalachian Mountains region (Larson and Moore 1985). Normal life span 5–6 years (Simpson and Wallace 1982). Aggressively defends feeding territories in streams. Used in carcinogen testing (Metcalfe 1989).

Migration
Migrates up to hundreds of miles between spawning streams and marine waters. Radio-telemetry studies indicate that steelhead move more slowly as they approach natal streams. Juveniles in the Gulf of Alaska quickly move offshore soon after entering the ocean (Burgner et al. 1992).

Food
Invertivore, piscivore. In lakes, feeds mostly on bottom-dwelling invertebrates (e.g., aquatic insects, amphipods, worms), fish eggs, plankton and occasionally small fish. In streams, feeds primarily on drift organisms, fish eggs and flesh of dead salmon. May ingest aquatic vegetation (probably for attached invertebrates). Diet changes seasonally, likely in response to food availability. In the ocean, diet chiefly comprised of fishes and squids but also includes euphausiids, amphipods, pteropods and pelagic polychaetes (Burgner 1992).

Phenology
May feed at any time, but usually feeds most actively around dusk and twilight. Migrations into fresh water chiefly nocturnal (Morrow 1980). Juveniles wintering in freshwater are nocturnal.

Global habitat
Spawns in coastal rivers and streams of moderate to steep gradient with silt-free substrate; some may overwinter in deep, low-velocity river pools or lakes (Sublette et al. 1990). Relatively eurythermic, and does best where dissolved oxygen concentrations ≥ 7 ppm. Usually requires a gravel stream riffle for successful spawning. Eggs are laid in a depression in gravel. Salinity of 8 ppt is the upper limit for normal development of eggs and fry (Morgan et al. 1992). Fry and parr utilize stream channel edges and debris pools for rearing habitat; adults utilize near-surface marine waters for foraging.

State habitat
Spawning: Spawning occurs in moderate to steep gradient sections of streams, usually in heads of riffles or the tails of pools where hydraulic conditions are conducive to intragravel flow (Burgner et al. 1992). Side channels and the anterior portions of islands are also used. Adequate cover from predation, water temperature, number of fish in spawning population and gravel size (5–10 cm preferred) are important factors in redd site selection (ADFG 1985, Burgner et al. 1992). Pre-spawning fish usually hold in water at least 4 ft deep with moderate current.

Rearing: In the Situk River, fry utilized channel edges with shallow, low-velocity water; parr were found in willow edges and debris pools that contained deeper water and were located near (but not in) fast water (Thedinga et al. 1993). Stark (1999) found juveniles in the Gulkana River within a few meters of spawning Chinook (*Oncorhynchus tshawytscha*) and Sockeye (*O. nerka*) salmon; interspecific competition may influence habitat selection.

Wintering: Some fall-run steelhead overwinter in lakes (Thedinga et al. 1993). Deep pools and large substrate (10–40 cm) are important for overwintering juveniles (ADFG 1985).

At sea: Available evidence suggests a preference for near-surface waters (Burgner et al. 1992).

Global range
Native to Pacific Coast streams from the Kuskokwim River, Alaska, south to northern Baja California; upper Mackenzie River drainage (Arctic basin), Alberta and British Columbia; also endorheic (i.e. having no outflow of water) basins of southern Oregon (Page and Burr 1991). Widely introduced and established in suitable habitats all over the world (Lee et al. 1980). At sea, found throughout the North Pacific above 40° N from the North American coast to the Sea of Okhotsk (Burgner et al. 1992). Most abundant in the Gulf of Alaska and eastern part of the North Pacific, conforming to the 5°C isotherm in the north and 15°C isotherm in the south. Seasonal shifts in distribution are correlated with changes in water temperature (Sutherland 1973).

State range
Found throughout Southeast Alaska and in the Copper River Drainage, lower Kenai Peninsula, Kodiak Island Archipelago and Alaska Peninsula. Occurrence is most extensive in Southeast region from Dixon entrance north to Cape Yakataga, where steelhead have been documented in 331 streams (Harding and Brookover 2003). The Copper River system has 7 documented steelhead streams including the Middle Fork of the Gulkana River, the northernmost steelhead population in Alaska (Fleming 2000). The lower Kenai Peninsula and Kodiak Island Archipelago have 5 and 17 known steelhead streams, respectively (VanHulle 1985, Begich 1997). Alaska Peninsula steelhead populations appear to be small with distribution restricted to 6 streams on the north and south sides of the peninsula (Eaton and Adams 1995).

Situk River stock: Occurs in about 75% of the study reaches in all channel types of the Situk River except PA3 of the Situk River system (see map and description of channel types in Thedinga et al. 1993). About 40% of the parr population occurs in the West Fork. Most fall spawning occurs in the first 8 km downstream of Situk Lake. Some fall spawning occurs in the remainder of the main stem upstream of the highway, and in Mountain Stream, West Fork and Old Situk River. Spring spawning typically occurs in the main stem of the river above and below the highway. Other spawning areas utilized during spring run include the Old Situk River and the West Fork (Thedinga et al. 1993).

Global abundance
Total annual abundance for all North American steelhead stocks estimated at 1.6 million fish (Burgner et al. 1992).

State abundance
Alaska stocks estimated at 73,000 wild fish (Burgner et al. 1992). Most abundant in Southeast Alaska. Of 331 Southeast streams containing steelhead, less than 200 had escapements under 100 fish; 56 streams estimated runs over 500 fish; and 12 streams had runs of over 1,000 fish (Lohr and Bryant 1999). Copper River tributary returns range from 200 to 1,000 fish (Fleming 2000). Stark (1999) found 20–50 adult steelhead and 100–200 residents spawning in the Middle Fork of the Gulkana River during a 1993–1995 study. The rivers of the lower Kenai Peninsula each have annual returns between 50 and 2,000 fish (Walis and Balland 1983). Kodiak Island Archipelago, including the Karluk River, has an estimated annual return above 10,000 fish (Begich 1997). Alaska Peninsula populations believed to be small, yet little is known about overall abundance (Eaton and Adams 1995).

Situk River stock: The steelhead stock present in the Situk River, Southeast Alaska, represents the largest population in the state, as well as one of the largest remaining wild steelhead stocks in the world (ADFG 2005). Historically, returns were over 20,000 fish (Bain et al. 2003); present-day annual return is between 5,000–9,000 adults (Johnson and Jones 2001). The majority (~75%) of adults return to the Situk during the spring. In a 1987–1989 study of juvenile salmonids, fry and parr densities were greater in the upper river than the lower river; within habitat types, parr were typically larger in the lower river (Thedinga et al. 1993).

Global trend
Of 867 steelhead stocks in British Columbia and the Yukon, Slaney et al. (1996) categorized 9 as extirpated, 8 as high risk, 10 as moderate risk, 143 as special concern, 282 as unthreatened, and 415 as of unknown status. Many winter steelhead populations are at very low levels; populations have declined in nearly all streams in central and southern California (see Nehlsen et al. 1991 for further details). Winter steelhead stocks from Siuslaw River north to Tillamook Bay, Oregon, have been declining since 1990 (Nehlsen et al. 1991). In the Illinois River (tributary to the Rogue River), Oregon, winter steelhead catches have declined since the mid-1970s (Nehlsen et al. 1991). Several winter populations in the Puget Sound area of Washington have also experienced declines (Nehlsen et al. 1991).

State trend
Populations declined in the late 1980s and early 1990s after record sport and commercial harvest in the mid-1980s (Lohr and Bryant 1999, Harding and Brookover 2003). Recent surveys in Southeast Alaska indicate a decline in abundance from 1997 through 2002 (Harding and Brookover 2003).

Global protection
Unknown.

State protection
In Alaska, steelhead and their habitat are protected under several state and federal laws that include harvest restrictions on sport,

commercial and subsistence fisheries. Steelhead are managed by the Alaska Department of Fish and Game with federal regulations established by NOAA Fisheries. Since 1994, most steelhead sport fisheries were limited to catch and release or harvest of fish 36" or larger with an annual limit of two fish. Current regulations are expected to protect 95% of return to the southeast region. Sport harvest decreased 92% from 1994–1999 compared to 1989–1993. Current regulations prohibit commercial take although steelhead caught in other fisheries may be sold or kept for personal use (Begich 1997). In December 2002, the Federal Subsistence Board implemented and modified federal regulations to allow the direct harvest of steelhead in the Situk and Ahrnklin Rivers and on Prince of Wales Island (Harding and Brookover 2003). Habitat is protected from threats such as logging by state and federal buffer strip requirements.

Global threats

Winter stocks from Siuslaw River north to Tillamook Bay, Oregon, have been declining since 1990, possibly due to deterioration of ocean feeding conditions, widespread use of hatchery stock, predation by marine mammals, and ocean drift-net fishing (Nehlsen et al. 1991). Declining winter catches on the Illinois River (tributary to the Rogue River), Oregon, since the mid-1970s have been attributed to water withdrawal for irrigation (Nehlsen et al. 1991). In the Columbia River basin, winter stocks are threatened by habitat degradation, main stem passage problems, and interactions with hatchery fish (Nehlson et al. 1991). Several winter populations in the Puget Sound area of Washington have declined, primarily as a result of habitat degradation (e.g., water quality problems, siltation, and sedimentation); predation by sea lions has been reported as a problem for the Lake Washington population (Nehlsen et al. 1991). Whirling disease has caused population declines in some areas. The disease is caused by a protozoan pathogen (inadvertently introduced from Europe) and involves tubifex worms as an alternate host. Brown trout (*Salmo trutta*) are unaffected by the protozoan and serve as a reservoir.

State threats

The relatively small stock sizes in Alaska increases species sensitivity to threats such as overexploitation by sport and subsistence fisheries, bycatch in commercial fisheries, and habitat degradation. Small populations are at greater risk of extinction because of demographic and genetic instability, and are more susceptible to environmental/natural catastrophes (Meffe and Carroll 1997). In Alaska, sport fishing has increased since the late 1970s; between 1999 and 2001, an average of 22,211 steelhead were caught in Southeast sport fisheries (Harding and Brookover 2003). Commercial bycatch has remained relatively low, although absolute levels are unknown. Habitat degradation has occurred as a result of logging practices and recreational activities such as ATV use. Timber harvest may adversely affect the growth of fry and the seasonal distribution and abundance of parr, particularly in Southeast Alaska (Johnson et al. 1986). Uncontrolled use of ATVs on the Yakutat forelands has resulted in substantial damage to wetlands and fish habitat (Mooney 2001, USFS 2002). In the Situk River watershed, trails cross at fragile and highly productive salmonid rearing and spawning habitats. Naturally-occurring threats include predation by fishes, diving birds and mammals, and abiotic factors such as flooding. Possible effects of flooding events include scouring, filling or loss of rearing habitat, inundation and sedimentation of spawning habitat, displacement of rearing salmonids and changes in migration patterns of adult salmonids (Thedinga et al. 1993).

State research needs

Research is needed on the degree of interaction between stocks, overwintering and spawning survival, and natural population fluctuations. Identify factors that may be limiting populations, including the effects of sport catch and release on fish survival.

State inventory needs

More accurate population estimates needed – continue monitoring streams for escapement. Distribution and abundance of Alaska Peninsula populations needs study. Better information on run-timing is needed to minimize bycatch in commercial fisheries.

State conservation and management needs

More accurate information needed on the amount and origins of commercial harvest. Bycatch in commercial fisheries should be monitored and controlled. The effects of subsistence fisheries on steelhead populations are currently unknown and require investigation and monitoring.

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Acknowledgements

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