

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

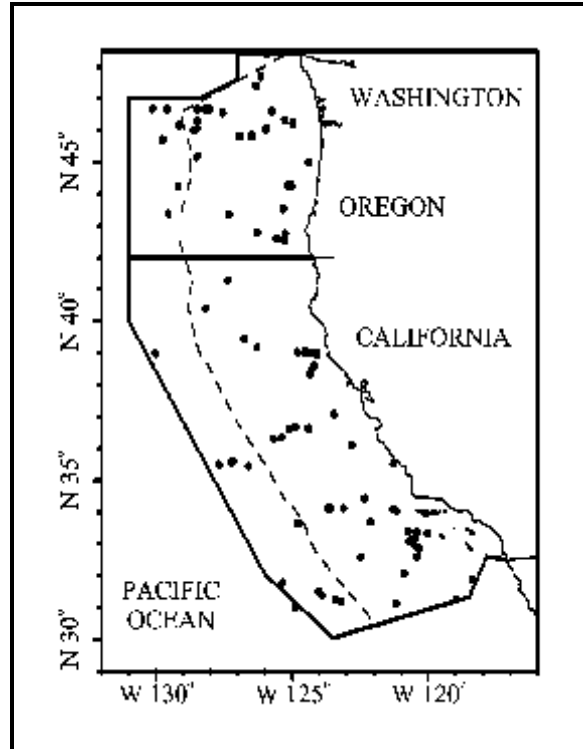
### STOCK DEFINITION AND GEOGRAPHIC RANGE

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; Goshio 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 three sperm whales that were marked off southern California in January, one was caught by whalers 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). Very preliminary genetic analyses revealed significant differences between sperm whales off the coast of California, Oregon and Washington and those sampled offshore to Hawaii (Mesnick et al., unpubl. data); analyses of additional genetic samples are ongoing at the NMFS, Southwest Fisheries Science Center.

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 (1997) estimates 1,191 (CV=0.22) sperm whales along the coasts of California, Oregon, and Washington during summer/fall based on ship line transect surveys in 1991, 1993, and 1996 (lognormal 95% C.I.= 778-1,824). Forney et al. (1995) estimate 892 (CV=0.99) sperm whales off California during winter/spring based on aerial line-transect surveys (95% C.I.=176-4,506), but this estimate does not correct for diving whales that were missed. Because of the long dive time of sperm whales (Leatherwood et al. 1982), it is reasonable to assume that the true abundance would be three to



**Figure 1.** Sperm whale sighting locations based on aerial and shipboard surveys off California, Oregon, and Washington, 1989-96. Dashed line represents the U.S. EEZ, thick line indicates the outer boundary of all surveys combined. Greater effort was conducted off California (south of 42°N) and in the inshore half of the U.S. EEZ. See Appendix 2 of Barlow et al. (1997) and Barlow (1997) for data sources and information on timing and location of survey effort.

eight times the estimates from aerial surveys. 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 on 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. The most precise estimate of sperm whale abundance within the area of the drift gillnet fishery is therefore from the ship survey estimate of Barlow (1997); however, this is probably an underestimate of true abundance because recent studies suggest sperm whale group sizes may have been underestimated on past line-transect surveys (Barlow and Taylor 1998).

### **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 summer/fall ship surveys off California, Oregon and Washington (Barlow 1997) or approximately 992. 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 fairly stable in California coastal waters between 1979/80 and 1991 (Barlow 1994). 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 ( 992) 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 2.0.

### **HUMAN-CAUSED MORTALITY**

#### **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**

Sperm whales in this stock are likely to be caught only in offshore drift gillnets. Detailed information on this

fishery is provided in Appendix 1 of Barlow et al. (1997). A summary of known fishery mortality and injury for this stock of sperm whales is given in Table 1. In 1996-97, a pinger experiment was conducted to evaluate whether these acoustic alarms may reduce cetacean entanglement rates in the drift gillnet fishery. Based on the positive results of this study (Cameron 1998), pingers were made mandatory in this fishery in November 1997. The 1996-97 mortality estimates were stratified for pingered and unpingered drift gillnets. Only one whale was observed in a pingered net in 1996; this whale sustained significant injuries and was not expected to survive (Cameron 1998). The average annual fishery mortality is estimated to be 3.0 sperm whales for the five most recent years of monitoring (1993-97). In addition, an estimated 1.6 sperm whales per year were entangled but released alive. In addition, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net. The deaths of two stranded sperm whales in California were attributed to entanglement in fishing gear between 1983 and 1991 (J. Cordaro, pers. comm.). Drift gillnet fisheries for swordfish and sharks exist along the entire Pacific coast of Baja California, Mexico and may take animals from the same population. Quantitative data are available only for the Mexican swordfish drift gillnet fishery, which has increased from two vessels in 1986 to 29 vessels in 1992-(Sosa-Nishizaki et al. 1993). The total number of sets in this fishery in 1992 can be estimated from data provided by these authors to be approximately 2,700, with an observed rate of marine mammal bycatch of 0.13 animals per set (10 marine mammals in 77 observed sets; Sosa-Nishizaki et al. 1993). This overall mortality rate is similar to that observed in California driftnet fisheries during 1990-95 (0.14 marine mammals per set, Julian and Beeson 1998), but species-specific information is not available for the Mexican fisheries.

**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 (Julian and Beeson 1998; Julian 1997; Cameron 1998). Injury includes any entanglement that does not result in immediate death and may include serious injury resulting in death. The injured whale observed in 1996 was not expected to survive. n/a indicates that data are not available.

| Fishery Name   | Year(s) | Data Type | Percent Observer Coverage | Observed Mortality (and injury in parentheses) | Estimated Mortality (CV in parentheses) | Mean Annual Takes 1993-97 (CV in parentheses) |
|--|---------|-----------|---------------------------|--|---|---|
| CA/OR thresher shark/swordfish drift gillnet fishery | 1993    | observer  | 13.4%                     | 2 (1)  | Mortality                               | Mortality                                     |
|  | 1994    | data      | 17.9%                     | 0  | 15,0,0,0,0                              | 3.0 (0.66)                                    |
|  | 1995    |           | 15.6%                     | 0  | (0.66,0)                                |   |
|  | 1996    |           | 12.4%                     | 0 (1)  | Injury                                  | Injury  |
|  | 1997    |           | 26.6%                     | 0  | 7,0,0,1,0                               | 1.6 (n/a)                                     |
| <b>Total annual takes</b>                            |         |           |                           |  |   | 4.6 (0.66)                                    |

### Ship Strikes

Ship strikes were implicated in the deaths of two unidentified whales in 1990 (J. Cordaro, pers. comm.). Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma.

### STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. Sperm whales are formally listed as "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 (3.0 per year) is greater than the calculated PBR for this stock (2.0) which would also result in the classification of this stock as "strategic". In addition, an annual average of 1.6 sperm whales are estimated to be entangled and injured, but released alive. Total fishery mortality is not approaching zero mortality and serious injury rate. In comparing gillnet mortality with the PBR, it should be remembered that the PBR does not include sperm whales found further offshore which possibly belong to the same population. A fishery interaction problem appears to exist for sperm whales taken in the drift gillnet fishery, but enough uncertainties exist that one should not conclude from this information that sperm whales are necessarily declining in abundance off the U.S. West Coast. A take reduction plan for the drift gillnet fishery, including mandatory pingers and a minimum 6-fathom suspender length, was implemented in 1997, and preliminary results indicate that cetacean mortality has decreased markedly (Cameron 1998). 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".

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