

Sperm whale depredation of sablefish longline gear in the northeast Pacific Ocean

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Sablefish (*Anoplopoma fimbria*) are a commercially important fish species in the northeast Pacific Ocean. The Alaska sablefish fishery primarily is hook-and-line, the gear is fished on-bottom and thirty to forty million circle-type hooks are deployed each year (Sigler et al. 2003). Catches in the Alaskan EEZ have averaged 15,000 mt in recent years with an annual value of about \$100 million. In Alaska, sperm whales (*Physeter macrocephalus*) prey upon sablefish which have been caught using longline gear. Fishermen report that when sperm whales are present, sablefish catches sometimes decrease. In addition, some fish are damaged in characteristic ways, including missing body parts, crushed tissue, and blunt tooth marks. Damage occurs during gear retrieval, when sperm whales have been detected on the vessel depth finder located off-bottom and adjacent to the longline and on underwater video with their mouth around the line knocking caught sablefish from hooks (J. Straley, pers. obs.). Anecdotal reports indicate sperm whale depredation in the sablefish fishery may be increasing. This may be due to the implementation of the Individual Fishing Quota (IFQ) management system in 1995. Prior to the IFQ system, the fishery was open-access and season length ranged from ten days to one month. In 1995 the season was extended to 8-1/2 months and primarily occurs during the summer months, the time when sperm whales are commonly sighted in the coastal waters of Alaska.

Since 1978, the U. S. National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center (AFSC) has conducted annual longline surveys with Japan (Japan-U.S. cooperative longline survey, 1978-94) and alone (1987-present, domestic longline survey). The survey has covered the upper continental slope (1978-present) and selected gullies (1987-present) of the Gulf of Alaska and the upper continental slope of the eastern Bering Sea (1982-94, biennially since 1997) and Aleutian Islands region (1980-94, biennially since 1996). The survey area generally covers the commercial fishing area, which is subdivided into six areas for sablefish management: Bering Sea, Aleutian Islands, Western Gulf of Alaska, Central Gulf of Alaska, West Yakutat, and Southeast. Standard locations (stations) are located 30-60 km apart along the continental slope and in deep water cross-shelf gullies and the gear samples the sea floor at water depths from 150 to 900 m. Typically one station consisting of 7,200 hooks is sampled each day. The longline gear is set in the morning. Soak time ranges from 3 to 10 hours and varies because of the length of time needed to retrieve the gear. Hooks are spaced 2-m apart and are baited with squid. The longline gear is weighted with 3-kg weights every 100 m ensuring the gear is fished on-bottom. Catch is recorded by hook so the total number of fish caught at each station is known.

Sperm whales are commonly observed during survey operations. Sperm whale depredation observations have been collected since 1998. Sperm whale depredation is assumed when sperm whales are present (typically 100 meter or less from the vessel) and sablefish damaged in characteristic ways (missing body parts, crushed tissue, blunt tooth marks, shredded bodies, lips remaining on hooks) are retrieved. It seems reasonable to classify this damage as due to sperm whales because sperm whales were observed under the vessel on the vessel fish finder when this characteristic damage was observed on a few occasions, the blunt teeth of sperm

whales likely would cause the crushed tissue and blunt tooth marks observed, and the sharp teeth of other potential predators such as sharks would result in cut tissue with well-defined borders. Information recorded includes the number of sperm whales present and the number of damaged sablefish retrieved.

We analyzed data from 1998-2004 to estimate the magnitude of sperm whale depredation on sablefish longline survey catches and to determine whether the depredation rate has increased recently. Frequency of occurrence of sperm whales was calculated as the number of sampling days where sperm whales were observed divided by the total number of sampling days. Frequency of occurrence of sperm whale depredation was calculated as the number of sampling days where sperm whale depredation was observed divided by the number of sampling days where sperm whales were observed. The percentage of damaged sablefish retrieved per sampling day was computed as the number of damaged sablefish divided by the total number of sablefish retrieved.

The effect of sperm whale depredation on sablefish catches was analyzed by comparing sablefish catch rates for stations where depredation was observed to stations where no depredation was observed. The average catch rate for a station was computed as the average sablefish catch rate (kg per hook) by depth strata weighted by the size of each depth strata (Sigler and Fujioka 1988). Only the area east of 159° W longitude where sperm whale depredation was observed was analyzed (Central Gulf of Alaska, West Yakutat, and Southeast sablefish management areas), which encompasses four statistical areas: Chirikof, Kodiak, Yakutat, and Southeast.

Sperm whales were observed on 16% of sampling days, mostly (95% of sightings) over the continental slope, and were most common in the central and eastern Gulf of Alaska (98% of sightings), occasional in the western Gulf of Alaska and Aleutian Islands, and not observed in the Bering Sea. Catches were commonly preyed upon when sperm whales were present (65% of sightings), as evidenced by damaged fish. Neither sperm whale presence ($p = 0.71$) or depredation rate ($p = 0.78$) increased significantly from 1998 to 2004. Catch rates were about 2% less at locations where depredation occurred, but the effect was not significant ($p = 0.34$).

Results indicate sperm whale prey upon sablefish caught on longline gear, but the overall effect appears to be minimal. These results are similar to other sperm whale depredation studies which have measured catch rate reductions between 1-3% (Straley et al. 2005, Hucke-Gate 2004, Purves et al. 2004, and Hill et al. 1999). Although the impact on fishery yield appears to be low, sperm whale depredation remains a concern. Specific factors such as vessel acoustic signatures, offal discharge, and fishing locations may affect depredation rates and the overall impacts of depredation. Sperm whale depredation during the sablefish longline survey continues to be monitored and occurrences are annually reported in the sablefish Stock Assessment and Fishery Evaluation Reports (Hanselman et al. 2006). These reports can be found at the following link: <http://www.afsc.noaa.gov/Publications/assessments.htm>

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