Sei Whale
(Balaenoptera borealis)

5-Year Review:
Summary and Evaluation

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National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD

June 2012

5-YEAR REVIEW
Sei Whale *(Balaenoptera borealis)*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office:
Amanda Keledjian, Office of Protected Resources, 301-427-8402
Larissa Plants, Office of Protected Resources, 301-427-8403
Shannon Bettridge, Office of Protected Resources, 301-427-8402

1.2 Methodology used to complete the review:

The first draft of this review was completed by Amanda Keledjian and relied heavily on the final recovery plan for the sei whale. After the first draft was completed, it was reviewed by others in the Office of Protected Resources and the National Marine Fisheries Service Regional Offices.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

77 FR 5491, February 3, 2012

1.3.2 Listing history

<u>Original Listing</u>
FR notice: None ("grandfathered" in from precursor to ESA)
Date listed: 1973
Entity listed: Sei Whale *(Balaenoptera borealis)*
Classification: Endangered

1.3.3 Associated rulemakings: N/A

1.3.4 Review History:

Previous review:

S.L. Perry, D.P. DeMaster, and G.K. Silber. 1999. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. Marine Fisheries Review 61:1, pp.44-51. Department of Commerce.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 9, which indicates that threats are low, recovery potential is high, and there is the potential for conflict.

1.3.6 Recovery Plan or Outline

Name of plan or outline: Final Recovery Plan for the Sei Whale (*Balaenoptera borealis*)
Date issued: Final plan issued December 2011
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__X_ *Yes, go to section 2.1.2.*
_____ *No, go to section 2.2.*

2.1.2 Is the species under review listed as a DPS?

____ *Yes, go to section 2.1.3.*
__X_ *No, go to section 2.1.4*

2.1.3 Was the DPS listed prior to 1996?

____ *Yes, give date and go to section 2.1.3.1.*
____ *No, go to section 2.1.4.*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____ *Yes, provide citation and go to section 2.1.4.*
____ *No, go to section 2.1.3.2.*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____ *Yes, discuss how it meets the DPS policy, and go to section 2.1.4.*
____ *No, discuss how it is not consistent with the DPS policy and consider the 5-year review completed. Go to section 2.4., Synthesis.*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

__ *Yes*

_X_ *No, go to section 2.2., Recovery Criteria.*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan[1] containing objective, measurable criteria?

__X__ *Yes, continue to section 2.2.2.*
____ *No*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

__X_ *Yes, go to section 2.2.2.2.*
____ *No*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

__X_ *Yes, go to section 2.2.3.*
____ *No*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

If you answered *yes* to both 2.2.2.1. and 2.2.2.2., evaluating whether recovery and/or downlisting criteria have been met in section 2.2.3, may be sufficient to evaluate the species listing classification and no further analysis may be necessary; *go to section 2.4., Synthesis.*

If you answered *no* to either 2.2.2.1 or 2.2.2.2, *continue to section 2.3.*

[1] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion.

Downlisting Criteria from the Final Sei Whale Recovery Plan:

1. **Given current and projected threats and environmental conditions, the sei whale population in each ocean basin in which it occurs (North Atlantic, North Pacific and Southern Hemisphere) satisfies the risk analysis standard for threatened status (has no more than a 1 percent chance of extinction in 100 years) *and* the global population has at least 1,500 mature, reproductive individuals (consisting of at least 250 mature females and at least 250 mature males in each ocean basin). Mature is defined as the number of individuals known, estimated, or inferred to be capable of reproduction. Any factors or circumstances that are thought to substantially contribute to a real risk of extinction that cannot be incorporated into a Population Viability Analysis (PVA) will be carefully considered before downlisting takes place.**

It is not known whether this criterion has been met. While NMFS acknowledges that MMPA stock structure does not align with the ESA listed entity for sei whales, MMPA stock assessment reports contain the best available demographic information for sei whales in U.S. waters. The final 2011 stock assessment reports provide the following minimum population estimates for sei whales in U.S. waters: Nova Scotia stock: 386; Hawaii stock: 37; and Eastern North Pacific stock: 83. While there is currently no accepted recent abundance estimate for sei whales in the Southern Ocean, the best available information indicates that there were approximately 9,700 sei whales estimated from surveys conducted throughout the 1980s (International Whaling Commission 1996). While it is likely that the minimum population threshold has been met in the North Atlantic Ocean and Southern Hemisphere, the best available science indicates that it has not been met in the North Pacific Ocean. Furthermore, PVAs have not yet been conducted for these populations. More detailed abundance information by ocean basin follows.

<u>North Atlantic</u>

No estimates of pre-exploitation population size are available and the total number of sei whales in the North Atlantic Ocean is not known (Waring *et al.* 2009). Based on tag-recapture and shipboard strip survey data, Mitchell and Chapman (1977) estimated that during the late 1960s, there were approximately 1,400–2,200 whales between the putative Nova Scotia (minimum 870) and Labrador Sea (minimum 965) stocks. During the late 1970s and early 1980s, a very imprecise springtime estimate of approximately 250 sei whales was made for continental shelf and shelf-edge waters between North Carolina and Nova Scotia and presumed to belong to the putative Nova Scotia stock (Cetacean and Turtle Assessment Program 1982). A shipboard sighting survey in 1989 produced an estimate of about 10,300 sei whales (CV 0.27) in Icelandic and Faroese waters (Cattanach *et al.* 1993).

There are insufficient data to determine current population trends for this species in the North Atlantic (Waring *et al.* 2009). However, five recent abundance estimates are available for portions of sei whale habitat in the North Atlantic Ocean: in Nova Scotian waters during the 1970s, U.S. Atlantic waters 1979–1981, and in the U.S. and Canadian Atlantic in 2002, 2004, and 2006 (Waring *et al.* 2009). In 2002, an abundance estimate (n=71, CV=1.01) was obtained from an aerial survey covering 7,465 km of waters more than 1000 m deep from the southern edge of Georges Bank to Maine (Palka 2006). The 2004 abundance estimate (n=386, CV=0.85) is considered the best available for the Nova Scotia sei whale stock (Palka 2006). However, this estimate must be considered low and limited given the known range of sei whales in the entire western North Atlantic and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. In 2006, an abundance estimate (n=207, CV=0.62) was obtained from an aerial survey conducted in the summer covering 10,676 km of trackline from the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Waring *et al.* 2009). Additionally, based on vessel-based surveys, MacLeod *et al.* (2005) reported that an estimated 1,011 sei whales (CI=497–2058) occur in waters off Scotland.

North Pacific

In terms of pre-exploitation estimates, the application of various models to whaling catch and effort data suggests that the total population of adult sei whales in the North Pacific declined from about 42,000 to 8,600 individuals between 1963 and 1974 (Tillman 1977). Because 500 to 600 sei whales were killed off Japan per year from 1910 to the late 1950s, the stock size by 1963 was presumably already below its carrying capacity (Tillman 1977). The catch per unit effort for sei whales in California declined by 75 percent between 1960 and 1970 (Rice 1977), which is consistent with the assumption that the overall population was substantially reduced.

More recently, ship surveys of coastal waters off California and Baja California in 1979/1980 and 1991 yielded no meaningful estimates of sei whale abundance, in part because of the failure to consistently distinguish sei from Bryde's whales (Barlow 1994). Even if it were assumed, however, that all whales logged as "unidentified sei or Bryde's whale" were sei whales, the estimated abundance from these surveys would be very low (several tens to several hundreds). Comparably small abundance numbers were obtained from summer and fall surveys conducted in 1991–2008 within 550 km (300 nautical miles (nmi)) of the coasts of California, Oregon, and Washington (Barlow *et al.* 1997). Based on genetic studies, Wada and Numachi (1991) concluded that sei whales in the North Pacific likely belong to a single population despite caveats due to small sampling size and area (632 sei whales collected in 1974 and 1975 east of 160°E).

Southern Hemisphere

In the Southern Hemisphere, the IWC has divided the Southern Ocean into six baleen whale feeding areas. Although some degree of separation among IWC Areas I–VI has been noted and sei whales have been observed to make dynamic movements between stock designation areas (Donovan 1991), there is little information on the population structure in these management areas within Antarctic waters.

Braham (1991) provided a pre-exploitation estimate of 65,000 individuals (no CV) in the Southern Hemisphere sei whale population. This estimate is supported by findings from Mizroch *et al.* (1984), who estimated a total of 63,100 sei whales (no CV) occurring in these waters prior to exploitation. In the Southern Hemisphere, more recent population estimates range between 9,800 and 12,000 sei whales (no CV) (Mizroch *et al.* 1984; Perry *et al.* 1999).

Similarly, the IWC reported an estimate of 9,718 sei whales (no CV) based on survey results from 1978 to 1988 (International Whaling Commission 1996).

and

2. Factors that may limit population growth, *i.e.*, those that are identified in the threats analysis in the recovery plan as high, medium, or unknown under relative impact to recovery, have been identified and are being or have been addressed to the extent that they allow for continued growth of populations. Specifically, the factors in 4(a)(l) of the ESA are being or have been addressed as follows:

Factor A: The present or threatened destruction, modification, or curtailment of a species' habitat or range.

- *Effects of reduced prey abundance due to climate change continue to be investigated and action is being taken to address the issue, as necessary.* (Threat discussed in Recovery Plan section G.11)

This criterion has not been met.

The threat severity posed by environmental variability to sei whale recovery was ranked as medium in the recovery plan due to the oceanographic and atmospheric conditions that have changed over the last several decades. Uncertainty was ranked as high, due to the unknown potential impacts of climate and ecosystem change on sei whale recovery and regime shifts on prey species. Thus, the relative impact to recovery was ranked as unknown but potentially high. For an in-depth discussion of the status, distribution, and location of prey species, see the Sei Whale Recovery Plan.

Climate change has received considerable attention in recent years, with growing concerns about global warming and the recognition of natural climatic oscillations on varying time scales, such as long-term shifts in the Pacific Decadal Oscillation or short-term shifts in the El Niño Southern Oscillation. Changes to climate and oceanographic processes will likely lead to different patterns of prey distribution and availability. Evidence suggests that the amount and timing of phytoplankton growth in the North Pacific (Mackas *et al.* 1989; Quinn and Niebauer 1995) and other oceans could be affected by oceanographic changes due to changing currents, wind patterns, and other climatic processes. Such changes could affect sei whales that are dependent on those affected prey. Recent work has found that copepod distribution has shown signs of shifting in the North Atlantic due to climatic changes (Hays *et al.* 2005). While there are no equivalent studies to date in the North Pacific Ocean or Southern Hemisphere, it is conceivable that such shifting of prey distribution could occur in those areas as well.

Increases in global temperatures are expected to have profound impacts on arctic and sub-arctic ecosystems, notably the extent of sea ice coverage that largely determines the timing and abundance of phytoplankton blooms. Also, it is also possible that copepod growth may be stunted if the oceans continue becoming more acidic. Though the extent and uniformity of these impacts remains unknown, these changes are projected to accelerate during this century (Arctic Climate Impact Assessment 2004; Anisimov *et al*. 2007).

The potential overall impacts of climate and oceanographic change on sei whales mainly pertain to habitat and food availability. Sei whale migration, feeding, and breeding locations may be influenced by ocean currents or water temperature, and any changes in these oceanographic features could change the distribution and location of preferred habitat areas. It is unknown whether more or less suitable habitat would exist as a result of climate change. Sei whales have a large feeding range and consequently, it is likely that they may be more resilient to climate change, should it affect preferred copepod prey, than a species with a narrower range.

- *Effects of anthropogenic noise continue to be investigated and actions taken to minimize potential effects, as necessary.* (Threat discussed in Recovery Plan section G.2)

This criterion has not been met.

The relative impact of anthropogenic noise to the recovery of sei whales is ranked in the recovery plan as unknown due to an unknown severity and a high level of uncertainty. As human activities increase in the ocean, so does the potential for noise. The effects of anthropogenic noise are difficult to ascertain and research on this topic is ongoing. For a discussion of discrete and ambient anthropogenic noise and its potential to cause hearing impairment, behavioral changes, or cause auditory interference, see the Final Recovery Plan for the Sei Whale (section G.2).

<u>Ship Noise</u>

The severity of the threat of ship noise remains unknown with a high degree of uncertainty due to the potential for increased vessel noise in the future and the gaps in knowledge on their impacts on sei whale physiology and behavior. Therefore, the impact of ship noise on sei whale recovery remains unknown.

Sound emitted from large vessels is the principal source of noise in the ocean today, primarily due to the properties of sound from cargo vessels. Ship propulsion and electricity generation from engines, compressors, and pumps essential for ship operations all contribute to noise emissions into the marine environment. Prop-driven vessels also generate noise through cavitations, which account for approximately 85 percent or more of the noise emitted by large shipping vessels, which tend to generate sounds that are louder and at lower frequencies compared with smaller vessels (Richardson *et al.* 1995; National Research Council 2005).

The uncertainty surrounding the impacts of anthropogenic noise on large whales becomes more problematic when considering the anticipated rise in ocean noise in the coming years. Ross (1976) estimated that between 1950 and 1975, shipping caused a rise in ambient noise levels of 10 decibels (dB) worldwide (on a logarithmic scale, a 6 dB increase is equivalent to a doubling in noise level). He predicted that this would increase by another 5 dB by the beginning of the 21st century. Scientists estimate that the background ocean noise level at 100 Hz has been increasing by about 1.5 – 3 dB per decade since the advent of propeller-driven ships (Andrew *et al.* 2002; McDonald *et al.* 2006; McDonald *et al.* 2008).

The possible impacts of the various sources of anthropogenic noise on sei whales have not been well studied and remain unknown. Recent controlled exposure experiments are being conducted to evaluate the effect of mid-frequency sound on a variety of marine mammals, including large whale species (Southall et al. 2011). Additionally, Clark *et al.* (2009) found that mysticetes showed diminished call rates in the presence of passing vessels, with humpback whales exhibiting behavioral changes in the presence of noise approximately 200 km away (Risch et al. 2012). If sei whale density in a given area is low, any diminished calling might make it more difficult to locate potential mating partners. Means of quieting large vessels are currently being investigated to develop future ways of mitigating the negative impacts of shipping noise in the marine environment. Should anthropogenic noise, in fact, be a threat to the recovery of sei whales, reducing the severity of the threat would promote sei whale recovery.

Oil and Gas Activities

A number of activities associated with oil and gas exploration and development result in the introduction of sound into the underwater environment. The relative impact to sei whale recovery due to oil and gas activities remains unknown because the severity of this threat is unknown and the uncertainty is high.

Oil and gas activities involve a variety of devices and technologies that introduce energy into the water for purposes of geophysical research, bottom profiling, and depth determination. Loud sound sources from seismic surveys to locate undersea oil reserves may adversely affect marine mammals. Baleen whales are known to detect the low-frequency sound pulses emitted during seismic surveys through the use of airguns and have been observed to change behavior near these vessels (McCauley *et al*. 2000; Stone 2003). Despite the potential impacts, there have been no reported seismic-related or industry ship-related mortalities or injuries to sei whales or other large whale species in areas when marine mammal observers monitor oil and gas exploration and development operations.

Drilling for oil and gas generally produces low-frequency sounds with strong tonal components in frequency ranges in which large baleen whales communicate. There are few data on the noise from conventional drilling platforms, but recorded noise from an early study of one drilling platform and three combined drilling production platforms found that noise was so weak it was almost undetectable alongside the platform at Beaufort scale sea states of three or above. The strongest tones were at low frequencies, near 5 Hz (Richardson *et al*. 1995).

In addition to the low-frequency pulses emitted during exploration-related activities, underwater noise is also introduced by low-flying aircrafts engaged in a variety of surveillance and survey activity. The impacts of aircraft sound on cetaceans or other marine mammals while they are in the water is influenced by the animal's depth, the aircraft's altitude, aspect, and strength of the noise coming from the aircraft. Generally, sound levels received underwater and risks to disturbing sei whale behavior are greatest when aircrafts fly lower (Richardson *et al*. 1995). However, sound is dispersed through the air and is likely so transient that the effect on individual whales over their life span would be undetectably small. Short-term effects would likely be limited to areas such as the vicinity of airports with final approaches over marine waters when whales are present.

Military Sonar and Explosives

The relatively large spatial scale, frequency, duration, and diverse nature of military training activities in areas where sei whales occur suggest that these activities have the potential to adversely affect sei whales. The severity of the effect of military sonar and detonations on sei whales remains largely unknown with a high degree of uncertainty. Therefore, the relative impact to sei whale recovery due to this threat is ranked as unknown in the recovery plan.

No evidence is available to assess whether military activities in the North Atlantic or North Pacific Oceans have had an impact on sei whale populations. However, the large scale and diverse nature of military activities throughout these ocean basins creates potential situations where disturbance, injury, or mortalities could occur. Military training activities by the U.S. Navy regularly occur in the Atlantic (including the Gulf of Mexico and Mediterranean Sea), Indian, and Pacific Oceans. These activities include anti-submarine warfare, surface warfare, anti-surface, mine warfare exercises, missile exercises, sinking exercises, and aerial combat exercises. In addition to these training activities, the U.S. Navy conducts ship shock trials, which involve detonations of high explosive charges.

As part of its suite of training activities, the U.S. Navy employs low-, mid-, and high-frequency active sonar systems. The Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar system, which produces loud signals in the 100–500 Hz frequency range, has typically operated in the western and central Pacific Ocean. The U.S. Navy employs several mid-frequency sonar systems that range from large systems mounted on the hulls of ships (*e.g.*, sonar devices referred to as AN/SQS-53 and -56) to smaller systems that are deployed from helicopters and fixed-wing aircraft, sonobuoys, and torpedoes. These sonar systems can produce loud sounds at frequencies between 1 and 10 kHz and higher (Evans and England 2001; U.S. Department of the Navy 2008).

The effect of active sonar on sei whales has not been studied and remains uncertain; however, active sonar associated with naval training activities might adversely affect sei whales in several ways. First, low-frequency sonar transmissions that overlap with the frequency ranges of sei whale vocalizations might mask communication between whales which could affect the social ecology and social interactions of sei whale groups. Second, overlap between sei whale hearing and low- and mid-frequency sonar might result in noise-induced losses of hearing sensitivity or behavioral disturbance as sei whales avoid or evade sonar transmissions. Studies on the effects of SURTASS LFA sonar on foraging blue and fin whales in California, migrating gray whales off California, and singing humpback whales in Hawaii did not detect biologically significant responses (*e.g.,* detected effects were primarily short-term, with variance between individuals and with context) (U.S. Department of the Navy 2007).

Underwater detonations associated with military training activities range from large explosives such as those associated with sinking exercises or ship shock trials, to missile exercises, gunnery exercises, mine warfare, disposal of unexploded ordnance, and grenades. Whales that occur close to a large detonation might be killed or seriously injured; more distant whales might suffer

lesser injury (*i.e.,* tympanic membrane rupture, or slight to extensive lung injury); and whales that are still farther away might experience physiological stress responses or behavioral disturbance whose severity depends on their distance from the detonation.
Various measures have been developed to prevent sei whales from being exposed to active sonar transmissions or underwater detonations during testing or exercises, although these measures would not necessarily be employed during combat use. For example, the SURTASS LFA sonar system employs a high-frequency active sonar that allows the U.S. Navy to detect large and most small cetaceans. If marine mammals are detected, the U.S. Navy is required to shut down sonar transmissions until whales have moved away from the sonar source. As another example, the suite of monitoring protocols the U.S. Navy developed during the ship shock trial on the U.S.S. Winston Churchill were effective at preventing sei whales, other cetaceans, and sea turtles from being exposed to the shock wave associated with those detonations (Clarke and Norman 2005). Other measures are being developed and tested to reduce the probability of exposing sei whales and other cetaceans to active sonar transmissions and shock waves of underwater detonations.

Factor B: Overutilization for commercial, recreational, or educational purposes.

- *Management measures are in place that ensure that any direct harvest (commercial, subsistence, and scientific) is at a sustainable level.* (Threat discussed in Recovery Plan section G.9)

This criterion has been partly met as long as the U.S. remains a party to the IWC (*i.e.*, management measures are in place). Although historical whaling activities were responsible for the depletion of sei and other large whale species worldwide, they are now hunted only by Japan in relatively small numbers, and therefore, the current overall threat of overutilization by directed hunts is low. However, if the IWC's moratorium on commercial whaling were ended, hunting could again become a threat to sei whales. Based on this information, this threat is considered to have a medium level of severity and a medium level of uncertainty. Thus, the relative impact to sei whale recovery is ranked as medium in the recovery plan.

The IWC's moratorium on the commercial hunting of whales has been in force for almost three decades, and it has almost certainly had a positive effect on the species' recovery. There is currently no commercial whaling for sei whales by IWC member nations party to the moratorium. Iceland has consistently expressed a strong interest in resuming its whaling industry targeting fin, sei, and minke whales (Sigurjónsson 1989). Iceland and Norway do not adhere to the IWC's moratorium on commercial whaling because both countries filed objections or reservations to that moratorium[2].

In the North Atlantic, sei whales were hunted in large numbers in waters off Norway and Scotland from the very beginning of modern whaling (Thompson 1919; Brown 1976; Jonsgård and Darling 1977). In a single year (1885), more than 700 sei whales were killed off Norway (Andrews 1916). Small numbers of sei whales were also taken off Spain and Portugal beginning

[2] In 1982, the IWC adopted a moratorium on the commercial whaling of all whale species, effective from 1986. Norway objected to the moratorium, but nevertheless introduced a temporary ban on minke whaling pending more reliable information on the state of the stocks. The Norwegian government unilaterally decided to resume whaling in 1993. Norway's legal right to hunt minke whales is not disputed, as Norway objected to the moratorium when it was adopted by the IWC. Iceland conducts commercial whaling under a reservation to the moratorium.

in the 1920s (at least sometimes misidentified as fin whales in the catch statistics; Aguilar and Lens 1981; Aguilar and Sanpera 1982; Sanpera and Aguilar 1992) and by Norwegian and Danish whalers off West Greenland from the 1920s to 1950s (Kapel 1985). In Iceland, a total of 2,574 sei whales were taken between 1948 and 1985 (Sigurjónsson 1988). A total of 825 sei whales were taken on the Scotian Shelf between 1966 and 1972, but no commercial whaling of sei whales is known to have occurred in the western and central North Atlantic since 1972 and 1986, respectively. Well-documented pirate whaling in the northeastern Atlantic occurred as recently as 1979 (Best 1992; Sanpera and Aguilar. 1992), and attempted illegal trade in baleen whale meat has been documented throughout the 1990s (Baker and Palumbi 1994). Since the mid-1970s, there has been some demand in world markets (most of it centered in Japan) for baleen whale meat (Aguilar and Sanpera 1982).

In the North Pacific, more than 2,000 sei whales were killed in British Columbian waters between 1962 and 1967 (Pike and Macaskie 1969) and smaller numbers were taken off the coast of California during the same period (Rice 1977). Heavy exploitation by pelagic whalers began in the early 1960s, with total catches throughout the North Pacific averaging 3,643 per year from 1963 to 1974 (total 43,719; annual range 1,280–6,053; Tillman 1977). The total reported kill of sei whales in the North Pacific by commercial whalers was 61,500 between 1947 and 1987 (Barlow *et al.* 1997). Between 1988 and 2009, Japan took 592 sei whales in the northwestern Pacific Ocean (International Whaling Commission 2010). In the Southern Hemisphere, a total of 152,233 sei whales were killed in commercial whaling activities between 1910 and 1975 (Horwood 1987), peaking at over 20,000 individuals in 1964 (Mizroch *et al.* 1984) and ceasing altogether in 1977 (Perry *et al.* 1999).

In terms of recreational and educational uses, sei whales have recently been sighted and viewed more commonly by whale watching vessels in the northeast U.S., though impacts of these activities on the whales is unknown.

Factor C: Disease or Predation.

- *There are no criteria for this factor because there are no data to indicate that disease or predation are more than low threats.* (Threat discussed in Recovery Plan section G.5 and G.8)

Factor D: The inadequacy of existing regulatory mechanisms.

- *Hunting is addressed under Factor B.*

Factor E: Other natural or manmade factors affecting its continued existence.

- *Ship collisions continue to be investigated and actions taken to minimize potential effects as necessary*. (Threat discussed in Recovery Plan section G.3)

This criterion has not been fully met.

The possible impacts of ship strikes on the recovery of sei whale populations are not well understood. Ship collisions continue to be recorded when reported or observed, and necropsies on stranded whales are performed when possible to confirm cause of death. Federal agencies continue to consult with NMFS and take measures to reduce the likelihood of ship strikes. However, no new ship strike prevention regulations specific to sei whales have been implemented. Therefore, the threat of ship strikes is ranked as having a low severity and high degree of uncertainty in the recovery plan. Thus, the relative impact of ship strikes on sei whale recovery is unknown but potentially low.

In a database of nearly 300 vessel strike records worldwide between 1975 and 2002, Jensen and Silber (2004) reported two sei whale vessel strikes in the North Atlantic (one each off Massachusetts and Maryland); none in North Pacific waters; and one struck in 1994 in Hauraki Gulf, New Zealand. A total of three sei whale deaths were attributed to collisions with vessels between 2003 and 2008 in the waters off of the U.S. eastern seaboard (Nelson et al. 2007; Glass et al. 2009; Waring et al. 2009) and one was reported in the NMFS stock assessment reports for the North Pacific Ocean (off Washington) in 2003 (Carretta *et al.* 2010).

A global database of large whale ship strikes being administered by the IWC contains a single known sei whale ship strike, having occurred off Senegal in 1998 (R. Leaper, pers. comm.). Sei whale distribution and apparent preference for areas with less vessel traffic may account for a lower number of recorded ship strikes compared to other close taxonomic relatives. Because many ship strikes likely go unreported or undetected, the estimates of serious injury or mortality should be considered as minimum estimates.

- *Entanglement with gear associated with the offshore gillnet fishery continues to be investigated and actions taken to minimize potential effects as necessary*. (Threat discussed in Recovery Plan section G.1)

This criterion has not yet been met.

Because sei whales are more commonly located offshore and are relative scarce in Atlantic and Pacific coastal waters, sei whales likely have a relatively low incidence of entrapment and entanglement in fishing gear. Additionally, data on entanglement and entrapment in non-U.S. waters is largely anecdotal and not reported systematically because observer coverage is not 100 percent in all fisheries. Therefore, the threat of fishing gear entanglement occurs at a low severity level and with a medium level of uncertainty. Based on those classifications, the relative impact of this threat to sei whale recovery is ranked as unknown but potentially low.

Heyning and Lewis (1990) suggested that most whales killed by offshore fishing gear do not drift far enough to strand on beaches or be detected floating nearshore where most boat traffic occurs. Like other large whale species, sei whales may break through or carry away fishing gear. Whales carrying gear may die later, become debilitated or seriously injured, or have normal functions impaired, but with no evidence of the incident recorded. In the North Atlantic, one documented record of a sei whale death resulting from fishery interactions was noted by Waring *et al.* (2009) in 2006 (the gear type was not determined).

In the North Pacific, Carretta *et al.* (2010) indicated that the offshore drift gillnet fishery is the only fishery likely to take sei whales, based on the reasoning that other large whale species have been taken in this fishery in the past. However, there have been no sei whale deaths or serious injuries reported in the fishery. Heyning and Lewis (1990) made a crude estimate of about 73 rorquals killed per year in the southern California offshore drift gillnet fishery during the 1980s, some of which may have been sei whales. Baleen whales may also be taken in the drift gillnet fisheries targeting sharks and swordfish along the Pacific coast of Baja California, Mexico (Barlow *et al.* 1997). Observer coverage in the Pacific offshore fisheries has been too low for any confident assessment of species-specific entanglement rates (Barlow *et al.* 1997).

2.3 Updated Information and Current Species Status

Covered in Section 2.1.

2.4 Synthesis

Recovery criteria outlined in the sei whale recovery plan (NMFS 2011) are current and meet the ESA standards of objective and measurable recovery criteria by including both “biological” criteria on abundance, trends, or risk analysis, and “threats-based” criteria that address the five factors outlined in section 4 of the ESA. However, whether these criteria have been met is unknown because of data deficiencies.

With regard to the biological criteria, no reliable trend information is available for any of the three ocean basins (Criterion 1), and a risk analysis has not been conducted (Criterion 1) because sufficient information to conduct a robust analysis is not available at this time. With regard to the threats-based criteria, the magnitude and impact of the threat is uncertain (e.g., ship strikes, anthropogenic noise, fisheries entanglements, and loss of prey base due to climate change), thus making the degree of threat unknown. This problem is exacerbated by the lack of information on the status and trends of the species, which, if known to be increasing steadily, would assist in determining whether these factors are limiting the recovery of the species. Finally, while actions have been taken to address some of the factors that may be limiting recovery of other baleen whales as required by the threats-based criteria (*e.g.*, ship strike rule, fishing gear entanglement risk reduction measures), additional measures may be necessary to fully mitigate these threats.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X_ No change is needed

3.2 New Recovery Priority Number: 9

Brief Rationale: Based on an assessment of the threats contained in the recovery plan, the overall threats are low and the potential for recovery is high, but there is still the potential for conflict due to fisheries entanglement, anthropogenic noise, ship strikes, and climate change.

3.3 Listing and Reclassification Priority Number, if reclassification is recommended *(see Appendix E)*

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (Removal from list regardless of current classification) Priority Number: ____

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The lack of ocean-wide status and trend information called for under Criterion 1 underscores the need for abundance surveys for sei whales (which could be combined with surveys for other large whale species). This is necessary to ascertain the status of sei whales and to gain an understanding of the effect of the whaling moratorium, which has now been in place for nearly three decades. While ocean-wide surveys are of the utmost importance, continuing surveys in U.S. waters could also enhance information on U.S. populations and their threats, and provide trend data on a subset of North Atlantic and North Pacific sei whales. These surveys should be conducted in such a way as to collect comparable data periodically to ensure that trend data are meaningful.

The degree to which several potential threats impact sei whale recovery is currently unknown and should continue to be researched. These include (1) anthropogenic noise from vessels, energy-related activities, and military training; (2) ship strikes; (3) fisheries entanglements; and (4) loss of prey resources due to the anticipated ecosystem-level impacts of climate change.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Sei whale

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X_No change is needed

Review Conducted By: Amanda Keledjian, Office of Protected Resources, Silver Spring, MD; Larissa Plants, Office of Protected Resources, Silver Spring, MD; Shannon Bettridge, Office of Protected Resources, Silver Spring, MD.

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries Service

Approve: ____ Date: ________

Cooperating Regional Administrator, NOAA Fisheries Service

_____Concur _____ Do Not Concur

Signature____ Date______

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

__✓__Concur _____ Do Not Concur

Signature____ Date 6/26/12