SPERM WHALE (*Physeter macrocephalus*): California/Oregon/Washington Stock

**STOCK DEFINITION AND GEOGRAPHIC RANGE**

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer but the majority are thought to be south of 40°N in winter (Rice 1974; Gosho et al. 1984; Miyashita et al. 1995). For management, the International Whaling Commission (IWC) had divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150°W at the equator, is 160°W between 40-50°N, and ends up at 180°W north of 50°N; however, the IWC has not reviewed this stock boundary in many years (Donovan 1991). Sperm whales are found year-round in California waters (Dohl et al. 1983; Barlow 1995; Forney et al. 1995), but they reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). They were seen in every season except winter (Dec.-Feb.) in Washington and Oregon (Green et al. 1992). Of 176 sperm whales that were marked with Discovery tags off southern California in winter 1962-70, only three were recovered by whalers: one off northern California in June, one off Washington in June, and another far off British Columbia in April (Rice 1974). Recent summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150°W) and tapers off northward towards the tip of Baja California. The structure of sperm whale populations in the eastern tropical Pacific is not known, but the only photographic matches of known individuals from this area have been between the Galapagos Islands and coastal waters of South America (Dufault and Whitehead 1995), suggesting that the eastern tropical animals constitute a distinct stock. A recent survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific revealed no apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii (Barlow and Taylor 1998). Recent analyses of genetic relationships of animals in the eastern Pacific found that mtDNA and microsatellite DNA of animals sampled in the California Current is significantly different from animals sampled further offshore and that genetic differences appeared larger in an east-west direction than in a north-south direction (Mesnick et al. 1999).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) California, Oregon and Washington waters (this report), 2) waters around Hawaii, and 3) Alaska waters.

**POPULATION SIZE**

Barlow and Taylor (2001) estimated 1,407 (CV=0.39) sperm whales along the coasts of California, Oregon, and Washington during summer/fall based on ship line transect surveys in 1993 and 1996. Forney et al. (1995) estimated 892 (CV=0.99) sperm whales off California during winter/spring based on aerial line-transect surveys in 1991-92, but
this estimate does not correct for diving whales that were missed and is now more than eight years out of date. The most recent abundance estimate is based on summer/autumn shipboard surveys conducted within 300 nmi of the coasts of California, Oregon, and Washington in 1996 (Barlow 1997) and 2001 (Barlow 2003). The combined weighted estimate for the 1996 and 2001 surveys is 1,233 (CV = 0.41) sperm whales (Barlow 2003). Green et al. (1992) report that sperm whales were the third most abundant large whale (after gray and humpback whales) in aerial surveys off Oregon and Washington, but they did not estimate population size for that area. A large 1982 abundance estimate for the entire eastern North Pacific (Gosho et al. 1984) was based on a CPUE method which is no longer accepted as valid by the International Whaling Commission. Recently, a combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based acoustic detections and visual group size estimates (Barlow and Taylor 1998). However, it is not known whether any or all of these animals routinely enter the U.S. EEZ. In the eastern tropical Pacific, the abundance of sperm whales has been estimated as 22,700 (95% C.I.=14,800-34,600; Wade and Gerrodette 1993), but this area does not include areas where sperm whales are taken by drift gillnet fisheries in the U.S. EEZ and there is no evidence of sperm whale movements from the eastern tropical Pacific to the U.S. EEZ. Barlow and Taylor (2001) also estimated 1,640 (CV=0.33) sperm whales off the west coast of Baja California, but again there is no evidence for interchange between these animals and those off California, Oregon and Washington.

Clearly, large populations of sperm whales exist in waters that are within several thousand miles west and south of the California, Oregon, and Washington region that is covered by this report; however, there is no evidence of sperm whale movements into this region from either the west or south and genetic data suggest that mixing to the west is extremely unlikely. There is limited evidence of sperm whale movement from California to northern areas off British Columbia, but there are no abundance estimates for this area. The most precise and recent estimate of sperm whale abundance for this stock is therefore from the ship surveys conducted in 1996 and 2001 (Barlow 2003).

**Minimum Population Estimate**

The minimum population estimate for sperm whales is taken as the lower 20th percentile of the log-normal distribution of abundance estimated from the 1996-2001 summer/fall ship surveys off California, Oregon and Washington (Barlow 2003) or approximately 885. More sophisticated methods of estimating minimum population size would be available if a correction factor (and associated variance) were available to correct the aerial survey estimates for missed animals.

**Current Population Trend**

Sperm whale abundance appears to have been rather variable off California between 1979/80 and 1996 (Barlow 1994; Barlow 1997) but does not show any obvious trends. Although the population in the eastern North Pacific is expected to have grown since large-scale pelagic whaling stopped in 1980, the possible effects of large unreported catches are unknown (Yablokov 1994) and the ongoing incidental ship strikes and gillnet mortality make this uncertain.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

There are no published estimates of the growth rate for any sperm whale population (Best 1993).

**POTENTIAL BIOLOGICAL REMOVAL**

The potential biological removal (PBR) level for the California portion of this stock is calculated as the minimum population size (885) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species), resulting in a PBR of 1.8.

**HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

**Historic Whaling**

Between 1800 and 1909, about 60,842 sperm whales were estimated taken in the North Pacific (Best 1976). The reported take of North Pacific sperm whales by commercial whalers between 1947 and 1987 totaled 258,000 (C. Allison, pers. comm.). Ohsumi (1980) lists an additional 28,198 sperm whales taken mainly in coastal whaling operations from 1910 to 1946. Based on the massive under-reporting of Soviet catches, Brownell et al. (1998) estimate that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. The Japanese coastal operations apparently also under-reported catches by an unknown amount (Kasuya 1998). Thus a total of at least 436,000 sperm whales were taken between 1800 and the end of commercial whaling for this species in 1987.
Of this grand total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980, IWC statistical Areas II and III), and 965 were reported taken in land-based U.S. West coast whaling operations between 1947 and 1971 (Ohsumi 1980). In addition, 13 sperm whales were taken by shore whaling stations in California between 1919 and 1926 (Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980.

**Fishery Information**

The offshore drift gillnet fishery is the only fishery that is likely to take sperm whales from this stock. Detailed information on this fishery is provided in Appendix 1. A 1997-2001 summary of known fishery mortality and injury for this stock of sperm whales is given in Table 1. After the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders, overall cetacean entanglement rates in the drift gillnet fishery dropped considerably (Barlow and Cameron 2003). However, two sperm whales have been observed taken in nets with pingers (1996 and 1998). Because sperm whale entanglement is rare and because those nets which took sperm whales did not use the full mandated complement of pingers, it is difficult to evaluate whether pingers have any effect on sperm whale entanglement in drift gillnets. Mean annual takes for this fishery (Table 1) are based on 1997-2001 data. This results in an average estimate of 1.0 (CV = 0.89) sperm whale mortalities per year.

**Table 1. Summary of available information on the incidental mortality and injury of sperm whales (CA/OR/WA stock) for commercial fisheries that might take this species (Cameron and Forney 1999; 2000; Carretta 2001; 2002). Injury includes any entanglement that does not result in immediate death and may include serious injury resulting in death. n/a indicates that data are not available. Mean annual takes are based on 1997-2001 data unless noted otherwise.**

<table>
<thead>
<tr>
<th>Fishery Name</th>
<th>Year(s)</th>
<th>Data Type</th>
<th>Percent Observer Coverage</th>
<th>Observed Mortality (and injury in parentheses)</th>
<th>Estimated Mortality (CV in parentheses)</th>
<th>Mean Annual Takes (CV in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA/OR thresher shark/swordfish drift gillnet fishery</td>
<td>1997</td>
<td>observer data</td>
<td>23.0%</td>
<td>0</td>
<td>0</td>
<td>0 (0.79)</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>observer data</td>
<td>20.0%</td>
<td>0</td>
<td>0</td>
<td>0 (0.89)</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>observer data</td>
<td>20.0%</td>
<td>0</td>
<td>0</td>
<td>0 (0.89)</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>observer data</td>
<td>22.9%</td>
<td>0</td>
<td>0</td>
<td>0 (0.89)</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>observer data</td>
<td>20.4%</td>
<td>0</td>
<td>0</td>
<td>0 (0.89)</td>
</tr>
<tr>
<td>Total annual takes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 (0.89)</td>
</tr>
</tbody>
</table>
"endangered" under the Endangered Species Act (ESA), and consequently the California to Washington stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The annual rate of kill and serious injury (1.0 per year) is less than the calculated PBR for this stock (1.8). Total fishery takes may not be approaching zero mortality and serious injury rate. The increasing levels of anthropogenic noise in the world’s oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the oceans “sound channel”.

REFERENCES

Allison, C.  International Whaling Commission. The Red House, 135 Station Road, Impington, Cambridge, UK CB4 9NP.


Berdegué, J. 2002.  Depredación de las especies pelágicas reservadas a la pesca deportiva y especies en peligro de extinción con uso indiscriminado de artes de pesca no selectivas (palangres, FAD’s, trampas para peces y redes de agallar fijas y a la deriva) por la flota palangrera Mexicana.  Fundación para la conservación de los picudos.  A.C. Mazatlán, Sinaloa, 21 de septiembre.


Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037, USA.


Cordaro, J. Southwest Region, NMFS, 501 West Ocean Blvd, Long Beach, CA 90802-4213.


