North Pacific Right Whale
(Eubalaena japonica)

Five-Year Review:
Summary and Evaluation

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

September 2012

5-YEAR REVIEW
North Pacific Right Whale (*Eubalaena japonica*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office: Office of Protected Resources – Shannon Bettridge, 301-427-8402
Cooperating Science Center: Alaska Fisheries Science Center, National Marine Mammal Lab - Phillip Clapham, 206-526-4037

1.2 Methodology used to complete the review

The first draft of this review was completed by Amanda Keledjian and relied on information in the North Atlantic Right Whale Recovery Plan and other recent publications. The draft document was reviewed by staff in the Office of Protected Resources, Alaska Fisheries Science Center, and Alaska Regional Office.

1.3 Background

Section 4(c)(2) of the Endangered Species Act (ESA) requires, at least every five years, a review of all threatened and endangered species to determine if they should be removed from the list of threatened or endangered species or changed in their listing status. For species for which no recovery plan has been written (e.g., the North Pacific right whale), a five-year review entails analyzing all available information on such species relative to the definitions of endangered and threatened and in the context of the factors listed in section 4(a)(1) of the ESA. The five-year review is also used to help track the recovery of a species.

The following information identifies previous documentation of recovery actions, listing decisions, and status updates required under the ESA, and thus provides the foundation for analysis and incorporation of any relevant new information related to the recovery, listing status, and classification of North Pacific right whales.

1.3.1 FR Notice announcing initiation of this review: 77 FR 16538; March 21, 2012

1.3.2 Listing history

Original Listing
FR notice: 35 FR 18319[1]
Date listed: December 2, 1970
Entity listed: Northern Right Whale (*Eubalaena spp.*)
Classification: Endangered

Revised Listing
FR notice: 73 FR 12024
Date listed: March 6, 2008
Entity listed: North Pacific Right Whale (*Eubalaena japonica*)
Classification: Endangered

1.3.3 Associated rulemakings

- Critical habitat was designated in the Pacific for the Northern right whale on July 6, 2006 (71 FR 38277)
- Critical habitat was designated for the North Pacific right whale on April 8, 2008 (73 FR 19000)

1.3.4 Review History

- Perry, S.L., DeMaster, D.P., 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. U.S. Department of Commerce.

- National Marine Fisheries Service. 2006. Review of the Status of the Right Whales in the North Atlantic and North Pacific Oceans. U.S. Department of Commerce NOAA Technical Memorandum. http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/rightwhale2006.pdf

1.3.5 Species' Recovery Priority Number at Start of Five-Year Review

This species has a recovery priority number of 7, indicating moderate degree of threat, low to moderate recovery potential, and known conflict with economic activities.

1.3.6 Recovery Plan or Outline

Name of plan or outline: Final Recovery Plan for the Northern Right Whale
Date issued: December 1991

[1] "Grandfathered" under the Endangered Species Conservation Act of 1969, the precursor to the ESA.

Dates of previous revisions, if applicable: The Final Recovery Plan for the North Atlantic Right Whale was revised in July 2001 and August 2004 and includes information on the North Pacific right whale.

The National Marine Fisheries Service (NMFS) recently initiated the development of a recovery plan for the North Pacific right whale and published a notice in the Federal Register (77 FR 22760; April 17, 2012).

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**, If the DPS listing remains valid, go to section 2.2, Recovery Criteria. If the new information indicates the DPS listing is no longer valid, consider the 5-year review completed, and go to section 2.4, Synthesis.

__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[2] containing objective, measurable criteria?

____ **Yes**, continue to section 2.2.2
__X_ **No**, but a final Recovery Plan for North Pacific right whales is currently being drafted and will likely be available in 2013 (see 77 FR 22760; April 17, 2012).

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?

____ **Yes**, go to section 2.2.2.2
____ **No**, go to section 2.2.3, and note why these criteria do not reflect the best available information. Consider developing recommendations for revising recovery criteria in section 4.0.

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)?

____ **Yes**, go to section 2.2.3
____ **No**, go to section 2.2.3, and note which factors do not have corresponding criteria. Consider developing recommendations for revising recovery criteria in section 4.0.

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.*

[2] 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.

If you answered *no* to either 2.2.2.1 or 2.2.2.2, continue to section 2.3 and consider adding updating of recovery criteria in Recommendations for Future Actions.

2.3 Updated Information and Current Species Status

Where available, new information on North Pacific right whale biology, abundance, and habitat use is summarized below, followed by an analysis of any relevant changes in the threats that factor into the listing status determination.

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Little new information exists on the biology and life history of North Pacific right whales, although Ivashchenko and Clapham (2012) have recently analyzed Soviet whaling records from the 1960s which provide rare data on length and sexual maturity for this species. As noted in the previous review, life history characteristics make these baleen whales very slow to adapt to changes in their habitat (Reynolds et al. 2002). Adults are generally between 45 and 55 feet in length, with females growing larger than males. The maximum recorded length of a North Pacific right whale was 19.8 m (65 feet) for a female killed by the USSR in the Gulf of Alaska in 1963 (Ivashchenko and Clapham 2012). Right whales have large heads, no dorsal fins, and are mostly black in color with callosities around the head region and a broad, deeply notched tail (NMFS 2006).

Right whales are thought to feed largely on copepods (IWC 1986). Right whales are skim ("ram") feeders, continuously filtering through their baleen while moving through a patch of zooplankton. This type of feeding strategy requires exceptionally high prey densities (Baumgartner *et al.* 2003; Baumgartner and Mate 2003; Baumgartner *et al.* 2011). As reported in the previous status review (NMFS 2006), stomach content analysis revealed that whales feeding in the Gulf of Alaska, Sea of Okhotsk, and the eastern Aleutian Islands consumed primarily *Neocalanus plumchrus*, *Metridia sp*., and *N. cristatus*, respectively (Omura 1958; Omura 1986; Omura et al. 1969). The predominant prey species in the southeast Bering Sea has since been identified as *Calanus marshallae*, followed by *P. newmani* and *A. longiremis* (Tynan 1999; Coyle 2000; Tynan et al. 2001). However, it is difficult to extrapolate dietary shifts and preferences in the North Pacific based on these limited survey samples (Shelden et al. 2005). North Pacific right whales were recently observed in three consecutive years (2004–2006) in late summer apparently feeding in the Barnabus Trough area on Albatross Bank, south of Kodiak Island in the Gulf of Alaska (Wade et al. 2011b). In all three years, the whales were associated with a high-density demersal layer of zooplankton at ~175m depth. The only net tow through this layer in proximity to a right whale found a mix of euphausiids and late-stage calanoid copepods rich in depot lipids, with a copepod assemblage of *Neocalanus cristatus* (26%), *N. flemingeri* (14%), *N. plumchrus* (10%), and *Calanus marshallae* (10%), similar to previous observations of stomach contents.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

As noted in the status review (NMFS 2006), the North Pacific right whale remains one of the most endangered whale species in the world, likely numbering fewer than 1,000 individuals between the eastern and western populations. Despite high levels of survey effort in the eastern North Pacific (Miyashita and Kato 1998; Perry et al. 1999; Zerbini et al. 2006; Ford et al. 2010), right whale sightings have been very rare and geographically scattered, leading to persistent uncertainty and data gaps. In the last three decades, right whale sightings have been so rare that single sightings have resulted in scientific publications (e.g., Herman et al. 1980; Rowntree et al. 1980; Rowlett et al. 1994; Goddard and Rugh 1998; Gendron et al. 1999; Salden and Mickelsen 1999; Waite et al. 2003; Carretta et al. 2007).

Small populations and the few sightings documented since 1964 (likely due to illegal Soviet catches that occurred throughout the 1960s; Ivashchenko and Clapham 2012) make population parameters difficult to estimate. The rarity of sightings and small numbers of individuals seen in any year suggests the population in the eastern North Pacific is very small. The largest number of individuals detected in a single year is 17 from multiple ship surveys in 2004 (Wade et al. 2006). Aerial surveys in 2008 sighted 13 individuals, 10 of which were matched to previously identified whales (Clapham et al. 2009). More recently, Wade et al. (2011a) made the first abundance estimates for the eastern North Pacific population using mark-recapture data from the Bering Sea and Aleutian Islands, resulting in abundance estimates of 31 individuals (95% confidence interval 23–54) and 28 individuals (95% confidence interval 24–42) using photographic and genetic identification techniques, respectively. Additionally, Marques et al. (2011) used passive acoustic cue counting to derive a similar abundance estimate of 25 individuals (CV 29.1%; 95% confidence interval 13–47). Those abundance estimates refer only to the Bering Sea and Aleutian Islands but there is no evidence the entire eastern North Pacific population is much larger. Between the 1960s and 2002, only two individuals were sighted in the Gulf of Alaska; neither of which had been seen in the Bering Sea (Wade et al. 2011b). Wade et al. (2011b) reported three additional visual sightings and one acoustic detection in the Gulf of Alaska between 2004 and 2006.

In contrast, right whales have been sighted more regularly in the western North Pacific, notably in the Okhotsk Sea, Kuril Islands, and adjacent areas (Brownell et al. 2001). Based on sightings data collected during minke whale surveys that covered a portion of the historic right whale range, the western population has been estimated to contain approximately 900 individuals (confidence limit 404 – 2,108; Miyashita and Kato 1998).

Due to the logistical challenges of studying small populations, little is known about the reproductive rate, age structure, or sex ratio of North Pacific right whales. Very little new information is available, as there have been very few confirmed sightings of calves in the eastern North Pacific in the last several decades. The only available reports from the Bering Sea include one possible calf seen in 1996 (Goddard and Rugh 1998; Leduc 2004; Wade et al. 2006). The size of a right whale photographed in California was 12.2m, indicating it was a subadult (Caretta et al. 1994). Several of the right whales seen in the past few years also appear to be subadults

(Shelden and Clapham 2006; Wade et al. 2006; Wade et al. 2011b), likely born after the cessation of Soviet whaling in the early 1960s, suggesting some successful reproduction within the population (Wade et al. 2006). However, reproduction rate remains unknown but is likely low due to a persistent uneven sex ratio. In 2002, the ratio of females to males biopsied in the Bering Sea was 1:9. In 2004, biopsy results indicated a considerably higher ratio of 7:16. Most recently, photographic and genotypic survey data collected 1997-2008 suggest a ratio of 2:5 (Wade et al. 2011a). Low population estimates combined with the small number of females severely reduces the potential for North Pacific right whales to find viable mates.

Recent developments and research on cetacean metabolic energy systems can provide insights into physiological characteristics that inform ongoing management measures. Calves have been reported in the western North Pacific (Omura 1986; Brownell et al. 2001), but calculating meaningful reproduction rates remains impracticable. Right whales elsewhere in the world are known to calve every three to five years (Knowlton et al. 1994; Kraus et al. 2007). Studies have shown that calving success is tightly linked to maternal energy reserves, which is influenced by oceanographic oscillations that govern the whales' ability to locate prey (Kenney 1998; Fujiwara and Caswell 2001; Greene et al. 2003; Angell 2005; Miller et al. 2011). Most recently, Klanjscek et al. (2007) modeled and compared energetic models between southern and North Atlantic right whales and found that calving intervals and time of first parturition depended heavily on energy availability and feeding rate. Furthermore, modeled seasonal oceanographic variability had a significantly larger impact on reproductive success when feeding was presumed to be low, or when females were energy-limited (Klanjscek et al. 2007). These principles likely also apply to North Pacific right whales, where prevailing oceanographic conditions impact energy reserves and therefore reproductive output.

Similar to other life history characteristics, small population sizes and limited sampling opportunities have led to little new information on mortality rates within the eastern and western North Pacific populations. However, as reported in the previous review, natural mortality is likely very similar to that in western North Atlantic right whales, which has been calculated as 17 percent and 3 percent in yearling and subadult whales, respectively (Kraus 1990). An overall subadult mortality rate (including anthropogenic sources) of 27 percent (Kraus 1990) is likely an overestimate for the North Pacific, where ship strikes and entanglements appear to occur less frequently.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

As stated in the previous review, past commercial whaling left the small, remnant populations vulnerable to low genetic variability due to genetic drift and inbreeding. Low diversity potentially affects individuals by depressing fitness, lowering resistance to disease and parasites, and diminishing the whales' ability to adapt to environmental changes. At the population level, low genetic diversity can lead to slower growth rates, lower resilience, and poorer long-term fitness (Lacy 1997). Marine mammals with an effective population size of a few dozen individuals likely can resist most of the deleterious consequences of inbreeding (Lande 1991). However, it has also been suggested that if the number of reproductive animals is fewer than 50, the potential for impacts associated with inbreeding increases substantially (IUCN 2003). From a

dataset that included historical samples, Rosenbaum et al. (2000) found genetic diversity in North Pacific right whales to be relatively high compared to North Atlantic right whales (*E. glacialis*), but their limited dataset suggested lower genetic diversity from their few recent samples.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There has been no new genetic information relevant to taxonomic classification or nomenclature since the definitive separation of right whales into three species (NMFS 2006; 73 FR 12024, March 2008). This classification was based on the analysis of mtDNA control sequences taken from skin tissue biopsies, stranded animals, and historical whaling samples and showed that these whale lineages are genetically distinct and demonstrate a relatively strong historical separation, with no shared haplotypes among the three right whale species (Rosenbaum et al. 2000). More recently, Gaines et al. (2005) examined both mitochondrial (mtDNA) and nuclear (nuDNA) introns containing single nucleotide polymorphisms and confirmed the reclassification of the Northern right whale in the North Pacific as its own taxon (*Eubalaena japonica*).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Due to small population sizes, much remains unknown about how right whales live, breed, and feed in the eastern and western portions of the North Pacific. Information on the historical range, current known distribution, and potential migratory routes and seasonal patterns is discussed below.

Historical Range

Recent studies investigating the potential historical range of North Pacific right whales are largely based on integrating past whaling catch data with recent sightings and oceanographic models using innovative mapping techniques. It has been asserted that right whales historically ranged across the entire North Pacific Ocean from the western coast of North America to the Russian Far East and down to Baja California and the Yellow Sea (Woodhouse and Strickley 1982; Brueggeman et al. 1986; Scarff 1986; Goddard and Rugh 1998; Gendron et al. 1999; Brownell et al. 2001; Clapham et al. 2004; Shelden et al. 2005). However, Josephson et al. (2008a) present modeling data that suggest a pronounced longitudinal bimodal distribution, with fewer whales found in the central North Pacific compared to the eastern and western regions. Additionally, Shelden (2006) suggests that records of right whales in southern California and Hawaii likely represented vagrant individuals. Clapham et al. (2004) integrated 20th century sighting data with 19th century whaling records to reveal an extensive offshore distribution; however, some of these historical data concerned are now known to involve species other than right whales (Josephson et al. 2008a). Overall, the species range has most likely contracted in the North Pacific relative to its spread during the peak period of whaling in the 19th century (Clapham et al. 2004). Analysis of Soviet catch records (primarily from 1963/64) by Ivashchenko and Clapham (2012) show a broad offshore distribution in the Gulf of Alaska, consistent with 19th century historical whaling data (Townsend 1935).

Current Distribution and Research

The majority of directed research on eastern North Pacific right whales has been conducted by the NMFS National Marine Mammal Lab (NMML) under a program funded by the Bureau of Ocean Energy Management (Clapham et al. 2012). Recent research using habitat modeling and acoustic monitoring has revealed finer-scale spatial information useful for conservation planning throughout the species range. The western Gulf of Alaska and the southeast Bering Sea are both frequently used areas, with 90 percent of Japanese and Russian encounters (1940s–1960s) occurring between 170°W and 150°W south to 52°N and between 173°W and 161°W south from 58°N (Clapham et al. 2006). Similarly, Zerbini et al. (2010) tracked four whales throughout a relatively small area between 56–58°N and 163–167°W primarily in the 50-100m isobaths for over a month during summer and found that only one whale moved into the northern Aleutian Basin for two days, likely in search of prey. Though whales historically frequented the Gulf of Alaska, Albatross Bank is the only location within the gulf where this species has been consistently identified for the last four decades (Wade et al. 2011b).

With little sighting data available for this species, it is not yet apparent what areas have been abandoned or not yet reinhabited by the current stocks (Clapham et al. 2006). Based on aerial surveys in 2008 and 2009, Rone et al. (2010) suggest that right whales consistently occupy a smaller area than would be predicted based on identified critical habitat in the southeastern Bering Sea. Recent claims that right whales had shifted their distribution within the last 50 years (Tynan et al. 2001) were based on inadequate survey coverage and were disputed by the discovery of 17 right whales outside the middle-shelf domain in the southeastern Bering Sea in the summer of 2004 (Wade et al. 2006) and again in October 2005 when approximately 12 right whales were observed just north of Unimak Pass (NMML unpublished data).

Overall, while new information on distribution has come from NMML surveys of the Bering Sea (Clapham et al. 2012), there has been very little effort in the Gulf of Alaska, and almost no survey coverage of the offshore waters of the Gulf that were habitat for right whales as recently as the period of Soviet illegal catches in the 1960s.

Seasonal Migration

Little is known about the migratory behavior of either the western or eastern North Pacific right whales and little new information has arisen since the most recent review (NMFS 2006). Historical sighting and catch records provide the only information on possible migration patterns for North Pacific right whales (Omura 1958; Omura et al. 1969; Scarff 1986). Due to infrequent sightings and because whalers have never reported winter calving areas, calving locations in the North Pacific remain unknown (Brownell et al. 2001; Scarff 2001; Clapham et al. 2004; Shelden et al. 2005). However, in an attempt to elucidate potential calving grounds, Good and Johnston (2010) conducted likelihood modeling of the North Pacific based on habitat preferences of North Atlantic right whales, and identified southern California, the Northwest Hawaiian Islands, the southern coast of China, and the northern coast of Vietnam as potential areas based on depth, sea surface temperature, and surface roughness. These modeling results only present potential locations, as relatively few right whales have recently been seen in the North Pacific in fall, winter, or spring. However, there have been some sightings south of high latitudes in those seasons. Since 1950, there have been at least three sightings from Washington, twelve from California, two from Baja California, Mexico, and three from Hawaii (Brownell et al. 2001). In

the lower latitudes in the western North Pacific in fall, winter, and spring, since 1950 there have been two catches in the Yellow Sea in China, one catch in Korean waters in the Sea of Japan, two sightings in the Ryuku Islands, Japan (near Okinawa), four in the Bonin Islands (Ogasawara, Japan), and four on the Pacific side of Honshu, the main island of Japan (Brownell et al. 2001).

Unlike calving areas, more is known about right whale feeding areas. Based on recorded historical concentrations of whales in the Bering Sea and recent survey sightings, it is likely that feeding areas in the Okhotsk Sea and adjacent waters along the coasts of Kamchatka and the Kuril Islands together with the Gulf of Alaska have been important summer habitats for eastern North Pacific right whales (Scarff 1986; Goddard and Rugh 1998; Brownell et al. 2001; IWC 2001; Clapham et al. 2004; Shelden et al. 2005; Clapham et al. 2006). North Pacific right whales observed by Wade et al. (2011b) since 1998 in the Gulf of Alaska were all observed in shelf waters adjacent to Kodiak, Alaska. However, it should be noted that sightings in coastal or shelf waters may be partially a function of survey effort, and thus may not reflect current or historical distribution. In support of this caveat, sighting records also indicate that right whales can occur far offshore, with observed movements over abyssal depths (Scarff 1986; Mate et al. 1997). However, acoustic recorders in the Gulf of Alaska detected right whale calls on only 5 days out of a total of 70 months of recordings from 5 deep-water stations; the calls were heard at the deepwater station in the Gulf of Alaska ~500 km southwest of Kodiak Island on 5 days in August and September of 2000, but no calls were detected from 4 other instruments deployed in deep water farther east during 2000 and 2001 (Mellinger et al. 2004).

Based on acoustic recordings of right whale call patterns from 2000 to 2006, Munger et al. (2008) found that whales remain in the southeast Bering Sea later in the year than was previously thought and move into mid-shelf waters intermittently throughout the summer. More recent year-round acoustic monitoring has detected right whale vocalizations virtually year-round in the Bering Sea, although calls become far less common in mid-winter (Clapham et al. 2012). Fall and spring distribution is the most widely dispersed, with whales occurring in mid-ocean waters and extending from the Sea of Japan to the eastern Bering Sea. In winter, right whales have been found in the Ryukyu Islands, the Bonin Islands, the Yellow Sea, the Sea of Japan, Honshu Island Japan, Washington, California, and Baja California, Mexico (Omura et al. 1969; Scarff 1986; NMFS 2006). Although this general northward migration for spring and summer feeding is apparent, Clapham et al. (2006) cites uncertainty as to whether all or only some of the whales follow this seasonal movement. One individual sighted both in Hawaii and the Bering Sea in 1996 represents the only confirmed evidence of an annual migration (Kennedy et al. 2010). How these seasonal distribution patterns may have changed recently based on population structure, habitat availability and prey resources is unknown.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

North Atlantic and Southern right whales are observed primarily in low latitude shallow coastal waters during winter calving and in higher latitude, shelf waters during the summer when distribution is most tightly linked to patchily distributed zooplankton prey (Winn et al. 1986; Perry et al. 1999; Gregr and Coyle 2009). Eastern North Pacific right whales in summer have been found apparently feeding in shelf waters of the eastern Bering Sea, and shelf waters south

of Kodiak Island in the Gulf of Alaska (Tynan et al. 2001; Wade et al. 2011a; Wade et al. 2011b). As such, NMFS designated two areas as critical habitat in the Gulf of Alaska and the Bering Sea in 2006 (Allen and Angliss 2012; 73 FR 19000, April 2008). Clapham et al. (2006) have observed that although the historic distribution of North Pacific right whales is significantly reduced, the waters of the western Gulf of Alaska and the Bering Sea remain critical habitat for this depleted species. This work to characterize and map critical habitat has resulted in improved understanding of how these whales might be utilizing suitable habitat areas in the North Pacific.

As stated above (see section 2.3.1.2), right whales preferentially inhabit areas with high zooplankton abundance and must therefore adapt their behavior based on prevailing basin-scale oscillations and multi-year processes that govern currents, productivity, and food web structure (Kenney 1998; Greene et al. 2003; Angell 2005; Klanjscek et al. 2007; Gregr and Coyle 2009; Miller et al. 2011). Zooplankton abundance and density in the Bering Sea has been shown to be highly variable, and affected by climate, weather, ice extent, and oceanographic processes (Napp and Hunt 2001; Baier and Napp 2003). Shelden et al. (2005) plotted 20th century records and found that seasonal distribution between offshore and shelf waters largely depended on sea surface temperature, surface mixing, and the presence of upwelling canyons. In this case, they suggest that the location and timing of suitable habitat at the regional scale is determined by local oceanographic processes that would differ for the eastern and western populations. Similarly, Gregr (2011) overlaid whaling catches with ocean climate circulation models to show two non-overlapping areas of suitable habitat that consistently exhibited large water temperature gradients from year to year. In support of this idea, Gregr (2010) suggests that these right whale lineages may have developed different habitat preferences. Several potential hypotheses exist on how right whales successfully find and utilize dynamic and shifting habitat areas and then transmit this accumulated experience across generations (Gregr 2010). How these areas and processes will shift in a changing climate remains unknown, but these findings represent key information for present and future critical habitat designations.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

Below is an analysis of the five factors (natural and anthropogenic threats to habitat, overutilization for commercial, scientific, or educational purposes, and the efficacy of existing regulations and conservation measures) that determine listing status per section 4(a)(1) of the ESA, as applied to North Pacific right whales.

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Anthropogenic impacts on North Pacific right whales and their habitat remain largely unknown and unquantified. Increasing oil and gas activities, natural resource extraction, chemical contaminants, and anthropogenic noise all potentially impact individual health and the quantity and quality of available habitat. Although these impacts are likely minimal, they may be compounded by future climatic changes and will each be discussed below.

Oil and Gas Activities

Oil and gas activities including exploration, production, transport, spills, and spill responses are potential sources of habitat degradation that could threaten North Pacific right whales. Data on the effects of oil pollution on baleen whales remain inconclusive, but general concerns include ingestion of contaminated prey, irritation of skin and eyes, inhalation of toxic fumes, change in distribution, and compromised immune function (Geraci and Aubin 1980; Geraci 1990; Loughlin 1994). Fortunately, relatively few spills have occurred in the northern North Pacific Ocean to date, but the extent to which these activities may impact right whales is unknown. In addition to oil and gas activities, the demand for exploring and developing undersea mineral deposits has grown in recent years and may degrade habitat or curtail right whale behavior.

Past offshore oil and gas leasing has occurred in the Gulf of Alaska and Bering Sea in the northern areas of known right whale habitat. The Bureau of Ocean Energy Management (BOEM) proposed an Outer Continental Shelf leasing plan for 2007-2012 that prioritized lease sales for the North Aleutian Basin in 2010 and 2012 (Aplin and Elliott 2007), but was withdrawn by Presidential Executive Order. The development of oil fields off the Sakhalin Islands is occurring within habitat of the western North Pacific population of right whales (NMFS 2006). However, no oil exploration or production is currently underway in offshore areas of the Bering Sea or Gulf of Alaska and no lease sales are scheduled to occur in the 2012-2017 proposed program (Andrew et al. 2008). The possibility remains that there will be lease sales in these areas in the future even though no discoveries have yet been announced and most leases have not contained commercially viable deposits (NMFS 2006). Oil exploration is scheduled to occur in the Chukchi and Beaufort seas beginning in 2012, which will include an increased level of associated vessel traffic through the Bering Sea en route to and from the Arctic.

Chemical Contaminants

Chemical contaminants such as heavy metals, polychlorinated biphenyls (PCBs), and plastic debris are an additional potential source of habitat degradation for right whales that remains uncertain. Although additional research is needed, existing data indicate that the lower trophic level mysticetes should contain smaller contaminant burdens compared with many odontocetes (O'Shea and Brownell Jr. 1994; O'Shea 1999). The manner in which pollutants negatively impact animals is complex and difficult to study, particularly in animals for which many of the key variables and physiological pathways are unknown (Aguilar 1987; O'Shea and Brownell Jr. 1994). However, individuals with higher contaminant levels in tissues show increased susceptibility to infections, lesions, impairments and even reproductive failure (De Guise et al. 1995; Moore et al. 1998; Aguilar et al. 2002; Jenssen et al. 2003).

The transgenerational accumulation of contaminants (Colborn and Smolen 1996) is a source for concern and has been modeled in right whales elsewhere by Klanjscek et al. (2007), who found that calves can assimilate as much as 30 percent of maternal toxicant load through nursing. Additionally, these metabolic models predict that the concentration of toxicants increases when energy reserves (i.e., blubber) are low and are further released into tissues during periods of fasting or starvation brought on by environmental variability (Klanjscek et al. 2007). This study suggests that the combination of seasonal nutritional stress and pollutant exposure may be negatively impacting reproductive success and limiting right whale recovery in the North Atlantic by increasing calving intervals and decreasing fertility. Weisbrod et al. (2000) found

that the accumulation of PCBs and pesticides in North Atlantic right whales did not reach significant levels but varied depending on where along the coast copepod prey was consumed. Additionally, Wise et al. (2008) studied accumulated chromium levels in North Atlantic right whale tissues and concluded that this toxin occurs in concentrations that could prove harmful.

The impacts of chemical contamination on cetaceans and habitat are a growing concern in the North Pacific Ocean. While high latitude oceans receive less exposure to anthropogenic chemicals, global circulation brings these contaminants into polar regions where they are taken up into Arctic food webs (Tanabe 2002). In the North Pacific, PCB and DDT contamination more than doubled in the last decade, evidenced by rising concentrations in albatrosses (Finkelstein et al. 2006). Elliott and Scheuhammer (1997) found that concentrations of cadmium and lead were higher in seabirds living in the North Pacific compared with similar species on the east coast. Levels of PCBs and newly identified DDT-like microcontaminants in the blubber of some North Pacific cetaceans (including right whales) was greater than those in tropical locations, with levels exceeding those known to suppress immune function in harbor seals (Minh et al. 2000a; Minh et al. 2000b). However, contaminant levels were lower in humpback whales from Alaska than they were in whales from California and Washington, where there have been more known point sources of contaminants (Elfes et al. 2010). It is unknown how and if these effects are manifested at a population level relevant to recovery and management decisions.

Anthropogenic Noise

Ship propulsion and electricity generation from engines, compressors, and pumps essential for ship operations all contribute to noise emissions into the marine environment. 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 and 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; Andrew et al. 2008; McDonald et al. 2008).

While certain species of large whales have shown behavioral changes and adaptations to anthropogenic noise in the marine environment (Geraci and Aubin 1980; Geraci 1990), there have been few studies on how it might affect right whales. However, existing data suggest that the level of sensitivity to noise disturbance and vessel activity appears related to the behaviors in which they are engaged at the time (Watkins 1986; NMFS 2006). In particular, feeding or courting right whales may be relatively unresponsive to loud sounds and, therefore, slow to react to approaching vessels. Clark et al. (2009) attempted to quantify the effects of masking on mysticetes (including the North Atlantic right whale) exposed to ship noise and reported that whale call rates diminished in the presence of passing vessels. Malme et al. (1983) speculated on the potential detrimental impacts of the noise created during oil and gas production, but in general, the impact of noise from shipping and industrial activities on the communication, behavior, and distribution of right whales remains unknown but likely minimal at the population level.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

As discussed in the previous review, commercial whalers hunted North Pacific right whales heavily during the 19th and 20th centuries. The IWC estimates that 15,451 right whales were taken in the North Pacific in the 19th century with 741 additional catches recorded in the early 20th century (Brownell 1986; Best 1987; Brownell et al. 2001; Josephson et al. 2008b). Scarff (2001) adjusted that previous analysis to account for whales that were struck and lost and estimated that between 26,500 and 37,000 right whales were killed between 1839 and 1909.

Ivashchenko and Clapham (2012) reported that large illegal catches of right whales were made by the USSR in 1962-68 in the eastern North Pacific and in 1967/68 in the Okhotsk Sea. Their best estimate of total right whale catches was 661, consisting of 529 for the eastern North Pacific (compared to a previously published figure of 373 by Doroshenko 2000) and 132 for the Okhotsk Sea (cf a previous figure of 126 from the same study). Catches were distributed in the Bering Sea (115), eastern Aleutian Islands (28), Gulf of Alaska (366), Okhotsk Sea (132) and other areas (20). Detailed information on catches of 112 right whales taken in May/June 1963 shows a broad distribution in offshore waters of the Gulf of Alaska, consistent with 19th century historical whaling records compiled by Townsend (Townsend 1935). Other major areas in which right whales were caught include south of Kodiak Island, western Bristol Bay (southeastern Bering Sea), and the central Okhotsk Sea off eastern Sakhalin Island. These illegal catches—which in many cases involved the taking of large, mature whales—must have drastically reduced the recovery potential for the species, notably in the eastern North Pacific.

Right whales were historically hunted by native peoples along the Northwest Pacific coast and in the Aleutian Islands, although the level of such take was likely insignificant. No additional information on aboriginal catches in the western North Pacific has arisen since the last review, but given the current status of this species, the North Pacific right whale populations could not withstand even a very low level of commercial or aboriginal hunting.

Scientific research marks the continued efforts to learn more about this species and can involve close interactions with whales to obtain photographs, genetic samples, or tagging information. All of these activities are permitted and closely monitored in the U.S. and Canada, a process that ensures any potential negative impacts are minimized. The potential for disturbance or harassment through observing or approaching whales for behavioral studies, photography, satellite tagging, and data collection including samples for health and genetic analysis is likely minimal and is far-outweighed by the information that could prove critical in helping manage and recover the species. There are no recreational or educational uses of North Pacific right whales. However, if a right whale is seen in a highly accessible area, such as near the coast of California, there is always the potential for an enthusiastic response from whale watching operations.

2.3.2.3 Disease or predation:

Data do not currently exist to quantify the impact of predation and disease on the survivability of the North Pacific right whale and no new information has arisen since the previous review. As reported previously, it is likely that North Pacific right whales experience occasional predatory attacks from killer whales and large sharks. Although incidences have never been observed,

bodily scars reveal the likelihood of these events (Shelden and Clapham 2006). If these interactions do occur, they would likely have a larger impact on calf and subadult age classes. Bowhead whales, a pagophilic ("ice-loving") species, could be used as a conservative proxy for killer whale predation on right whales that are far more exposed to attacks without the protection of pack ice. Of 195 bowhead whales examined during fifteen years of the Alaskan subsistence hunt, 8 had been wounded by killer whales (George et al. 1994).

In terms of the impacts of disease, no recorded evidence exists of epizootics occurring in baleen whales. It has been suggested that the frequency of naturally-occurring red tide events that can lead to the ingestion of deleterious toxins may become more common with the rise of coastal development and anthropogenic activities (NMFS 2006). While these natural toxins have led to mass mortalities of many pinnipeds and cetaceans, there is currently no evidence linking red tide toxins to deaths or chronic health problems in North Pacific right whales. It is not known whether right whales suffer from stress-induced bacterial infections similar to those observed in captive cetaceans (Buck et al. 1987). The occurrence of skin lesions on North Atlantic right whales has been documented in recent years, but their origin and significance are unknown (Marx et al. 1999; Pettis et al. 2004). The system developed by Pettis et al. (2004) to assess health and body condition of North Atlantic right whales is currently being applied by NMML to photographs of North Pacific right whales.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Right whales are protected domestically under both U.S. and Canadian law and internationally by the International Whaling Commission (IWC)—the IWC has set the catch quota at zero for all signatory nations and given all right whale stocks a Protected designation (IWC 1995).

2.3.2.5 Other natural or manmade factors affecting its continued existence:

As sightings and research remain limited in the North Pacific, no new information exists on other natural or manmade threats since the latest review (NMFS 2006). In the North Atlantic, ship collisions and fishing gear entanglements are the most common known causes of right whale mortality (Kraus 1990; Gillespie and Leaper 2001; Knowlton and Kraus 2001), but little is known of the nature or extent of these problems in the North Pacific. The existing knowledge and persistent data gaps for each of these threats are described below.

Vessel Collisions

The impacts of vessel interactions on right whale mortality in the North Pacific remain unknown and due to their rare occurrence and scattered distribution, assessing this threat is impractical at this time (Allen and Angliss 2012). Major shipping traffic does not currently cross into areas where right whales have most recently and most commonly been sighted. However, other known right whale habitat (e.g., Unimak Pass) remains in close proximity to popular shipping lanes, suggesting that collisions with vessels may represent a threat to North Pacific right whales. Because of the rarity of right whales, the impact to the species from even low levels of interaction could be significant. Furthermore, the continued retreat of sea ice in the Arctic makes it inevitable that the Northwest Passage and Northern Sea Route to and from Europe will be regularly open during at least the summer in the relatively near future. When this occurs, the

volume of ship traffic transiting arctic waters, through the Bering Strait and into the Bering Sea, will dramatically increase. This will bring with it greatly increased noise pollution as well as a rise in the probability of ship collisions with cetaceans, including North Pacific right whales.

Fisheries Interactions

The eastern Bering Sea supports extensive fisheries throughout the year, but the impact of these activities on North Pacific right whales remains unknown. As with other threats, any potential impacts pose a high risk to populations with low abundance.

Only one case of entanglement is known from the western North Pacific (Kornev 1994; Perry et al. 1999; Brownell et al. 2001), though this number probably does not reflect the potential rate of interactions. Several cases of bowhead entanglements have been recorded during the Alaska Native subsistence hunt (Philo et al. 1992). Aerial photographs in at least two cases have shown ropes trailing from the mouths of bowheads (NMFS, NMML, unpublished data). A similar review of photographs of North Pacific right whales has shown a low apparent rate of interaction with fishing gear, but given the remoteness of the habitats concerned any mortalities would almost certainly pass unrecorded. Injuries and entanglements that are not initially lethal may result in a gradual weakening of entangled individuals, making them more vulnerable to other direct causes of mortality (e.g. predation, disease, etc.; Kenney and Kraus 1993). Additionally, entanglement-related stress may decrease an individual's reproductive success or reduce its life span, which may in turn depress population growth. Monitoring of scarring rates among North Pacific right whales is difficult due to the extreme rarity of this species, but this would provide significant insight into the extent of this problem in the region.

Climate Change

The impacts of climate change on baleen whales are as yet unknown, but it is considered one of the largest threats facing remote areas in the North Pacific (Macdonald et al. 2003). Most notably, the temporal and spatial distribution of zooplankton prey is largely governed by sea ice coverage and could change dramatically with altered oceanographic conditions (Baier and Napp 2003). This could lead to nutritional stress and diminished reproduction. Additionally, changing water temperature and currents could impact the timing of environmental cues important for navigation and migration and the location of critical habitat within the North Pacific right whale species range. It is possible that changes in ice extent, density and persistence may alter the dynamics of the Bering Sea shelf zooplankton community and in turn affect the foraging behavior and success of right whales (Clapham et al. 2006).

Cumulative Impacts

The cumulative impacts of the above threats remain unknown and have not been studied for large whales in the North Pacific. While none of the above threats is likely to significantly affect right whale recovery alone, it is possible that the cumulative burden of shifting natural processes and rising anthropogenic activities could impact right whales at the individual and population levels. Macdonald et al. (2003) suggest that the cumulative impacts of climate change, overfishing, and habitat modification alter the metabolic and physiological pathways involved in the absorption and bioaccumulation of chemical contaminants found in the North Pacific. In the North Atlantic Ocean, Kraus (2008) suggests that the cumulative impacts of all anthropogenic activities likely suppress right whale reproductive rates and compromise immune function, thus

inhibiting recovery and making the population less resilient to future climate change and anthropogenic threats.

2.4 Synthesis

Given that the North Pacific right whale population is extremely small and little current information is available, recovery is not anticipated in the foreseeable future (e.g., several decades to a century or more). Despite the damage to the population caused by illegal Soviet whaling in the 1960s, recent sightings have shown that right whales are extant in the eastern North Pacific, and there is evidence that some reproduction may be occurring in this population. Life history characteristics such as low reproductive rates, delayed sexual maturity, and reliance on high juvenile survivorship make long-lived species such as whales particularly vulnerable to demographic risks posed by anthropogenic related mortalities. Risks from overutilization, entanglement, and ship strikes currently pose little direct threat to recovery of North Pacific right whales, although injury or mortality from any of these sources would be noteworthy due to the limited size of the population. In contrast, oil and gas development activities, chemical pollution, and climate change could potentially impact critical habitat, foraging success, and reproductive rates in the future. As noted above, greatly increased shipping through the Bering Sea will potentially become a major risk to right whales in the future.

Many basic life history parameters and census data, including calving and growth rates, age structure, mortality, and distribution remain largely undetermined. These data are necessary to perform quantitative population analyses or develop surrogate models to evaluate the risk of extinction. When such reliable information on the biology and ecology of this population becomes available, managers will be able to make informed decisions by applying specific criteria to address the survival and recovery of this species. Based on little new information, the North Pacific right whale retains its status as endangered.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number: 7

Brief Rationale: Due to insufficient data, low abundance, and uncertain threats, this species remains endangered with a low potential for recovery.

3.3 Listing and Reclassification Priority Number: N/A

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (Removal from list) Priority Number: ____

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS -

The most urgent need is better information on the basic distribution and occurrence of right whales in the eastern North Pacific, including identification of their wintering areas and management of emerging threats to the population. Ship based surveys need to be continued, as well as the use of autonomous underwater recording devices and satellite-monitored radio tags.

5.0 REFERENCES

Aguilar, A. 1987. Using organochlorine pollutants to discriminate marine mammal populations: A revew and critique of the methods. Marine Mammal Science 3:242-262.

Aguilar, A., A. Borrell, and P. J. Reijnders. 2002. Geographical and temporal variation in levels of organochlorine contaminants in marine mammals. Marine Environmental Research 53:425-452.

Allen, B. M., and R. P. Angliss. 2012. Alaska marine mammal stock assessments, 2011

Andrew, R. K., B. M. Howe, and J. A. Mercer. 2002. Ocean ambient sound: comparing the 1960s with the 1990s for a receiver off the California coast. Acoustics Research Letters Online 3(2):65-70.

Andrew, R. K., B. M. Howe, and J. A. Mercer. 2008. Long-time trends in low-frequency ambient noise for four sites off the North American west coast. Pages 13 *in*. Applied Physics Laboratory, University of Washington, Seattle, WA.

Angell, C. 2005. Body fat condition of right whales, *Eubalaena glacialis* and *Eubalaena australis*. Dissertation. Boston University, Boston, MA.

Aplin, D., and W. Elliott. 2007. Conservation concerns for cetaceans in the Bering Sea and adjacent waters: Offshore oil development and other threats. IWC Scientific Committee, Anchorage, Alaska. 14.

Baier, C. T., and M. Napp. 2003. Climate-induced variability in *Calanus marshallae* population. Journal of Plankton Research 25:771-782.

Baumgartner, M., T. V. N. Cole, R. G. Campbell, G. Teegarden, and E. G. Durbin. 2003. Associations between north Antlantic right whale and their prey, *Calanus finmarchicus*, over diel and tidal time scales. Marine Ecological Progress Series 264:155-166.

Baumgartner, M., and B. Mate. 2003. The foraging ecology of North Atlantic right whales and its potential energetic implications. Pages 12 *in* Fifthteen Biennial Conference on the Biology of Marine Mammals., Greensboro, Nc.

Baumgartner, M. F., N. S. J. Lysiak, C. Schuman, J. Urban-Rich, and F. W. Wenzel. 2011. Diel vertical migration behavior of Calanus finmarchicus and its influence on right and sei whale occurrence. Marine Ecology Progress Series 423:167-184.

Best, P. B. 1987. Estimates of the landed catch of right whale (and other whalebone) whales in the American fisheries. Fisheries Bulletin of the U.S. 85(3):403-418.

Brownell, J., R. L. . 1986. Right Whale Survivorship Around Peninsula Valdes, Argentina. Report of the Workshop on the Status of Right Whales, International Whaling Commission Special Issue 15(Appendix 9):31.

Brownell, R. L., P. J. Clapham, T. Miyashita, and T. Kasuya. 2001. Conservation status of North Pacific right whales. Journal of Cetacean Research And Management (Special Issue 2):269-286.

Brueggeman, J. J., T. Newby, and R. A. Grotefendt. 1986. Catch records of the twenty North Pacific right whales from two Alaska whaling stations, 1917-39. Arctic 39(1):43-46.

Buck, J., L. Shepard, and S. Spotte. 1987. Clostridium perfringens as the cause of death of a captive Atlantic bottlenosed dolphin. Journal of Wildlife Disease 23(3):488-491.

Caretta, J., M. S. Lynn, and C. A. LeDuc. 1994. Right whale sighting off San Clemente Island, California. Marine Mammal Science 10(1):101-105.

Carretta, J. V., K. A. Forney, M. S. Lowry, J. Barlow, J. Baker, B. Hanson, and M. M. Muto. 2007. U.S. Pacific Marine Mammal Stock Assessments: 2007. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-SWFSC-414. 320.

Clapham, P. J., C. Good, S. E. Quinn, R. R. Reeves, J. E. Scarff, and J. Robert L. Brownell. 2004. Distribution of North Pacific right whales (Eubalaena japonica) as shown by 19th and 20th century whaling catch and sighting records. Journal of Cetacean Research And Management 6(1):1-6.

Clapham, P. J., A. S. Kennedy, B. K. Rone, A. N. Zerbini, J. L. Crance, and C. M. Berchok. 2012. North Pacific right whales in the southeastern Bering Sea: final report. Final Report to the Bureau of Ocean Energy Management under Inter-Agency Agreement Number M07RG13267 (AKC 063) 77.

Clapham, P. J., K. E. W. Shelden, and P. R. Wade. 2006. Review of Information Relating to Possible Critical Habitat for Eastern North Pacific Whales. Alaska Fisheries Science Center, National Marine Fisheries Service

Clapham, P. J., A. N. Zerbini, A. Kennedy, B. Rone, and C. Berchok. 2009. Update on North Pacific right whale research. Unpublished paper to the IWC Scientific Committee, Madeira, Portugal. 9.

Clark, C., W. T. Ellison, B. L. Southall, D. Ponirakis, L. Hatch, and S. M. Van Parijs. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Marine Ecological Progress Series 395:201-222.

Colborn, T., and M. Smolen. 1996. An epidemiological analysis of persistent organochlorine contaminants in cetaceans. Reviews of Environmental Contamination and Toxicology 146:91-172.

Coyle, K. O. 2000. Zooplankton densities in the right whale feeding areas of Cape Newenham, southeastern Bering Sea: report on the results of analysis of seven MOCHNESS tows taken in the whale foraging areas 13.

De Guise, S., D. Martineau, P. Beland, and M. Fournier. 1995. Possible mechanisms of action of environmental contaminants on St. Lawrence beluga whales (*Delphinapterus leucas*). Environmental Health Perspectives 103(4):73-76.

Doroshenko, N. V. 2000. Soviet whaling for blue, gray, bowhead, and right whales in the North Pacific Ocean, 1961-1979. Pages 96-103 *in* Soviet Whaling Data (1949-1979). Center for Russian Environmental Policy Marine Mammal Council, Moscow.

Elfes, C., G. VanBlricom, D. Boyd, J. Calambokidis, P. J. Clapham, R. Pearce, J. Robbins, J. Salinas, J. Straley, P. M. Wade, and M. Krahn. 2010. Geographic variation of persistent organic pollutant levels in humpback whale (Megaptera novaeangliae) feeding areas of the north Pacific and north Atlantic. Environmental Toxicology and Chemistry 29(4):824-834.

Elliott, J., and A. Scheuhammer. 1997. Heavy metal and metallothionein concentrations in seabirds from the Pacific coast of Canada. Marine Pollution Bulletin 34(10):794-801.

Finkelstein, M., B. Keitt, D. Croll, B. Tershy, W. Jarman, S. Rodriguez-Pastor, D. Anderson, P. Sievert, and D. Smith. 2006. Albatross species demonstrate regional differences in North Pacific marine contamination. Ecological Applications 16(2):678-686.

Ford, J. K. B., R. M. Abernethy, A. V. Phillips, J. Calambokidis, G. M. Ellis, and L. M. Nichol. 2010. Distribution and relative abundance of cetaceans in western Canadian waters from ship surveys, 2002-2008. Canadian Technical Report of Fisheries and Aquatic Sciences 2913: vi + 51pp.

Fujiwara, M., and H. Caswell. 2001. Demography of the endangered North Atlantic right whale. (Eubalaena glacialis). Nature 414(6863):537-541.
Gaines, C. A., M. P. Hare, S. E. Beck, and H. C. Rosenbaum. 2005. Nuclear markers confirm taxonomic status and relationships among highly endangered and closely related right whale species. Proceedings of the Royal Society of Biology 272:533-542.
Gendron, D., S. Lanham, and M. Carwardine. 1999. North Pacific right whale (Eubalaena glacialis) sighting south of Baja California. Aquatic Mammals 25(1):31-34.
George, J. C., L. M. Philo, K. Hazard, D. Withrow, G. M. Carroll, and R. Suydam. 1994. Frequency of killer whale attacks and ship collisions based on scarring on bowhead whales of the Bering-Chukchi-Beaufort seas stock. Arctic 47(3):247-255.
Geraci, J. R. 1990. Physiologic and toxic effects on cetaceans Academic Press, San Diego, CA.
Geraci, J. R., and D. J. S. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Marine Fisheries Review 42:1-12.
Gillespie, D., and R. Leaper. 2001. Right whale acoustics: Practical applications in conservations. International Fund for Animal Welfare, Yarmouth Port, Massachusetts.
Goddard, P. D., and D. J. Rugh. 1998. A group of right whales seen in the Bering Sea in July 1996. Marine Mammal Science 14(2):344-349.
Good, C., and D. Johnston. 2010. Spatial modeling of optimal North Pacific right whale (Eubalaena japonica) calving habitats. Pages 71 *in* Alaska Marine Science Symposium, Hotel Captain Cook, Anchorage, Alaska.
Greene, C., A. J. Pershing, R. D. Kenney, and J. W. Jossi. 2003. Impact of climate variability on the recovery of endangered North Atlantic right whales. Oceanography 16(4):98-103.
Gregr, E. J. 2010. Insights into North Pacific right whale habitat from historic whaling records. Pages 13 *in* Alaska Marine Science Symposium, Hotel Captain Cook, Anchorage, Alaska.
Gregr, E. J. 2011. Insights into North Pacific right whale Eubalaena japonica habitat from historic whaling records. Endangered Species Research 15(3):223-239.
Gregr, E. J., and K. O. Coyle. 2009. The biogeography of the North Pacific right whale (Eubalaena japonica). Progress in Oceanography 203(3-4):188-198.
Herman, L. M., C. S. Baker, P. Forestell, and R. Antinoja. 1980. Right whale sightings near Hawaii: a clue to the wintering grounds? Marine Ecological Progress Series 2:271-275.
Ivashchenko, Y. V., and P. J. Clapham. 2012. Soviet catches of bowhead (*Balaena mysticetus*) and right whales (Eubalaena japonica) in the North Pacific and Okhotsk Sea Endangered Species Research (in review).
IWC. 1986. Report of the workshop on the status of right whales. Report of the International Whaling Commission 10:1-33.
IWC. 1995. Chairman's Report of the forty-sixth annual meeting 52.
IWC. 2001. Report of the workshop on the comprehensive assessment of right whales: a worldwide comparison 1-56.
Jenssen, B. M., O. Haugen, E. G. Sormo, and J. U. Skaare. 2003. Negative relationship between PCBs and plasma retinol in low-contaminated free-ranging gray seal pups (Halichoerus grypus). Environmental Research 93(1):79-87.
Josephson, E., T. D. Smith, and R. R. Reeves. 2008a. Historical distribution of right whales in the North Pacific. Fish and Fisheries 9(2):155-168.
Josephson, E. A., T. D. Smith, and R. R. Reeves. 2008b. Depletion within a decade: The American 19th-century North Pacific right whale fishery. Pages 133-147 *in* D. Starkey, P.

Holm, and M. Bernard, editors. Oceans Past: Management Insights From the History of Marine Animal Populations. Earthscan, London, UK.
Kennedy, A. S., B. K. Rone, A. Zerbini, and P. J. Clapham. 2010. Eastern North Pacific right whales (Eubalaena japonica): They really do exist! Pages 148 *in* Alaska Marine Science Symposium, Anchorage, Alaska.
Kenney, R. D. 1998. Global climate change and whales: Western North Atlantic right whale calving rate correlates with the Southern Oscillation Index. International Whaling Commission Workshop on the Comprehensive Assessment of Right Whales: A Worldwide Comparison, Monkey Valley, South Africa. 11.
Kenney, R. D., and S. D. Kraus. 1993. Right whale mortality - a correction and an update. Marine Mammal Science 9(445-446).
Klanjscek, T., R. M. Nisbet, H. Caswell, and M. G. Neubert. 2007. A model for energetics and bioaccumulation in marine mammals with applications to the right whale. Ecological Applications 17(8):2233-2250.
Knowlton, A. R., and S. D. Kraus. 2001. Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean. Journal of Cetacean Research and Management Special Issue 2:193-208.
Knowlton, A. R., S. D. Kraus, and R. D. Kenney. 1994. Reproduction in north Atlantic right whales (*Eubalaena glacialis*). Canadian Journal of Zoology 72:1297-1305.
Kornev, S. I. 1994. A note on the death of a right whale off Cape Lopakta. Report of the International Whaling Commission 15:443-444.
Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales. Marine Mammal Science 6(4):278-291.
Kraus, S. D. 2008. The urban life of the North Atlantic right whale: The cumulative effects of traffic, fishing, noise, pollution, and disease in the coastal zone of North America. Pages 26 *in* Florida Marine Mammal Health Conference III, Whitney Laboratory, St. Augustine, FL.
Kraus, S. D., R. M. Pace III, and T. R. Frasier. 2007. High Investment, Low Return: The Strange Case of Reproduction in *Eubalaena Glacialis*. Pages 172-199 *in* S. D. Kraus, and R. Rolland, editors. The Urban Whale: North Atlantic Right Whales at the Crossroads. Harvard University Press, Cambridge, Massachusetts.
Lacy, R. C. 1997. Importance of genetic variation to the viability of mammalian populations. Journal of Mammalogy 78(2):35-75.
Lande, R. 1991. Applications of genetics to management and conservation of cetaceans.
Leduc, R. 2004. Report of the results of the 2002 Survey for North Pacific Right Whales. NOAA Technical Memorandum NMFS-SWFSC-357. 59p.
Loughlin, T. R. 1994. Tissue hydrocarbon levels and the number of cetaceans found dead after the spill. Academic Press.
Macdonald, R. W., B. Morton, and S. C. Johannessen. 2003. A review of marine environmental contaminant issues in the North Pacific: The dangers and how to identify them. Environmental Reviews 11(2):103-139.
Malme, C. I., P. R. Miles, C. Clark, P. L. Tyack, and J. E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. . Minerals Management Service, U.S. Department of Interior

Marques, T. A., L. Munger, L. Thomas, S. Wiggins, and J. A. Hildebrand. 2011. Estimating North Pacific right whale Eubalaena japonica density using passive acoustic cue counting. Endangered Species Research 13(3):163-172.

Marx, M. K., P. K. Hamilton, and S. D. Kraus. 1999. Skin lesions on North Atlantic right whales (*Eubalaena glacialis*): 1980-1996. Pages 116 *in* 13th Biennial Conference on the Biology of Marine Mammals, 28 November - 3 December 1999., Wailea, Hawaii.

Mate, B. R., S. L. Nieukirk, and S. D. Kraus. 1997. Satellite-monitored movements of the northern right whale. (Eubalaena glacialis). Journal of Wildlife Management 61(4):1393-1405.

McDonald, M. A., J. A. Hildebrand, and S. M. Wiggins. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, CA. . Acoustical Society of America 120(2):711-718.

McDonald, M. A., J. A. Hildebrand, S. M. Wiggins, and D. Ross. 2008. A 50-year comparison of ambient ocean noise near San Clemente Island: A bathymetrically complex coastal region off Southern California. Acoustical Society of America 124(4):1985-1992.

Mellinger, D. K., K. M. Stafford, S. E. Moore, L. Munger, and C. G. Fox. 2004. Detection of North Pacific Right Whale (*Eubalaena japonica*) Calls In the Gulf of Alaska. Marine Mammal Science 20(4):872-879.

Miller, C. A., D. Reeb, P. B. Best, A. R. Knowlton, M. W. Brown, and M. J. Moore. 2011. Blubber thickness in right whales *Eubalaena glacialis* and *Eubalaena australis* related with reproduction, life history status, and prey abundance. Marine Ecology Progress Series 438:267-283.

Minh, T. B., H. Nakata, M. Watanabe, S. Tanabe, N. Miyazaki, T. A. Jefferson, M. Prudente, and A. Subramanian. 2000a. Isomer-Specific Accumulation and Toxic Assessment of Polychlorinated Biphenyls, Including Coplanar Congeners, in Cetaceans from the North Pacific and Asian coastal waters. Archives of Environmental Contamination and Toxicology 39(3):398-410.

Minh, T. B., M. Watanabe, S. Tanabe, N. Miyazaki, T. A. Jefferson, M. S. Prudente, A. Subramanian, and S. Karuppiah. 2000b. Widespread contamination by tris(4-chlorophenyl)methane and tris(4-chlorophenyl)methanol in cetaceans from the North Pacific and Asian coastal waters. Environmental Pollution 110(3):459-468.

Miyashita, T., and H. Kato. 1998. Recent data on the status of right whales in the NW Pacific Ocean. (Eubalaena glacialis). IWC Scientific Committee 12.

Moore, M. J., C. A. Miller, A. V. Weisbrod, D. Shea, P. K. Hamilton, S. D. Kraus, V. J. Rowntree, N. Patenaude, and J. J. Stegeman. 1998. Cytochrome P450 1A and chemical contaminants in dermal biopsies of northern and southern right whales 18.

Munger, L. M., S. M. Wiggins, S. E. Moore, and J. A. Hildebrand. 2008. North Pacific right whale (Eubalaena japonica) seasonal and diel calling patterns from long-term acoustic recordings in the southeastern Bering Sea, 2000–2006. Marine Mammal Science 24(4):795-814.

Napp, J., and G. L. Hunt. 2001. Anomalous conditions in the southeastern Bering Sea, 1997: linkages among climate, weather, ocean, and biology. Fisheries Oceanography 10:61-68.

NMFS. 2006. Review of the Status of the Right Whales in the North Atlantic and North Pacific Oceans. U. S. D. o. Commerce, editor. NOAA.

O'Shea, T., and R. L. Brownell Jr. 1994. Organochlorine and metal contaminants in baleen whales: a review and evaluation of conservation implications. Science of the Total Environment 154(2-3):179-200.
O'Shea, T. J. 1999. Environmental contaminants and marine mammals. Pages 485-563 *in* I. John E. Reynolds, and S. A. Rommel, editors. Biology of Marine Mammals. Smithsonian Institution Press, Washington.
Omura, H. 1958. North Pacific right whale. Scientific Reports of the Whales Research Institute, Tokyo 13:1-52.
Omura, H. 1986. History of right whale catches in the waters around Japan. Report of the International Whaling Commission Special Issue 10:35-41.
Omura, H., S. Ohsumi, K. N. Nemoto, and T. Kasuya. 1969. Black right whales in the north Pacific. Scientific Reports of the Whales Research Institute 21.
Perry, S. L., D. P. Demaster, and G. K. Silber. 1999. The right whales. (Eubalaena). Marine Fisheries Review 61(1):7-23.
Pettis, H. M., R. M. Rolland, P. K. Hamilton, S. Brault, A. R. Knowlton, and S. D. Kraus. 2004. Visual health assessment of North Atlantic right whales (Eubalaena glacialis) using photographs. Canadian Journal of Zoology 82(1):8-19.
Philo, L. M., J. C. George, and T. F. Albert. 1992. Rope entanglement of bowhead whales (*Balaena mysticetus*). Marine Mammal Science 8(3):306-311.
Reynolds, J., D. Demaster, and G. Silber. 2002. Endangered species and populations. Pages 373-382 *in* W. Perrin, B. Wursig, and J. Thewissen, editors. Encyclopedia of Marine Mammals. Academic Press, San Diego, CA.
Rone, B. K., A. Zerbini, A. S. Kennedy, and P. J. Clapham. 2010. Aerial surveys in the southeastern Bering Sea: Occurrence of the endangered North Pacific right whale (Eubalaena japonica) and other marine mammals during the summers of 2008 and 2009. Pages 149 *in* Alaska Marine Science Symposium, Anchorage, Alaska.
Rosenbaum, H. C., R. L. Brownell Jr., M. W. Brown, C. M. Schaeff, V. A. Portway, B. N. White, S. Malik, L. Pastene, N. Patenaude, C. S. Baker, M. Goto, P. B. Best, P. J. Clapham, P. K. Hamilton, M. Moore, R. S. Payne, V. J. Rowntree, C. T. Tynan, and R. DeSalle. 2000. Worldwide genetic differentiation of *Eubalaena*: questioning the number of right whale species. Molecular Ecology 9:1793-1802.
Ross, D. 1976. Mechanics of Underwater Noise. Pergamon Press, New York.
Rowlett, R. A., G. A. Green, C. E. Bowlby, and M. A. Smultea. 1994. The first photographic documentation of a northern right whale off Washington state. (Eubalaena glacialis). Northwestern Naturalist 75(3):102-104.
Rowntree, V. J., J. Darling, G. Silber, and M. Ferrari. 1980. Rare sighting of a right whale (*Eubalaena glacialis*) in Hawaii. Canadian Journal of Zoology 58:308-312.
Salden, D. R., and J. Mickelsen. 1999. Rare sighting of a North Pacific right whale (Eubalaena glacialis) in Hawai'i. Pacific Science 53(4):341-345.
Scarff, J. E. 1986. Historic and present distribution of the right whale (Eubalaena glacialis) in the eastern North Pacific south of 50°N and east of 180°W. Report of the International Whaling Commission Special Issue 10:43-63.
Scarff, J. E. 2001. Preliminary estimates of whaling-induced mortality in the 19th century North Pacific right whale (Eubalaena japonicus) fishery, adjusting for struck-but-lost whales and non-American whaling. Journal of Cetacean Research and Management Special Issue 2:261-268.

Shelden, K. E. W. 2006. Habitat requirements and extinction risks of eastern North Pacific right whales. National Marine Fisheries Service 64.

Shelden, K. E. W., and P. J. Clapham. 2006. Assessment of Extinction Risk for Northern Right Whales in the Eastern North Pacific. Alaska Fisheries Science Center, National Marine Fisheries Service, U.S. Department of Commerce

Shelden, K. E. W., S. E. Moore, J. M. Waite, P. R. Wade, and D. J. Rugh. 2005. Historic and current habitat use by North Pacific right whales Eubalaena japonica in the Bering Sea and Gulf of Alaska. Mammal Review 35(2):129-155.

Tanabe, S. 2002. Contamination and toxic effects of persistent endocrine disrupters in marine mammals and birds. Marine Pollution Bulletin 45:69-77.

Townsend, C. H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica (N.Y.) 19(1):1-50.

Tynan, C. 1999. Right whale distributions, oceanographic features, and productivity of the southeast Bering Sea. Thirteen Biennial Conference on the Biology of Marine Mammals, 28 November - 3 December Wailea Maui HI. p.190.

Tynan, C. T., D. P. Demaster, and W. T. Peterson. 2001. Endangered right whales on the southeastern Bering Sea shelf. Science 294(5548):1894.

Wade, P., M. P. Heide-Jorgensen, K. Shelden, J. Barlow, J. Carretta, J. Durban, R. Leduc, L. Munger, S. Rankin, A. Sauter, and C. Stinchcomb. 2006. Acoustic detection and satellite-tracking leads to discovery of rare concentration of endangered North Pacific right whales. Biology Letters 2(3):417-419.

Wade, P. R., A. Kennedy, R. Leduc, J. Barlow, J. Carretta, K. Shelden, W. Perryman, R. Pitman, K. Robertson, B. Rone, J. C. Salinas, A. Zerbini, R. L. B. Jr, and P. J. Clapham. 2011a. The world's smallest whale population? (Eubalaena japonica). Biology Letters 7(1):83-85.

Wade, P. R., A. D. Robertis, K. R. Hough, R. Booth, A. Kennedy, R. G. Leduc, L. Munger, J. Napp, K. E. W. Shelden, S. Rankin, O. Vasquez, and C. Wilson. 2011b. Rare detections of North Pacific right whales in the Gulf of Alaska, with observations of their potential prey. Endangered Species Research 13(2):99-109.

Waite, J. M., K. Wynne, and D. K. Mellinger. 2003. Documented sighting of a North Pacific right whale in the Gulf of Alaska and post-sighting acoustic monitoring. Northwestern Naturalist 84(1):38-43.

Watkins, W. A. 1986. Whale Reactions to Human Activities in Cape-Cod Waters. Marine Mammal Science 2(4):251-262.

Weisbrod, A. V., D. Shea, M. J. Moore, and J. J. Stegeman. 2000. Organochlorine exposure and bioaccumulation in the endangered northwest Atlantic right whale (*Eubalaena glacialis*) population. Environmental Toxicology and Chemistry 19(3):654.

Winn, H. E., C. A. Price, and P. W. Sorensen. 1986. The distributional biology of the right whale in the western north Atlantic 129-138.

Wise, J. P., S. S. Wise, S. Kraus, F. Shaffiey, M. Grau, T. L. Chen, C. Perkins, W. D. Thompson, T. Zheng, Y. Zhang, T. Romano, and T. O'Hara. 2008. Hexavalent chromium is cytotoxic and genotoxic to the North Atlantic right whale (*Eubalaena glacialis*) lung and testes fibroblasts. Mutation Research/Genetic Toxicology and Environmental Mutagenesis 650(1):30-38.

Woodhouse, C. D., Jr., and J. Strickley. 1982. Sighting of northern right whale (Eubalaena glacialis) in the Santa Barbara Channel. Journal of Mammalogy 63(4):701-702.

Zerbini, A., A. S. Kennedy, B. K. Rone, C. L. Berchok, and P. J. Clapham. 2010. Habitat use of North Pacific right whales in the Bering Sea during summer as revealed by sighting and telemetry data. Pages 153 *in* Alaska Marine Science Symposium, Anchorage, Alaska.

Zerbini, A. N., J. M. Waite, J. L. Laake, and P. R. Wade. 2006. Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands. Deep Sea Research Part I: Oceanographic Research Papers 53(11):1772-1790.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
North Pacific Right Whale (*Eubalaena japonica*)

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

REGIONAL OFFICE APPROVAL:

Alaska Regional Administrator, NOAA Fisheries

Approve: _____ Date: 9.19.12

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

_X_ Concur _____ Do Not Concur

Signature _____ Date 10/11/12