



The Sei Whale

Introduction

The sei whale, *Balaenoptera borealis* Lesson 1828, is the third largest member of the family Balaenopteridae, following the blue, *B. musculus*; and fin, *B. physalus*, whales. At maturity, sei whales range from 12 to 18 m in length (Lockyer, 1977; Martin, 1983). Their coloration is gray, with a variable white region from the chin to the umbilicus. The undersides and sides of the whale may appear mottled, with gray or white circular scars caused by ectoparasitic copepods, *Penella* spp. (Andrews, 1916; Ivashin and Golubovsky, 1978), lampreys (Pike, 1951; Rice, 1977a), or cookiecutter sharks, *Isistius brasiliensis* (Shevchenko, 1977). The dorsal fin is generally tall, slender, and—compared to the blue and fin whale—further forward on the body (Fig. 30).

The sei whale is usually found alone or in small groups, and the species appears to have no well-defined social structure. Like other balaenopterids, they have fringed baleen plates instead of teeth and ventral grooves which expand to allow for engulfing large quantities of water during feeding on small zooplankton. Mead (1977) noted that sei whale baleen is much finer than that of other *Balaenoptera* species and is a reliable feature for species identification.

Distribution and Migration

Sei whales are found in all oceans (Fig. 31). These whales migrate long distances from high-latitude summer feeding areas to relatively low-latitude winter breeding areas. For the most part, the location of these winter areas remains a mystery. Compared to other

balaenopterids, sei whales appear restricted to the more temperate waters and occur within a smaller range of latitudes (Mizroch et al., 1984c). They do not associate with coastal features, but instead they are found in deeper waters associated with the continental shelf edge (Hain et al., 1985). There is some evidence from catch data of differential migration patterns by reproductive class, whereby females arrive at and depart from feeding areas earlier than males (Matthews, 1938; Gambell, 1968).

North Pacific

The IWC's Scientific Committee has designated the entire North Pacific Ocean as one sei whale stock unit (Donovan, 1991). However, mark-recapture studies using Discovery tag³⁸ and catch distribution data, as well as comparisons of morphology, indicate that more than one stock exists: one between long. 175°W and 155°W and another east of long. 155°W (Fig. 4, 5) (Masaki, 1976, 1977). During winter, sei whales are found from lat. 20° to 23°N and during the summer from lat. 35° to 50°N (Masaki, 1976, 1977). Horwood (1987) reported that 75–85% of the total North Pacific population of sei whales resides east of long. 180°W.

Within the U.S.EEZ⁶⁹ there is a significant lack of information regarding the distribution of sei whales in the eastern North Pacific (Barlow et al., 1997). Two whales tagged off California were later captured off Washington and British Columbia, revealing a possible link between these two areas (Rice, 1974). However, the lack of other tag recovery data makes these two cases inconclusive.

North Atlantic

The IWC recognizes three sei whale stocks in the North Atlantic (Fig. 32):

- 1) Nova Scotia,
- 2) Iceland-Denmark Strait, and
- 3) Northeast Atlantic.

However, the IWC noted that identification of sei whale stocks is very difficult, and that these three stocks are based on regions of past whaling operations, as opposed to biological information (Donovan, 1991). Mitchell and Chapman (1977) noted another possible stock boundary separating the Nova Scotia stock from sei whales off northeast Newfoundland and Labrador based on catch data, tag recoveries, and known migration patterns. In the northwest Atlantic, whales travel along the eastern Canadian coast in autumn, June, and July on their way to and from the Gulf of Maine and Georges Bank, where they occur in winter and spring (Mitchell, 1975b; Blaylock et al., 1995). Peak abundance in U.S. waters occurs in spring along eastern Georges Bank, into the Northeast Channel, and along the southwest edge of Georges Bank in the area of Hydrographer Canyon (CeTAP⁷⁰). In years of copepod abundance, more whales are found inshore of these areas, such as in the Great South Channel, on Stellwagen Bank, and in the Gulf of Maine (Payne et al., 1990; Schilling et al., 1992).

In the northeast Atlantic, sei whales winter south of Spain, move to the Spanish, Portuguese, and western Ireland coasts in early spring, to the northwest of the Shetland Islands, off the

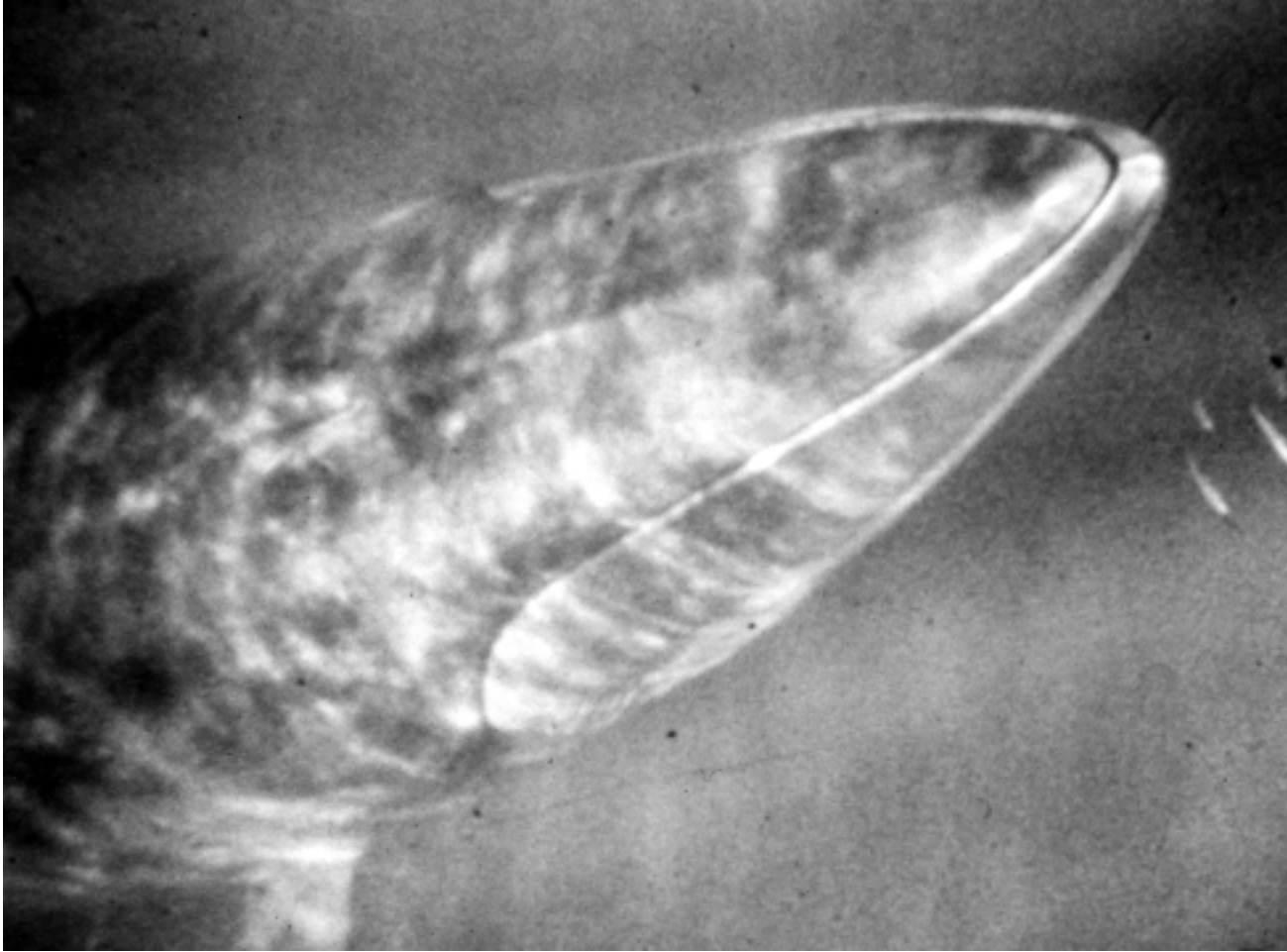


Figure 30.—Underwater views of a sei whale. G. Williamson, NMML Collection.

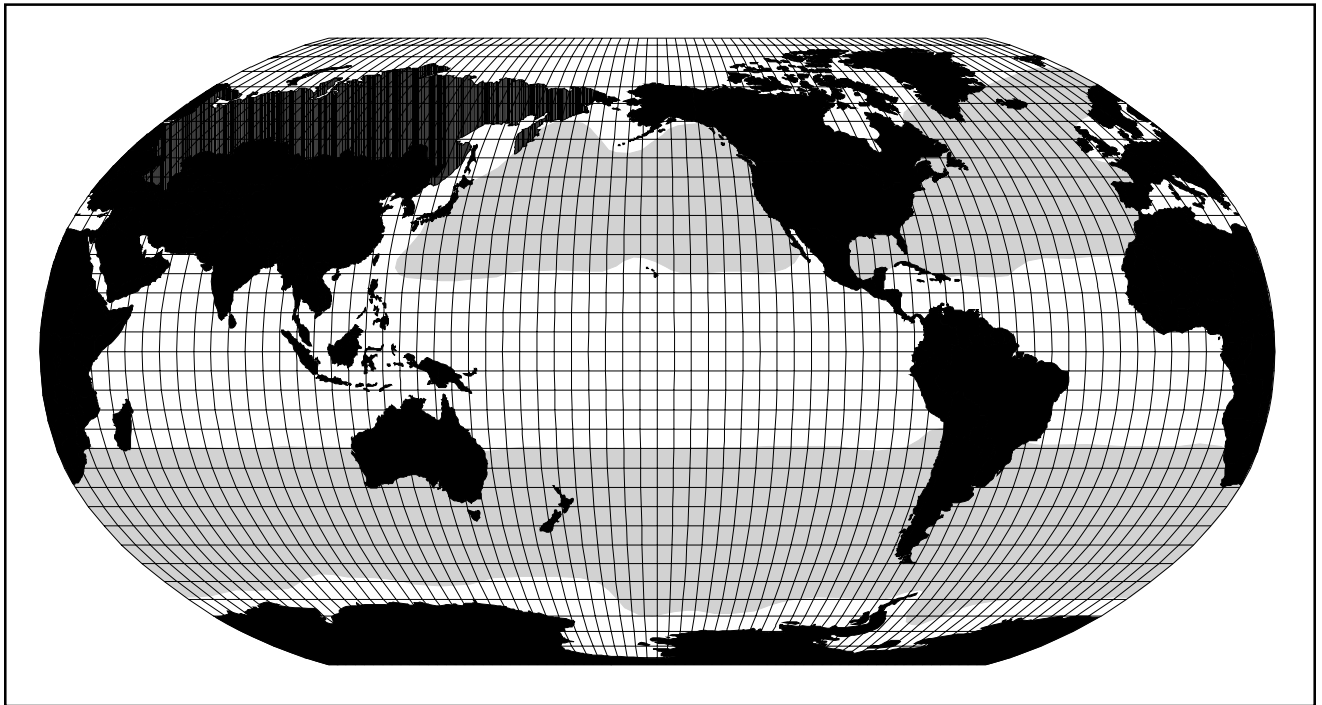


Figure 31.—Worldwide sei whale distribution. Adapted from Mizroch et al. (1984c).

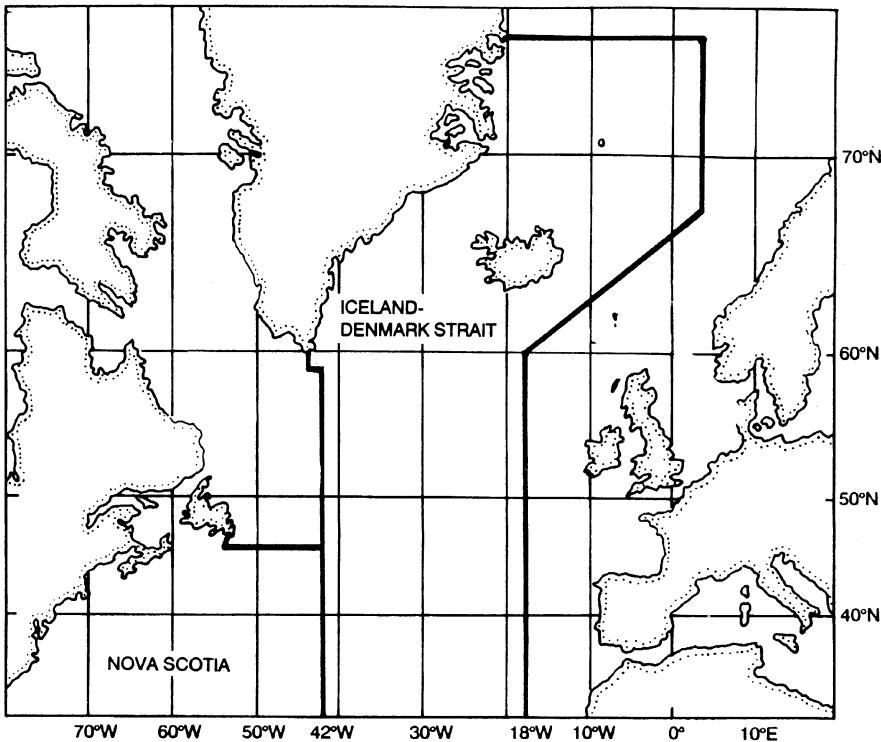


Figure 32.—North Atlantic sei whale stock boundaries recognized by the IWC (Donovan, 1991).

Hebrides, and west Norway in April through May, and summer off north Norway, west Norway, the Shetland Islands, the Hebrides, and the Faeroe Islands (Fig. 7) (Ingebrigtsen, 1929). Occasionally, sei whales are found as far north as Bear Island and Spitsbergen (about lat. 72°N) (Fig. 18) (Jonsgård, 1966).

Southern Hemisphere

The IWC recognizes six sei whale stock areas in the Southern Ocean (Fig. 9) (Donovan, 1991). In general, Antarctic austral summer distribution based on historic catch data is from lat. 40° to 50°S, while austral winter distribution is unknown (Mizroch et al., 1984c; Anonymous, 1994b). There is no conclusive evidence of potential wintering areas for any of these stocks, although Discovery tag³⁸ data from captured whales showed links between some regions (IWC, 1977). For instance, links were found between the Brazilian coast with the western half of Area II, the Natal Coast of South Africa with the eastern half of Area III and with the

western half of Area IV, and western and southeastern Australia with Area IV.

Current and Historical Abundance

North Pacific

The most current (1977) population estimate for the North Pacific Ocean is 9,110 (no CV) based on the history of catches and trends in CPUE²² (Tillman, 1977; Braham³). There are no estimates of abundance for this ocean based on aerial or ship sighting surveys. In California waters, there were only one confirmed and five possible sei whale sightings from 1991, 1992, and 1993 aerial and ship surveys (Hill and Barlow, 1992; Carretta and Forney, 1993; Mangels and Gerrodette, 1994). There were no confirmed sightings off Washington and Oregon during recent aerial surveys (Green et al.⁷⁵).

Prior to commercial whaling in the North Pacific (late 1800's to early 1900's), there were an estimated 42,000 sei whales (Tillman, 1977). By the end of the period of exploitation (1974), their numbers had been reduced to between 7,260 and 12,620 (no CV) (Tillman, 1977).

North Atlantic

The most current (1991) population estimate for the entire North Atlantic Ocean based on the history of catches and trends in CPUE²² is 4,000 (no CV) (Braham³). This low-precision estimate is not considered a true index of abundance (Blaylock et al., 1995). The most recent estimates for the Iceland/Denmark Strait stock are 1,290 (CV = 0.603) whales from ship-based surveys in 1987 and 1,590 (no CV) whales from ship-based surveys in 1989 (Cattanach et al., 1993). Based on data from Discovery tag³⁸ studies, Mitchell and Chapman (1977) provided a population estimate for the Nova Scotia stock of between 1,393 and 2,248 whales, with a minimum estimate of 870 for this stock. Estimates in U.S. waters (Nova Scotia stock), derived from the Cetacean and Turtle Assessment Program (CeTAP) data⁷⁰ in 1982, are not considered statistically reliable because of low survey effort and inaccuracy in accounting for sub-merged animals (Blaylock et al., 1995).

No sei whales were sighted during a more recent (August through October 1991) aerial survey conducted during the CeTAP study.

There is no information on the initial abundance of sei whales in the North Atlantic prior to commercial whaling. But, in 1966, there were an estimated 1,856 whales in the Nova Scotia stock and 828 whales in the Labrador Sea (Mitchell, 1974a).

Southern Hemisphere

Based on the history of catches and trends in CPUE²², current sei whale abundance estimates range from 9,800 to 12,000 whales in the Southern Oceans (IWC, 1980b; Mizroch et al., 1984c; Braham³). The IWC reported an estimate of 9,718 whales (no CV) based on results of the 1978 through 1988 JSV and IWC/IDCR survey data (IWC, 1996a).

Braham³ estimated that 65,000 sei whales occurred in the Southern Hemisphere prior to commercial whaling. Similarly, the IWC used catch data from the 1930's to estimate that 63,100 sei whales occurred prior to commercial whaling in the Southern Oceans (IWC, 1980b; Mizroch et al., 1984c).

Historic Exploitation Patterns

In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of some previously unobtainable large whale species. The North Pacific and Antarctic whaling operations soon added this modern equipment to their arsenal. After blue and fin whales were depleted in most areas, sei whales became the focus of operations. In the 1950's through 1970's, these whales were severely depleted by commercial whaling operations (Fig. 33).

North Pacific

From 1910 to 1975, approximately 74,215 sei whales were caught throughout the North Pacific Ocean (Horwood, 1987). From the beginning of the 20th century, Japanese whaling operations consisted of a large proportion of sei whales. In local waters off Japan, 300–600 sei whales were caught per year

from 1911 to 1955. The Japanese sei whale catch peaked in 1959, when 1,340 whales were caught. In 1971, after a decade of high sei whale catch numbers, this species became scarce in Japanese waters. After 1975, sei whales became protected in the western North Pacific under IWC authority (Mizroch et al., 1984c).

Off the west coast of North America, sei whales were commercially hunted by Canadians in British Columbia from the late 1950's until the mid 1960's, when the number of whales captured dropped to around 14 individuals per year. Along the U.S. coast, shore-based whaling operations existed in California (Cherfas, 1989). After 1971, hunting of sei whales ceased in the eastern North Pacific.

North Atlantic

From 1885 through 1984, approximately 14,295 sei whales were taken in the North Atlantic Ocean (Horwood, 1987). These whales were first hunted off Norway during the late 1800's, where they became the target species in late summer, after the blue and fin whales had already migrated out of high latitude North Atlantic waters. And, as the stocks of blue and fin whales became scarce, sei whale catches gained importance in this region (Mizroch et al., 1984c). Sei whales were originally hunted only off Norway and Iceland, but from 1967 through 1972, sei whales were also taken off Nova Scotia (Mitchell, 1975b).

Southern Hemisphere

A total of 152,233 sei whales were caught in the Southern Hemisphere from 1910 through 1979 (Horwood, 1987). Whaling in the Southern Oceans originally targeted humpback whales. By 1913, this target species had become rare and the catch of fin and blue whales began to increase. As these species likewise became scarce, sei whale catches increased rapidly in the late 1950's and early 1960's (Mizroch et al., 1984c). The catch peaked in 1964 at over 20,000 sei whales, but by 1976 this number dropped to below 2,000 and the species received IWC protection in 1977.

Recently revealed Soviet whaling catch data from the years 1947 through 1980 showed that over 17,000 more sei

whales were caught (total = 50,034) than were previously reported (33,001) to the IWC (Zemsky et al., 1995). One reason for this discrepancy may have been the misidentification of sei whales as fin whales in the original reporting.

Current Exploitation

From 1988 to 1995, there have been 12 reported takes of sei whales from the North Atlantic (Table 10). All of these takes were off Iceland and West Greenland. However, the IWC set a catch limit of zero for all stocks of sei whales beginning in 1985 (IWC, 1995b).

Life History and Ecology

Feeding

Sei whales spend the summer feeding in the relatively high latitudes of both hemispheres, particularly along the cold eastern currents of the North Pacific and North Atlantic Oceans and in

the Antarctic waters of the Southern Hemisphere. They range farther offshore than fin whales in search of prey concentrations.

Sei whales are less prey-selective than fin whales. Sei whales consume primarily copepods, but they also prey on euphausiids and small schooling fishes when these species are locally abundant (Table 15) (Mizroch et al., 1984c). This species seems to have the greatest flexibility relative to other balaenopterids in their feeding strategies, using both “engulfing” and “skimming” to capture prey (Nemoto, 1959).

In the Southern Hemisphere, there is some evidence that sei whales may minimize direct interspecific competition with the blue, fin, and minke whales by foraging in warmer waters than do the latter species, by consuming a relatively wider variety of prey, and by arriving later on the feeding grounds than other baleen whales (Kawamura, 1978,

1980, 1994; IWC, 1992a). However, Murphy et al. (1988) and Fraser et al. (1992) suggested that competition among whales and other krill predators in the Antarctic is relatively low (Clapham and Brownell, 1996).

Reproduction

Sei whales reach sexual maturity between 5 and 15 years of age. Similar to the fin whale, conception occurs during a 5-month period in the winter of either hemisphere. After a gestation period of around 12 months, a calf measuring about 4.4 m is born. Between 6 and 9 months after birth, the immature whale is weaned at a length of 9 m. The calving interval for sei whales ranges from 2 to 3 years (Rice, 1977a; Lockyer and Martin, 1983; Mizroch et al., 1984c).

Natural Mortality

Information on natural mortality in sei whales is scant. The estimated an-



Figure 33.—A raft of harvested sei whales. NMML Collection.

nual natural mortality rate is around 7.5% (Allen, 1980). This mortality rate is relatively higher for fin and blue whales and may be even greater among immature sei whales. Endoparasitic helminths are commonly found in sei whales, and these infestations can result in pathogenic effects, especially when found in the liver and kidneys (Rice, 1977a). Mizroch et al. (1984c) mentioned an unknown disease affecting approximately 7% of the California sei whale population, which results in loss of baleen plates and could hinder feeding.

Sei whale predation by killer whales has not been reported. However, it is likely, given observations of killer whale attacks on fin, blue, and sperm whales, that killer whale attacks result in mortality or serious injury to immature or weakened individuals. If such attacks occur, they likely go undetected by humans. Although they have not been reported, shark attacks may also result in mortality or serious injury to vulnerable sei whales (e.g. the very young or old and the ill or injured).

Human-related Mortality

Fisheries Interactions

There have been no reports of sei whale mortality caused by fishing activities in any eastern North Pacific fishery. However, Barlow et al. (1997) noted that a conflict may exist in the offshore drift gillnet fishery. Potential injury or mortality in this fishery may go undetected because entangled sei whales may swim away carrying gear.

In U.S. waters of the North Atlantic, fisheries-related mortality or serious injury was not reported in commercial fishing activities from 1989 to 1995 (Blaylock et al., 1995; Barlow et al., 1997). Total mortality and serious injury from fisheries-related incidents is considered biologically insignificant, but a comprehensive review of all fisheries has not been done.

Vessel Collisions

It is possible that ship strikes affect all stocks of sei whales but, due to their pelagic nature, go unreported because

the injured or killed animals do not strand. One death was documented in 1994, when a container ship arrived in Boston harbor with a sei whale carcass on its bow. The crew estimated that the whale had been struck approximately 4 days before the ship pulled into port (Waring et al., 1998).

Noise Disturbance

Although little is known of sei whale acoustic behavior, hearing thresholds, and tolerance of noise, they appear to respond to approaching vessel traffic in relatively the same manner as blue and fin whales. Responses to boats appear to depend on the behavior of the animals at the time of approach and the speed and direction of the approaching vessel. In general, however, sei whales exhibit more avoidance behavior than do fin whales when being approached by a vessel (Gunther, 1949).

Classification Status

The sei whale was listed as endangered under the ESA in 1973 and is protected under the MMPA. Endangered status is applied to all sei whale stocks in U.S. waters (Anonymous, 1994b). Internationally, an IWC "Protected Stock" classification has been assigned to the North Pacific, Nova Scotia, and Southern Hemisphere stocks by the Commission. Under this designation, the IWC recognizes that these stocks are 10% or more below their maximum sustainable yield (MSY) levels, and therefore commercial whaling is prohibited (IWC, 1995b). Two of the North Atlantic stocks, Iceland/Denmark Strait and Eastern North Atlantic, have no formal IWC classification; however, their catch limits will remain at zero until the Commission receives a comprehensive assessment of these stocks and until the

Table 15.—Sei whale prey items (Mizroch et al., 1984c).

Region	Prey type	Species
Northern Hemisphere	Fish	<i>Engraulis</i> spp. (anchovies) <i>Cololabis</i> spp. (sauries) <i>Trachurus</i> spp. (jack mackerel)
North Pacific	Copepod	<i>Calanus cristatus</i> <i>C. plumchrus</i> <i>C. pacificus</i>
	Euphausiid	<i>Euphausia pacifica</i> <i>Thysanoessa inermis</i> <i>T. longipes</i> <i>T. spinifera</i>
North Atlantic	Copepod	<i>Calanus finmarchicus</i>
	Euphausiid	<i>Meganyctiphanes norvegica</i> <i>Thysanoessa inermis</i>
Antarctic	Copepod	<i>Calanus tonsus</i> <i>C. similimus</i> <i>Drepanopus pectinatus</i>
	Euphausiid	<i>Euphausia superba</i> (Antarctic krill) <i>E. vallentini</i>

Table 16.—Factors possibly influencing the recovery of North Atlantic sei whale stocks under the ESA (1973) §4(a)(1), 1992 Amend. (Southern Hemisphere data is not available).

Factor	North Atlantic	North Pacific
1. Present or threatened destruction or modification of habitat	Unknown	Unknown
2. Overutilization for commercial, subsistence, recreational, scientific, or educational purposes	Icelandic harvest; whale watching, scientific research, photography, and associated vessel traffic	Whale watching, scientific research, photography, and associated vessel traffic
3. Disease or predation	Parasitic helminth infestations	Unknown
4. Other natural or man-made factors	Vessel collisions	Vessel collisions

current moratorium on commercial whaling is ended.

Since Braham's 1991 status review³, there has been little advance in the accuracy and availability of population estimates or stock identity. The factors possibly influencing the status and recovery of sei whales are summarized in Table 16. At this time, any reevaluation

of sei whale status awaits the collection of more reliable information on stock structure, distribution and migration patterns, trends in abundance, causes of mortality, and factors influencing the recovery of sei whale stocks, as well as the development of objective delisting criteria. A joint Recovery Plan has been developed for both sei and fin whales

(Anonymous⁷). This plan attempts to outline steps towards recovery of the sei whale through focused research priorities designed to increase our understanding of sei whale biology, identify current threats to their survival, alleviate the possibility of future threats, and encourage international cooperation.