

SEI WHALE (*Balaenoptera borealis borealis*): Eastern North Pacific Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The International Whaling Commission (IWC) recognizes one stock of sei whales in the North Pacific (Donovan 1991, Wada and Numachi 1991), but evidence exists for multiple populations (Masaki 1977; Mizroch *et al.* 1984; Horwood 1987). Kanda *et al.* (2006) reported there is likely a single population of sei whales in the western North Pacific, based on microsatellite analyses, for the region 37°N-45°N and 147°E-166°E. Sei whales are distributed far out to sea in temperate waters worldwide 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 tagged off California were later killed off Washington and British Columbia (Rice 1974). Sei whales are rare in the California Current (Dohl *et al.* 1983; Barlow 2016; Forney *et al.* 1995; Green *et al.* 1992), but were the fourth most common whale taken by California coastal whalers in the 1950s-1960s (Rice 1974). They are extremely rare south of California (Wade and Gerrodette 1993; Lee 1993). Lacking additional data on sei whale population structure, sei whales in the eastern North Pacific (east of longitude 180°) are considered as a separate stock. For the Marine Mammal Protection Act (MMPA) stock assessment reports, sei whales within the Pacific U.S. EEZ are divided into two discrete areas: (1) California, Oregon and Washington waters (this report) and (2) waters around Hawaii. The Eastern North Pacific stock includes animals found within the U.S. west coast EEZ and in adjacent high seas waters; however, because comprehensive data on abundance, distribution, and human-caused impacts are lacking for high seas regions, the status of this stock is evaluated based on data from U.S. EEZ waters of the California Current (NMFS 2023).

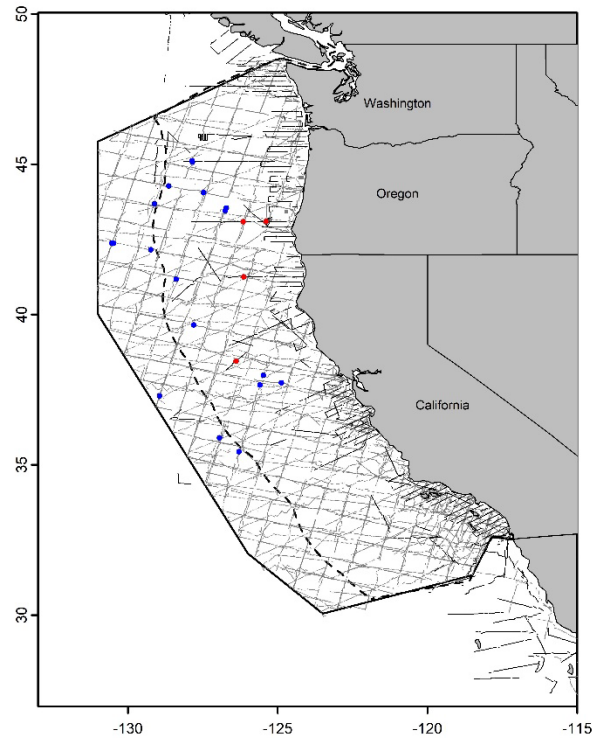


Figure 1. Sei whale sighting locations from shipboard surveys off California, Oregon, and Washington, 1991-2018. Dashed line represents the U.S. EEZ; thin lines indicate completed transect effort of all surveys combined. Sightings from the 2018 survey are shown in red.

POPULATION SIZE

Ohsumi and Wada (1974) estimated the pre-whaling abundance of sei whales to be 58,000-62,000 in the North Pacific. Tillman (1977) estimated sei whale abundance in the North Pacific and revised this pre-whaling estimate to 42,000. His estimates for the year 1974 ranged from 7,260 to 12,620. These previous studies depended on using the history of catches and trends in CPUE or sighting rates. Hakamada *et al.* (2017) estimated sei whale abundance at 29,632 sei whales (CV = 0.242, 95% CI 18,576-47,267) in the central and eastern North Pacific based on visual line-transect surveys between 2010 and 2012. This estimate corresponds with the first systematic sighting survey abundance estimate for this species over a pelagic high-seas region. However, while the study area of Hakamada *et al.* (2017) included waters north of 40°N latitude and west of 135°W longitude, it excluded waters of the California Current, where sightings are rare (Barlow 2016). The

most-recent estimate of sei whale abundance in the California Current (864, CV=0.40) is based on a 2014 survey, however this estimate is now 10 years old. Although there was no formal assessment of an abundance trend for sei whales, estimates reported in Barlow (2016) showed an increasing trend from 1991-2014, with the 2014 estimate being the highest estimated.

Minimum Population Estimate

Although the most-recent abundance estimate for this stock is from 2014, an estimate of minimum population size may be inferred by assuming the population size has at least been stable over the period 1991-2014 (Barlow 2016), based on increasing estimates of abundance. Thus, the minimum population size is calculated from the most-recent estimate (864, CV=0.40), resulting in a minimum population size of 625 whales.

Current Population Trend

No data on trends in sei whale abundance exist for the eastern North Pacific. 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), vessel strikes and gillnet mortality make this uncertain. Barlow (2016) noted that an increase in sei whale abundance observed in 2014 in the California Current is partly due to recovery of the population from commercial whaling, but may also involve distributional shifts in the population.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

There are no estimates of the growth rate of sei whale populations in the North Pacific (Best 1993).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (625) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 1.25 whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The California swordfish drift gillnet fishery is the most likely U.S. fishery to interact with sei whales from this stock, but no entanglements have been observed from 9,246 observed fishing sets from 1990-2021 (Carretta 2022, Table 1). Mean annual takes for this fishery (Table 1) are based on 2017-2021 data and are zero whales annually. However, some gillnet mortality of large whales may go unobserved because whales swim away with a portion of the net.

Table 1. Summary of available information on the incidental mortality and injury of sei whales (eastern North Pacific stock) for commercial fisheries that might take this species. n/a indicates that data are not available. Mean annual takes are based on 2017-2021 data unless noted otherwise.

Fishery Name	Year(s)	Data Type	Observer Coverage	Observed mortality (and injury in parentheses)	Estimated mortality (CV in parentheses)	Mean annual takes (CV in parentheses)
CA/OR thresher shark/swordfish drift gillnet fishery	2017	observer	0.186	0	0	0 (n/a)
	2018		0.251			
	2019		0.226			
	2020		0.222			
	2021		0.228			

Vessel Strikes

No vessel strikes of sei whales have been documented during the most-recent 5-yr period (2017-2021) (Carretta *et al.* 2023).

STATUS OF STOCK

The NMFS sei whale recovery plan notes that basic data such as distribution, abundance, trends and stock structure is of poor quality or largely unknown, owing to the rarity of sightings of this species (NMFS 2011). 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). The initial abundance has never been reported separately for

the eastern North Pacific stock, but this stock was also depleted by whaling. Kanda *et al.* (2006) found a high level of genetic variation among sei whale samples in the western North Pacific and hypothesized that the population did not suffer from a genetic bottleneck due to commercial whaling. Sei whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the eastern North Pacific stock is automatically considered a "depleted" and "strategic" stock under the MMPA. Total observed fishery mortality is zero and therefore is considered to be approaching zero mortality and serious injury rate. Risks to sei whales include vessel strikes, though none were recorded in the most-recent 5-yr period (Carretta *et al.* 2023). Increasing levels of anthropogenic sound in the world's oceans is a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (Croll *et al.* 2002). 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.

OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

The status review of sei whales under the ESA (NOAA 2021) includes threats to sei whales' prey base as the result of climate change. Specifically, the report notes that "In the Northeast Pacific, harmful algal bloom (HAB) events have been increasing in strength, intensity and extension resulting in mortality events for other cetacean and marine mammal species (Cook *et al.* 2015; Lefebvre *et al.* 2016; Häussermann *et al.* 2017). This indicates a similar process may be occurring in both hemispheres. In addition, Sasaki *et al.* (2012) reported that seasonal shifts in sei whale habitat in the western North Pacific is linked with changing oceanographic conditions due to climate change." Other potential impacts noted in the report include increasing vessel noise, impacts from oil and gas exploration, military sonar, vessel strikes, and entanglement in fishing gear.

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