



Photo credit: NOAA

KEY INFORMATION

Area(s) of Concern

“Salish Sea” (i.e., Puget Sound, Strait of Georgia, Strait of Juan de Fuca)

Year Identified as “Species of Concern”
2010

Factors for Decline

- Historic overfishing
- Climate change

Conservation Designations

IUCN: Not Evaluated

American Fisheries Society: Vulnerable

Washington State: Species of Concern and Priority Species

Brief Species Description:

Pacific cod are brown or gray fish with brown spots on their backs and sides. They have 3 dorsal fins, 2 anal fins, and a distinctive chin barbell (Love 1996). Adults average approximately 20–25 inches (50–60 cm) (Gustafson *et al.* 2000) and reach a maximum size of approximately 45 inches (114 cm) (Love 1996). In some parts of their range, Pacific cod are a commercially important food species.

Pacific cod inhabit the North Pacific Rim from the coast of northern China east into the Bering Sea and south along the Canada and U.S. west coasts to southern California (Palsson 1990, Gustafson *et al.* 2000). The Salish Sea (Figure 1) population of Pacific cod inhabits Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia in the northwestern U.S. and southeastern Canada.

Pacific cod are schooling fish living near the ocean bottom. In the Salish Sea, cod can be found over sand and mixed coarse bottom substrates (Palsson 1990). There is some evidence to indicate that eel grass (*Zostera marina*) may be an important habitat feature for juvenile Pacific cod (Johnson *et al.* 2003). Cod are nocturnal and opportunistic predators, feeding on krill, shrimp, sand lance, and crabs (Cohen *et al.* 1990, Love 1996). Cod provide prey for seals, halibut, and other fishes (Love 1996).

Cod reach sexual maturity at approximately 16 to 22 inches (40–56 cm) in length at approximately 2 years of age (Gustafson *et al.* 2000). Female cod produce from 225,000 to 5 million eggs per year (Gustafson *et al.* 2000). In the Salish Sea, cod migrate between shallow winter spawning areas and deeper summer feeding areas (Palsson 1990). Aggregations of cod in Agate Passage and Port Townsend Bay (both in Puget Sound) were historically subject to heavy sport and commercial fisheries (Palsson 1990, Gustafson *et al.* 2000). Pacific cod abundance in the Salish Sea has decreased significantly in the past 20 years (Gustafson *et al.* 2000, Palsson 2009).



Figure 1:

The Salish Sea

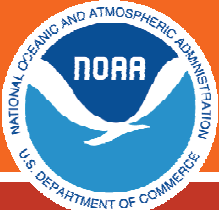
The inland waters of Washington State and British Columbia are referred to as the Salish Sea. The Sea includes the Strait of Juan de Fuca, Strait of Georgia and Puget Sound. The United States Board on Geographic Names approved this term to describe these marine basins on November 12, 2009.*

The Salish Sea is a unique marine ecosystem influenced by strong inputs of fresh water, distinctive current patterns, and the presence of shallow sills separating a series of deeper basins.

*http://geonames.usgs.gov/pls/gnisp.ublic/f?p=139:3:1000008909723198::NO::P3_FID,P3_TITLE:2573411%20Salish%20Sea



Image credit: Stefan Freelan, Western Washington University



Species of Concern

NOAA National Marine Fisheries Service

Rationale for “Species of Concern” Listing:

A previous Endangered Species Act status review for Pacific cod (Gustafson *et al.* 2000) concluded that the most likely population structure for this species included a distinct population segment (DPS) along the West Coast of North America including Puget Sound and coastal British Columbia north to at least Dixon Entrance. However, the report acknowledged a large degree of uncertainty associated with this conclusion and stated that there was insufficient information available at the time of the review to identify the exact northern boundary of the DPS. New genetic information indicates that cod in the Salish Sea represent a unique lineage and are genetically different from coastal Pacific cod (Cunningham *et al.* 2009, Canino *et al.* 2010). New analyses of elemental and isotopic composition of Pacific cod otoliths also suggest that inshore and offshore Pacific cod populations in the Pacific Northwest are separate populations (Gao *et al.* 2005). This information, in concert with the unique environment of the inland waters of Washington State and Salish Sea, suggests there is a separate population of Pacific cod inhabiting the Salish Sea.

Small population size due to past overfishing is the primary threat to Salish Sea Pacific cod. Pacific cod were once abundant and an important component of the sport and commercial fisheries in the Salish Sea (Palsson 1990). Participation in this fishery increased in the 1970s and peak harvests occurred in the late 1970s and early 1980s (Figure 2). Declining recreational and commercial catches (Figure 3) led the WDFW to enact fishery management changes in the early 1990s. Declining catches in research survey trawls confirmed the declining abundance of cod (Figure 3). Few Pacific cod remain in the Strait of Georgia, although they were common in the past with annual commercial fishery landings topping 1000 metric tons in the 1950s and 1980s (Wallace 2006). Although commercial and recreational harvest have been greatly reduced in the U.S. portion of the Salish Sea, cod abundance has not recovered to historic levels giving cause for concern about the species status. Although Pacific cod reach sexual maturity relatively quickly and are capable of producing large numbers of eggs, the population has not rebounded. In the Canadian portion of the Salish Sea, recreational fishing regulations allow a year-round harvest of 8 cod daily with no size limit (Department of Fisheries and Oceans (DFO) 2010a). There is no approved commercial fishery for Pacific cod in the Canadian portion of the Salish Sea (DFO 2010b).

Additional threats to the Salish Sea population of cod include climate change and predation (Gustafson *et al.* 2000, Beamish 2008). This population is near the southern limit of the species' range and is likely to be adversely affected by a warming climate (Beamish 2008). Other potential threats include bycatch in non-targeted fisheries (e.g., the lingcod fishery) and loss of near shore nursery habitats such as eel grass (West 1997). More research is needed to determine what factors may be limiting this population's ability to recover.

Status Reviews/Research Underway:

Current information on cod densities comes from Washington Department of Fish and Wildlife (WDFW) trawl surveys and commercial fishery landings (in North Puget Sound) (Figures 2 & 3). In a November 2000 status review (Gustafson *et al.* 2000) of Puget Sound marine fishes, we concluded that Puget Sound populations of Pacific cod were part of a larger population of cod including fish north to Dixon Entrance in British Columbia but noted considerable uncertainty regarding population structure. The review also noted declines in abundance throughout this population's range particularly in Puget Sound.



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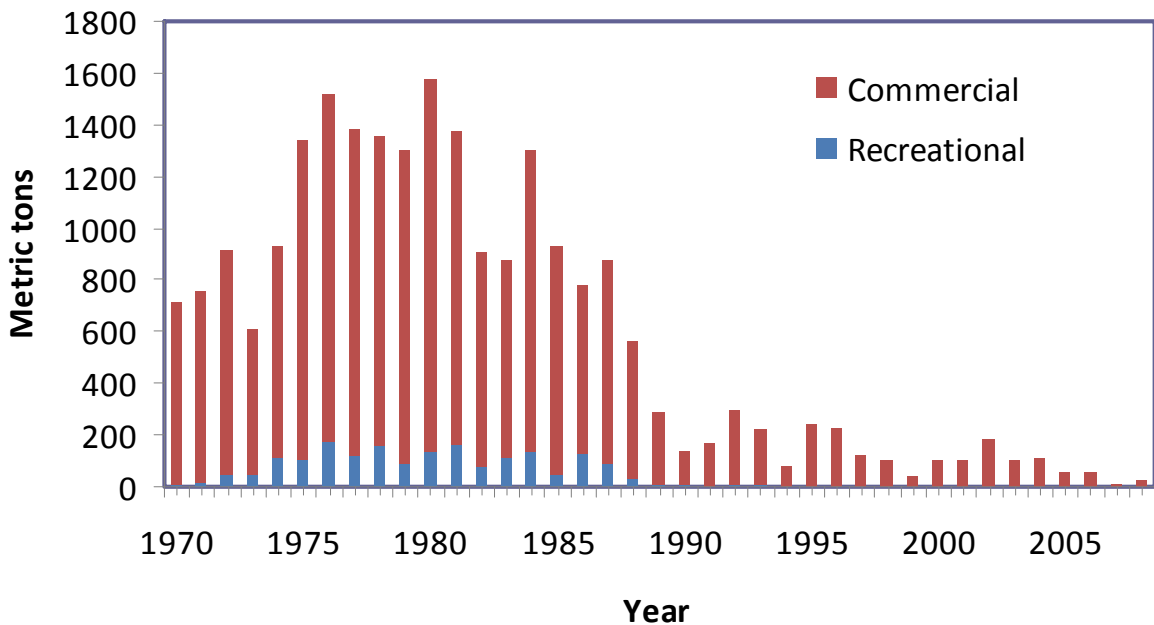


Figure 2: Puget Sound Cod Harvest: Recreational vs. Commercial (from Palsson 2009).

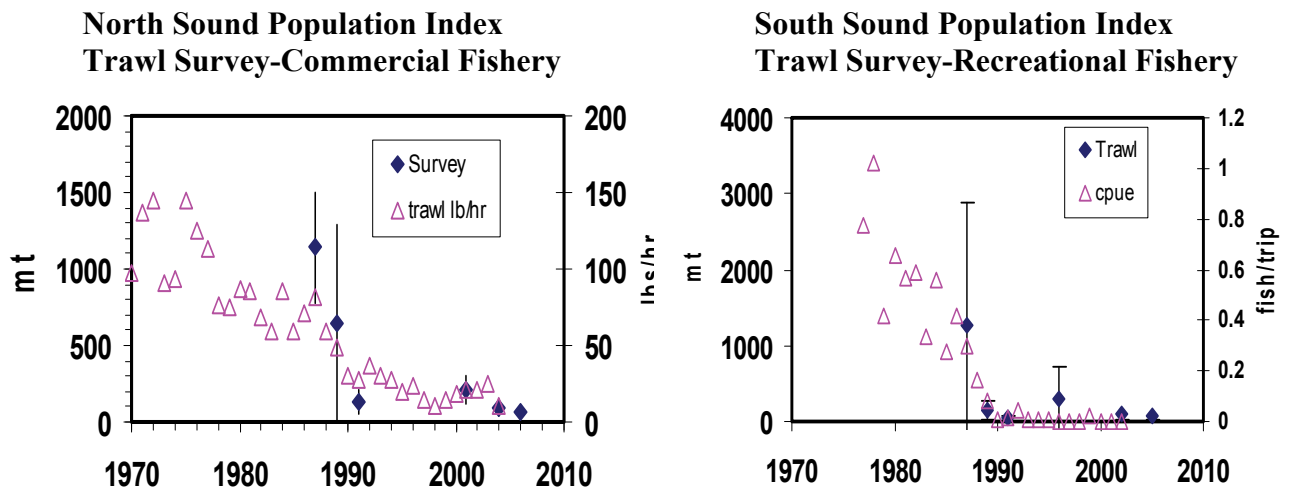


Figure 3: Puget Sound Cod Catch Trends from the North Sound and South Sound (from Palsson 2009).

Data Deficiencies:

There is limited fishery independent data from recent time periods on Pacific cod in the Salish Sea. Since fishery harvest was significantly reduced in the early 1990s, even less information on population status is available. Additional research into the genetic differences between this population and other North Pacific populations of cod would increase our understanding of how the Salish Sea population of cod is discrete from coastal populations. Additional research into population-specific limiting factors and threats would increase our understanding of why certain spawning aggregations have disappeared and of possible effects of climate change on this population.



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Existing Protections and Conservation Actions:

Recognizing the weak condition of Pacific cod stocks in the Salish Sea, WDFW has implemented a number of measures to reduce the impact of fishing. During the 1990s, WDFW progressively closed or limited the harvest of cod by commercial fisheries. They have prohibited the harvest of cod by recreational fishers south of Port Townsend and limited the daily recreational take to two fish per day in waters north of Port Townsend. WDFW also implemented a winter closure for all recreational fisheries in the waters once supporting spawning Pacific cod in Agate Passage in Puget Sound. WDFW continues to monitor the relative abundance of cod by conducting bottom trawl surveys in Puget Sound.

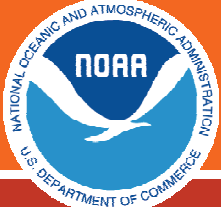
Links:

Pictures from Alaska Fisheries Science Center

http://www.afsc.noaa.gov/race/media/photo_gallery/fish_files/pacific_cod.htm

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Point(s) of contact for questions or further information:

For further information on this Species of Concern, or on the Species of Concern Program in general, please contact NMFS, Office of Protected Resources, 1315 East West Highway, Silver Spring, MD 20910, (301) 713-1401, soc.list@noaa.gov; or Eric Murray, (503) 231-2378, eric.murray@noaa.gov, 1201 NE Lloyd Blvd., Suite 1100, Portland, Oregon 97232.