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# SEI WHALE (*Balaenoptera borealis borealis*): Hawaii Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes one stock of sei whales in the North Pacific (Donovan 1991), but some evidence exists for multiple populations (Masaki 1977; Mizroch et al. 1984; Horwood 1987). Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features. Whaling effort for this species was distributed continuously across the North Pacific between 45-55°N (Masaki 1977). Two sei whales that were tagged off California were later killed in whaling operations off Washington and British Columbia (Rice 1974) and the movement of tagged animals has been noted in many other regions of the North Pacific. There is still insufficient information to accurately determine population structure, but from a conservation perspective it may be risky to assume panmixia in the entire North Pacific. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in four sightings in 2002 and three in 2010 (Figure 1; Barlow 2003; Bradford et al. 2013). There have been no reported strandings of sei whales in the Hawaiian Islands.

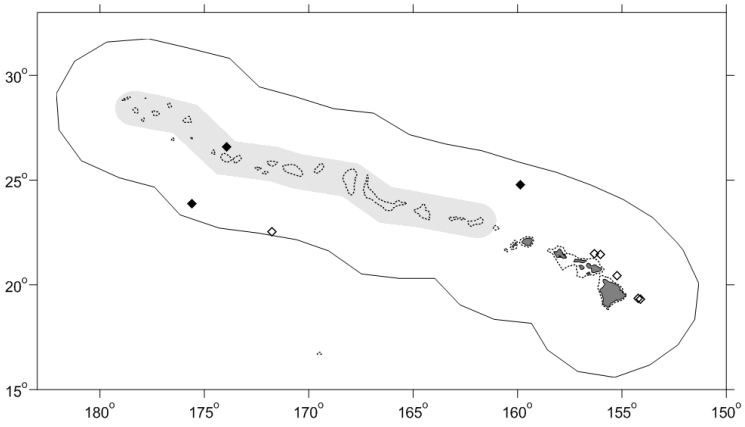


**Figure 1.** Sei whale sighting locations during the 2002 (open diamonds) and 2010 (black diamonds) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2003, Bradford et al. 2013; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1000m isobath.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into three discrete areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

## POPULATION SIZE

Ohsumi and Wada (1974) estimate the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Later, Tillman (1977) used a variety of methods to estimate sei whale abundance in the North Pacific and revised the pre-whaling estimate to 42,000. His estimates for the year 1974, following 27 years of whaling, ranged from 7,260 to 12,620. All methods depend on using the history of catches and trends in CPUE or sighting rates; there have been no direct estimates of sei whale abundance in the entire North Pacific based on sighting surveys. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 77 (CV=1.06) sei whales (Barlow 2003). More recently, the 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 178 (CV = 0.9) sei whales (Bradford et al. 2013). This is currently the best available abundance estimate for this stock, but the majority of sei whales would be expected to be in higher-latitude feeding grounds at this time of year.

### Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2010 abundance estimate or 93 sei whales within the Hawaiian Islands EEZ.

### Current Population Trend

No data are available on current population trend. Although the population in the North Pacific is expected to have grown since being given protected status in 1976, the possible effects of continued unauthorized takes (Yablokov 1994) make this uncertain. The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of trend with the available data.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for sei whales.

## POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (93) 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 with $N_{min}$ <1500; Taylor et al. 2003), resulting in a PBR of 0.2 sei whales per year.

## HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

### Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. In March 2011 a subadult sei whale was found near Lahaina, Maui entangled with one or two wraps of heavy-gauge polypropylene line around the tailstock and trailing about 30 feet of line including a large bundle (Bradford & Lyman 2013). Closer examination also revealed line scars on the body near the dorsal fin. Although disentanglement was attempted, the gear could not be removed. Although the source of the line entangling the whale could not be determined, this injury is considered serious based on extent of trailing gear and condition of the whale (Bradford & Lyman 2013, NMFS 2012). This serious injury record results in an average annual serious injury and mortality rate of 0.2 sei whales for the period 2007 to 2011.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no sei whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (McCracken 2013, Bradford & Forney 2013).

### Historical Whaling

The reported take of North Pacific sei whales by commercial whalers totaled 61,500 between 1947 and 1987 (C. Allison, IWC, pers. comm.). There has been an IWC prohibition on taking sei whales since 1976, and commercial whaling in the U.S. has been prohibited since 1972.

## STATUS OF STOCK

Previously, sei whales were estimated to have been reduced to 20% (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). Sei whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The observed rate of fisheries-related mortality or serious injury within the Hawaiian Islands EEZ (0.2 animals per year) is equal to the PBR (0.2), though the responsible fishery is unknown. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales (Richardson et al. 1995). Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen et al. 2013), but it is unknown if sei whales respond in the same manner to such sounds.

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