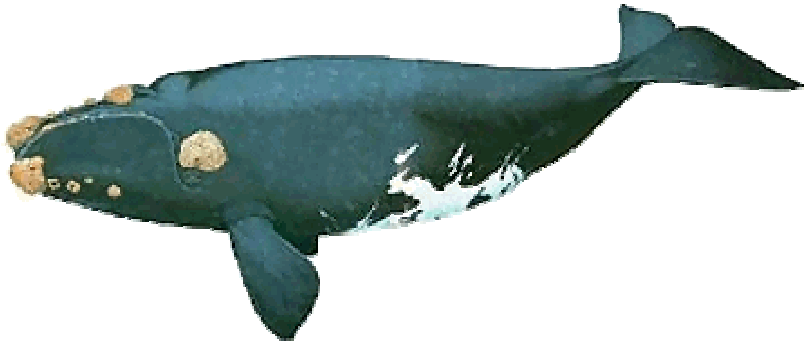
Review of the Status of the Right Whales in the North Atlantic and North Pacific Oceans



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Executive Summary

This status review report assesses the status of right whales in the North Atlantic and North Pacific Oceans. Specifically, the population structure is described and the extent to which phylogenetic uniqueness exists between right whales found in the North Atlantic and North Pacific is examined. The biological status and threats to the northern right whale and their habitat are examined.

In December 1970, the right whale (*Eubalaena spp.*) was listed as endangered under the Endangered Species Conservation Act of 1969, the precursor to the Endangered Species of 1973 (16 U.S.C. 1531 *et seq*.; the ESA)(35 FR 8495). When the ESA was passed in 1973, the right whale was included in the newly created List of Endangered and Threatened Wildlife and Plants as endangered. In addition it was listed as depleted under the Marine Mammal Protection Act (MMPA) in that same year. The National Marine Fisheries Service has jurisdiction for all species of marine mammals in the order Cetacea, including the northern right whale (USFWS and NMFS 1974).

In April 2003, the National Marine Fisheries Service (NMFS) published a technical revision in the *Federal Register* to reflect the genetic distinctiveness between North Atlantic and North Pacific right whales as recognized and accepted by the scientific community and supported by the scientific literature. This technical revision revised the species name of the northern right whale as follows: the North Atlantic right whale (*Eubalaena glacialis*) and the North Pacific right whale (*Eubalaena japonica*) (68 FR 17560). In 2005, NMFS published a final rule in the *Federal Register*, removing the technical revisions made to the right whale listing by the April 2003 rule (70 FR 1830). NMFS determined that the issuance of the April 2003 final rule was both procedurally and substantively flawed. NMFS concluded that it had not followed the procedural requirements of ESA Section 4, because it had not provided public notice or an opportunity for comment. In addition, the final rule did not comply with the ESA's substantive requirements of conducting a status review of the species to determine whether the species was endangered or threatened because of one or more of the five factors identified in section 4(a)(1) of the ESA.

Genetic data now provide unequivocal support to distinguish three right whale lineages (including the southern right whale) as separate phylogenetic species (Rosenbaum *et al*. 2000). Rosenbaum *et al*. (2000) concluded that the right whale should be regarded as three separate species as follows:

1. The North Atlantic right whale (*Eubalaena glacialis*) ranging in the North Atlantic Ocean;
2. The North Pacific right whale (*Eubalaena japonica*), ranging in the North Pacific Ocean; and;
3. The southern right whale (*Eubalaena australis*), historically ranging throughout the southern hemisphere's oceans.

In addition, this status review indicates that the formerly-used genus *Balaena* should be updated to reflect the proper genus, for right whale species, *Eubalaena*. This classification conforms to the taxonomy currently accepted by the scientific community and supported by the scientific literature.

This status review indicates that separating the northern right whale into two different species is warranted in light of the compelling evidence provided by recent scientific studies on right whale taxonomy and classification. Accordingly, this status review is a compilation of the best available scientific and commercial information on the status of the North Pacific right whale and North Atlantic right whale.

The ESA defines an endangered species as any species in danger of extinction throughout all or a significant portion of its range, and a threatened species as any species likely to become endangered within the foreseeable future. Section 4(b)(1)(a) of the ESA requires that determinations of whether a species is threatened or endangered be based solely on the best scientific and commercial data available, after taking into account those efforts, if any, being made to protect the species. The Secretary shall determine whether any species is endangered or threatened because of any of the following factors listed under section 4(a)(1) of the ESA:

1. The present or threatened destruction, modification, or curtailment of habitat or range;
2. Overutilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms;
5. Other natural or manmade factors affecting its continued existence.

North Atlantic Right Whale (*Eubalaena glacialis*)

There is reason for serious concern about the future of the North Atlantic right whale. The current distribution and migration patterns of the eastern North Atlantic right whale population are unknown. Based on whaling records, it appears that the eastern population migrated along the coast from northern Europe to northwest Africa. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare. The current size of the western North Atlantic population is approximately 300 animals. Due to the continued anthropogenic threats to the species, and the whale's life history, the North Atlantic right whale is in significant danger of extinction throughout its range. Because the right whale is a long-lived species, extinction may not occur in the near future, but the possibility of biological extinction in the next century is very real.

The most significant anthropogenic factors that place the North Atlantic right whale in danger of extinction remain ship collisions and entanglement in fishing gear. The available evidence strongly suggests that the North Atlantic right whale cannot sustain the current number of deaths that result from vessel and fishing gear interactions. If mortality from these activities continue at current rates, it is likely to result in the extirpation of North Atlantic right whales.

Based on an analysis of the best scientific and commercial data available and after taking into consideration current population trends and abundance, demographic risk factors affecting the continued survival of the species and ongoing conservation efforts it is clear that the North Atlantic right whale is in danger of extinction throughout its range.

North Pacific Right Whale (*Eubalaena japonica*)

The current population size of right whales in the North Pacific is likely fewer than 1,000 animals. A large portion of this estimate, approximately 900 right whales, comes from minke whale surveys conducted off Kamchatka. To date, the largest number of eastern North Pacific right whale individuals identified in the Bering Sea is 23 based on genetic sampling. This appears to include at least 2 calves. Based on the current population size, the continued anthropogenic threats and other factors discussed below, the North Pacific right whale faces a high risk of extinction throughout its range into the foreseeable future. The life history characteristics and habitat requirements of this species make it extremely vulnerable to environmental variation and demographic stochasticity at such low numbers.

The basic life history parameters and census data, including population abundance, growth rate, age structure, breeding ages, and distribution remain undetermined for the North Pacific right whale. These data are necessary to perform quantitative population analyses or to develop surrogate models to evaluate the risk of extinction. However there are a number of factors that put North Pacific right whales at considerable risk of extinction. These include but are not limited to the following: (1) life history characteristics such as slow growth rate, long calving intervals, and longevity; (2) distorted age, size or stage structure of the population and reduced reproductive success; (3) strong depensatory or Allee effects; (4) habitat specificity or site fidelity; and (5) habitat sensitivity.

Ship strikes may affect the continued existence of North Pacific right whales. Little is known of the nature or extent of this problem in the North Pacific. The area where right whales have been seen in recent surveys is not in a major vessel traffic lane. However, the proximity of the other known right whale habitats to shipping lanes (e.g. Unimak Pass) suggests 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.

Entanglements of North Pacific right whales in fishing gear appear to be uncommon. Only one case of entanglement is known from the western North Pacific (Brownell *et al*. 2001) though the occurrence of right whales near pot fisheries in the Bering Sea indicates a potential for conflict. Given the low population size of North Pacific right whales, the impact of even low levels of interactions could be significant.

Based on an analysis of the best scientific and commercial data available and after taking into consideration current population trends and abundance, demographic trends and life history traits affecting the continued survival of the species and ongoing conservation efforts, it is clear that the North Pacific right whale remains in significant danger of extinction throughout its range.

1. Introduction

This status review report assesses the status of right whales in the North Atlantic and North Pacific Oceans. Specifically, the population structure is described and the extent to which phylogenetic uniqueness exists between northern right whales found in the North Atlantic and North Pacific is examined. The biological status and threats to the northern right whale and their habitat are examined.

In December 1970, the right whale (*Eubalaena spp*.) was listed as endangered under the Endangered Species Conservation Act of 1969, the precursor to the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.; the ESA)(35 FR 8495). The National Marine Fisheries Service has jurisdiction for all species of marine mammals in the order Cetacea, including the northern right whale (USFWS and NMFS 1974). When the ESA was passed in 1973, the right whale was included in the newly created List of Endangered and Threatened Wildlife and Plants (the List) as endangered and was listed as depleted[1] under the Marine Mammal Protection Act (MMPA) in that same year. Under Section 4(a) of the ESA and 50 CFR 424, National Marine Fisheries Service (NMFS) makes determinations on whether a species warrants listing as either endangered or threatened and whether a species should be reclassified or removed from the List. Most scientific papers considered right whales in the North Atlantic Ocean and North Pacific Ocean comprised a single species of northern right whales. NMFS published a recovery plan for the northern right whale in 1991, and revised recovery plans in 2001, 2004 and 2005.

Recent genetic evidence indicates that the genetic distinctness between right whales found in the North Atlantic and North Pacific supports a reclassification of these populations as two separate species. In 2003, NMFS published a technical revision in the *Federal Register* to separate the northern right whale into two separate species: the North Atlantic right whale (*Eubalaena glacialis*) and the North Pacific right whale (*Eubalaena japonica*) (68 FR 17560). Following the publication of the technical revision, NMFS received a Notice of Intent to Sue (NOI) written on behalf of the Center for Biological Diversity, which alleged that NMFS had violated the ESA by failing to designate critical habitat for right whales in the Pacific Ocean. The NOI argued that the April 2003 technical revision listed a new species under the ESA, the North Pacific right whale, and the agency was now legally obligated to designate critical habitat.

In 2005, NMFS published a final rule in the *Federal Register*, which removed the technical revisions made to the right whale listing by the April 2003 rule (70 FR 1830). NMFS determined that the issuance of the April 2003 final rule was both procedurally and substantively flawed. NMFS explained that the procedural requirements of Section 4 were not followed

[1] The MMPA defines "depleted" as any case in which (A) the Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under Title II of this Act, determines that a species or population stock is below its optimum sustainable population; (B) a State, to which authority for the conservation and management of a species or population stock is transferred under section 109, determines that such species or stock is below its optimum sustainable population; or (C) a species or population stock is listed as an endangered or threatened species under the ESA (16 U.S.C. 1362(1)).

because NMFS did not provide public notice or an opportunity for comment. In addition, the final rule did not comply with the ESA's substantive requirements of conducting a status review of the species to determine whether the species should be listed as endangered or threatened. Therefore, the changes NMFS intended to make in the April 2003 final rule were not valid.

2. Right Whale Taxonomy

In 1758, Linnaeus published the first description of the right whale, categorizing all right whale species (i.e., bowhead and right whales) under the genus *Balaena.* In 1864, J.E. Gray published a reclassification of right whales as *Eubalaena* based on new evidence that right whales were a distinct species from bowhead whales (*Balaena mysticetus*). Over the last three decades the literature concerning the correct nomenclature for the right whale has been inconsistent. For example, the U.S. Fish and Wildlife Service (FWS), which maintains the official lists of Endangered and Threatened Species for both NMFS and FWS, listed right whales in the 1973 edition of Threatened Wildlife of the United States as *Eubalaena glacialis* (USFWS 1973). The current List of Endangered and Threatened Wildlife lists the right whale as *Balaena glacialis* (incl. *australis*) (50 CFR 17.11). Similarly, some authorities continued to place right and bowhead whales in the same genus, *Balaena* (Rice, 1977, 1998).

Despite this inconsistent nomenclature, the proper genus for right whales, *Eubalaena*, is the most widely recognized and commonly used in the scientific community.[2] For instance virtually all related scientific literature and popular literature on marine mammals rely on the genus *Eubalaena* to identify right whales as a distinct genus from bowheads. The NMFS has used this nomenclature in several published documents, including the annual Stock Assessment Reports, the Recovery Plan for the Northern Right Whale (NMFS 1991, 2005), and other technical reports dating back to the early 1990s. The NMFS list of endangered species lists right whales as endangered under the nomenclature, *Eubalaena ssp.* (50 C.F.R. 224.101(b)).

2.1 Species Delineation

The historic species distinction between right whales in the northern hemisphere (*E. glacialis*) and right whales in the southern hemisphere (*E. australis*) was based upon a morphological difference in the orbital region of the skull (Muller 1954), a character which has been shown to be ontogenetic[3] and thus uninformative (Rosenbaum *et al.* 2000). With respect to the right whales in the North Pacific, taxonomic classification has historically been in conflict. For example, at various stages, right whales in the North Pacific have either been classified as a sub-species of their North Atlantic counterparts (e.g., *E. glacialis sieboldii*) or elevated to full species status (*E. sieboldii* or *E. japonica*), with the former interpretation being the most widely recognized.

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[2] The International Code of Zoological Nomenclature provides a specific set of rules for determining the correct scientific name to apply to any particular taxon. The rule of priority states that when determining the valid name for any species (or genus or higher level category), the first published name applied should be used. The name *Eubalaena*, published by J.E. Gray in 1864, is the first published name applicable only to the right whale and, therefore, is the valid genus name under the rule of priority.

[3] Based on visible morphological characters and not necessarily indicative of natural evolutionary relationships.

In 1998, there was a recommendation (Rice 1998) to treat all right whales as a single species, *Balaena glacialis*. In June 2000, based on this recommendation, the International Whaling Commission's (IWC's) scientific committee decided to review the prevailing right whale taxonomy. Although morphological differences are virtually nondetectable, the most recent genetic evidence demonstrates that right whales of the North Atlantic, North Pacific, and Southern Ocean possess fixed, unique genetic patterns indicating complete and long-established reproductive isolation (Rosenbaum *et al.* 2000). The committee examined mitochondrial DNA (mtDNA) control region sequences from the three ocean basin forms of right whales (North Atlantic (NA) = 269; North Pacific (NP) = 8; Southern Ocean (SO) = 55)(sample size for each region). Population Aggregation Analysis (PAA)[4](Davis and Nixon 1992) revealed that each of the three forms is characterized by a small number of diagnostic nucleotide positions (number of fixed diagnostic characters: NA = 3; NP = 3; SO = 4). A phylogenic analysis confirmed the groupings of mitochondrial lineages into three monophyletic clades[5] concordant with the three forms that indicate that each form is phylogenetically unique enough to be considered three separate species. In addition, the genetic data show that North Pacific and southern right whales are more closely related to each other than either is to North Atlantic right whales, which indicates that the traditional combination of North Atlantic and North Pacific animals as "northern right whales" is systematically erroneous. Based on the evidence reviewed, the IWC committee recommended that the three populations should be considered separate species. The committee also addressed the issue of right whale nomenclature. The committee recommended the retention and use of the generic name *Eubalaena* to separate right whales from bowhead whales (*Balaena mysticetus*) as published by Gray (1864), acknowledging the protocol established by the International Code of Zoological Nomenclature.

Recent advances in the study of genetics and whales have, for the first time, been able to provide a comprehensive and definitive analysis of the taxonomic structure of right whales. Rosenbaum *et al.* (2000) concluded that the right whale should be classified as three separate species as follows :

1. The North Atlantic right whale (*Eubalaena glacialis*), historically ranging in the North Atlantic Ocean from latitudes 60° N to 20° N;
2. The North Pacific right whale (*Eubalaena japonica*), historically ranging in the North Pacific Ocean from latitudes 70° N to 20° N; and
3. The southern right whale (*Eubalaena australis*), historically ranging throughout the southern hemisphere's oceans.

Prior to the completion of these recent genetic studies, there was sufficient haplotypic (genetic) divergence between right whales found in the North Atlantic and South Atlantic Oceans to

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[4] PAA is a phylogenetic technique that identifies unique fixed characters among local populations as a means to delineate species. Under the PAA concept these fixed diagnostic nucleotide positions indicate that three distinct species of right whale exist.

[5] A clade is a grouping of individuals who are more similar to each other genetically than others in separate clades, implying closer evolutionary distance. A group is monophyletic if it consists of a common ancestor and all its descendants.

indicate that the northern and southern populations have not interbred for approximately 3 – 12.5 million years (Malik *et al.* 2000; Schaeff *et al.* 1997). The recent evidence supporting genetic distinctiveness is based on laboratory analyses of the variations in gene products (i.e., proteins), which are taken from individual samples. Mitochondrial DNA was used to examine genetic diversity because this gene reflects the rapid rate of sequence divergence in non-coding genetic sequences and allows for comparisons with other studies. Mitochondria are cellular organelles that contain their own genomes separate from the cell's nucleus; they are transmitted maternally and thus convey strong information about female lineages (but not male lineages). Variants in that DNA material can provide information on population divergence.

With respect to right whales, the analysis of mtDNA control sequences taken from skin tissue biopsies, stranded animals and historical whaling samples indicate that northern and southern right whales are genetically distinct and, in addition, demonstrate a relatively strong historical separation of North Atlantic, North Pacific, and Southern Ocean right whale lineages (Rosenbaum *et al.* 2000). In other words, no haplotypes were shared among these three right whale populations. This study included the only available analysis of eastern North Atlantic specimens, and concluded that the eastern and western populations were not genetically distinct. In addition, the study suggested that the loss of genetic variation in the North Atlantic population during the 20th century was relatively low; however, it was recognized that the greatest loss of variation may have occurred prior to this time, during periods of major exploitation. Therefore, the analysis of genetic data supports the conclusion that these right whale populations are three evolutionarily distinct entities. Moreover, the probability of future interbreeding among the three lineages is extremely low considering their current ranges and distributions.

More recently, Gaines *et al*. (2005) examined both mitochondrial (mtDNA) and nuclear (nuDNA) from right whale samples from the North Atlantic, North Pacific and the southern ocean. The addition of nuDNA was used to confirm the phylogenic distinctness found by Rosenbaum *et al.*'s (2000) examination of mtDNA. Using both mitochondrial and nuclear introns containing single nucleotide polymorphisms (SNPs) to complement one another, Gaines *et al.* (2005) found that the two markers support the reclassification of the right whale in the North Pacific as its own taxon (changed from the North Pacific population of *Eubalaena glacialis* to *Eubalaena japonica*, the North Pacific right whale). The results of this study provide strong additional evidence that right whale populations in the North Atlantic, North Pacific and southern ocean are three separate distinct evolutionarily entities (Gaines *et al*. 2005).

2.2 Species Considered for Listing

Based on the new genetic evidence from recent genetic studies, this review concludes that the generally accepted analyses by Rosenbaum *et al.* 2000 constitute the best available scientific information regarding current taxonomic classification of right. Rosenbaum *et al*. (2000) concluded that the right whale should be regarded as three separate species as follows:

1. The North Atlantic right whale (*E. glacialis*), ranging in the North Atlantic Ocean;
2. The North Pacific right whale (*E. japonica*), ranging in the North Pacific Ocean; and

3. The southern right whale (*E. australis*), historically ranging throughout the southern hemisphere's oceans.

The recommended taxonomic changes reflect actions already taken in the scientific community. Genetic data now provide unequivocal support to distinguish three right whale lineages as separate phylogenetic species (Rosenbaum *et al*. 2000). In addition, this review of the best available scientific information and commercial data leads to a conclusion that the formerly-used genus *Balaena* should be updated to reflect the proper genus for right whale species, *Eubalaena*. This classification conforms to the taxonomy generally accepted by the scientific community based on the best available scientific data available.

2.2.1 North Atlantic Right Whale (*Eubalaena glacialis*)

The IWC recognizes two right whale populations in the North Atlantic: a western and eastern population (IWC 1986). The western population migrates along the North American coast from Nova Scotia to Florida. The western North Atlantic population is believed to contain only about 300 individuals, and it is unclear whether its abundance is remaining static, undergoing modest growth, or declining, as recent modeling exercises suggest (Caswell *et al*. 1999). Based on whaling records, it appears that the eastern population migrated along the coast from northern Europe to northwest Africa. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare (Best *et al.* 2001).

There is also evidence from whaling records that a third population may have existed in the central Atlantic Ocean, migrating from east of Greenland to the Azores or Bermuda (Reeves and Mitchell 1986). This theory was considered at a 1983 right whale workshop sponsored by the IWC. In light of the uncertainty surrounding the range and distribution of the central population, the workshop participants agreed to the provisional division of an eastern and western population (IWC 1986).

2.2.2 North Pacific Right Whale (*Eubalaena japonica*)

Historically, right whales ranged throughout the entire North Pacific north of latitude 35ºN (Braham and Rice 1984, see also Perry *et al*. 1999). The IWC considers that the question of whether there are two populations of right whales in the North Pacific remains open. The IWC did note in a review (IWC 2001a) that the different catch and recovery histories support the view that there "were once at least two populations, at least with regard to feeding ground divisions". This review also concluded that the current east-west population separation should remain in place until new data are available (IWC 2001a).

Some researchers (e.g., Klumov 1962; Brownell *et al.* 2001) who have discussed the possibility that right whales in the North Pacific exist in discrete eastern and western North Pacific populations have also suggested that the western group may occur in two different populations. However, at present no subdivision of either population is recognized. The idea that the western

population can be further subdivided into two parts (Omura 1986) is regarded as unlikely, but cannot be ruled out based on existing data (IWC 2001a).

Very little is known about right whales in the eastern North Pacific, which were severely depleted by commercial whaling in the 1800s (Brownell *et al.* 2001). In the last several decades there have been markedly fewer sightings due to the drastic reduction in number, caused by illegal Soviet whaling in the 1960s (Doroshenko 2000).

3. Natural History and Biology

The northern right whale (Müller 1776) is a large baleen whale. Adults are generally between 45 and 55 feet in length and can weigh up to 70 tons. Females are larger than males. The distinguishing features of right whales include a stocky body, generally black coloration (although some individuals have white patches on their undersides), lack of a dorsal fin, large head (about 1/4 of the body length), strongly bowed margin of the lower lip, and callosities on the head region. Two rows of long (up to about eight feet in length), dark baleen plates hang from the upper jaw, with about 225 plates on each side. The tail is broad, deeply notched, and all black with smooth trailing edge.

3.1 North Atlantic Right Whale (*Eubalaena glacialis*)

As discussed (see Section 2.2.1), there are two recognized right whale populations in the North Atlantic, an eastern and western population (IWC 1986). The distribution and migration pattern of the eastern population are unknown (Perry *et al* 1999, Best *et al.* 2001). The western population migrates along the coast of North America from Florida to Nova Scotia (Perry *et al.* 1999), and is estimated to contain only about 300 individuals.

3.1.1 Reproduction

Most known right whale nursery areas are in shallow, coastal waters. In the western North Atlantic, calving takes place between December and March. In both the northern and southern hemisphere, females give birth to their first calf at an average age of nine years (Best *et al.* 1998; Hamilton *et al.* 1998a). Calves are 5.5-6.0 meters in length at birth (Best 1994). Gestation lasts from 357 to 396 days in southern right whales (Best 1994), and it is likely to be similar in the northern species. Weaning seems to be variable, and has been reported as 8 to 17 months in North Atlantic right whales (Hamilton and Marx 1995).

Standard reproductive rates for the western North Atlantic population have yet to be calculated. Calculating such rates is complicated by the occurrence patterns of mature females, for whom the probability of sighting in studied habitats is dependent upon reproductive condition. Between 1990 and 2005 the number of calves born has varied from one (in 2000) to 31 (in 2001), with an average number of 14 (Knowlton *et al.* 1994; A. Knowlton, personal communication; NMFS unpublished data). The calving interval for right whales is between 2 and 7 years, with means ranging from 3.12 (95% CI 3.05-3.17) to 3.67 years (95% CI 3.3-4.1) (Knowlton *et al.* 1994, Best *et al.* 2001, Burnell 2001; Cooke *et al.* 2001). However, in the western North Atlantic, a significant increase in the calving interval was documented from 3.67 years for the period 1980 to 1992 (Knowlton *et al.* 1994) to 5.8 years for the period 1990 to 1998 (Kraus *et al*. 2001). The calving interval during 1990-98 is markedly different from that of southern right whale populations, whose mean calving interval is between three and four years, with modes generally around three years. The increase in the interval is of particular concern

and, together with other perplexing biological parameters, may suggest the population is under rather unusual biological, energetic, or reproductive stress. Most recently (2001-2005), a dramatic increase in North Atlantic right whale calving (23 calves per year) indicates that the calving interval may have decreased to levels more similar to that of the southern right whale (Kraus *et al.* in press).

It is possible to calculate a theoretical maximum birth rate from knowledge of three parameters: sex ratio, proportion of females that are sexually mature, and mean interbirth interval. The sex ratio of the western North Atlantic population is known to be even (Brown *et al.* 1994), and recent work by Hamilton *et al.* (1998a) has suggested that 60% of females in this population are mature. Given a normal average interbirth interval of 3 years, the expected maximum annual birth rate should be approximately 0.10.[6] A longer interbirth interval (such as that suggested above), or a lower proportion of mature (or reproductively active) females, would decrease this rate accordingly.

3.1.2 Mortality

Deaths resulting from human activities account for at least one-third of all known mortalities in the western North Atlantic right whale population (Kraus 1990). Ship collisions and fishing gear entanglements are the most common anthropogenic causes of mortality in western North Atlantic right whales. For the period 1999 through 2003, the total estimated human-caused mortality and serious injury to right whales is estimated at 2.6 per year (U.S. waters, 1.6; Canadian waters, 1.0). This is derived from two components: 1) non-observed fishery entanglement records at 1.6 per year (U.S. waters, 0.8; Canadian waters, 0.8), and 2) ship strike records at 1.0 per year (U.S. waters, 0.8; Canadian waters, 0.2)(Waring *et al.* 2006). Collisions with ships and entanglements in fishing gear are clearly inhibiting the recovery of the species (see section 6.1.5).

The extent to which natural factors, such as disease and predation, affect mortality rates is not known. Kraus (1990) used photo-identification data from the western North Atlantic population to calculate an average mortality rate of 17 percent per year in first-year right whales, while second- through fourth-year whales had an average mortality rate of 3 percent per year. Including all sources of mortality, both natural and anthropogenic, 27 percent of all western North Atlantic right whales die before reaching four years of age (Kraus 1990).

In 1996, 5 North Atlantic right whale deaths were reported off the southeast United States from January through March. One of these deaths was due to a ship strike. It was not possible to determine the cause of death for the remainder of the individuals. Between late 2003 and early 2005 another cluster of 8 mortalities were reported. These deaths included 6 adult females (3 carrying fetuses). At least 4 and likely 5 deaths were due to anthropogenic factors (Kraus *et al.* 2005).

[6] The calculation here is 1.00 divided by 2 (sex ratio), times 0.6 (proportion of females that are mature), divided by 3 (calving interval in years).

Various species of large sharks and killer whales (*Orcinus orca*) may be predators of right whales, particularly young or sick individuals. However, no such attacks have been observed in this species. Scars from killer whale attacks have been photographed on North Atlantic right whales (Kraus 1990), although the level of killer whale attacks and the extent to which they result in death is not known. More recently, Mehta (2004) concluded that scars recorded on the bodies of North Atlantic right whales are more consistent with harassment by some smaller cetacean, possibly pilot whales (*Globicephala spp.*) and do not originate from killer whales.

3.1.3 Feeding and Prey Selection

Research indicates that the right whale's primary prey in the Northwest Atlantic Ocean are adult copepods at appropriate densities (CCS 2003). The presence of large concentrations of copepods is probably the single most important biological component of right whale habitat within New England waters (Watkins and Schevill 1976, Wishner *et al.* 1988, 1995, Murison and Gaskin 1989, Mayo and Marx 1990, Beardsley *et al.* 1996, Woodley & Gaskin 1996, Baumgartner *et al.* 2003, Baumgartner and Mate 2003). Right whales are frequently observed feeding on copepod aggregations at the surface within Cape Cod Bay (Mayo and Marx 1990), but diving below the surface to zones of highest copepod densities appears to be the more common foraging strategy (Kenny *et al.* 1995, Baumgartner and Mate 2003). High concentrations of copepods are essential for triggering foraging activities of right whales. Data supporting this relationship have been collected by measuring densities of copepods at the surface in the path of actively foraging right whales (Mayo and Marx 1990), and detailed analysis of vertical profiles of the dives of right whales together with vertical plankton sampling (Baumgartner and Mate 2003).

Available evidence from right whale foraging and habitat studies shows that right whales focus foraging activities where physical oceanographic features (e.g., water depths, currents and mixing fronts) combine to concentrate copepods (Wishner *et al.* 1988, Mayo and Marx 1990, Murison and Gaskin 1989, Baumgartner *et al.* 2003). For example, Baumgartner *et al.* (2003) concluded that spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer, within the Bay of Fundy and Roseway Basins. Copepods (*Calanus finmarchicus)* aggregated over the deepest water depths in these areas. Within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column, which allows more efficient foraging. Hence, the biological and physical features characteristic of right whales' foraging habitat are a combination of both:

- Biological Oceanography – specific areas of the Gulf of Maine which contain significant numbers of adult *C. finmarchicus* either as right whale foraging areas (e.g., the Great South Channel) or as prey refuges (e.g., Jordan Basin), and
- Physical Oceanography – the hydrographic processes that work in some areas of the Gulf of Maine to concentrate zooplankton above some threshold that allows efficient foraging (see Kenny *et al.* 1986, Mayo and Goldman 1992).

3.1.4 Competition

It has been suggested that interspecific competition with either sei whales (*Balaenoptera borealis*) or planktivorous fish may limit northern right whale prey consumption (Mitchell 1975; Kraus *et al.* 1988; Payne *et al.* 1990). In the North Atlantic, sei whales are sympatric with the right whales, and because both species feed on small zooplankton species, they may compete (Mitchell 1975). There is also speculation about competition with certain species of fish in the Gulf of Maine, including sand lance (*Ammodytes* spp.), herring (*Clupea* spp.), Atlantic mackerel (*Scomber scombrus*), river herrings (shad, blueback; *Alosa* spp.), menhaden (*Brevoortia tyrannus*), and basking sharks (*Cetorhinus maximus*). While the potential for interference competition exists for right whales, direct evidence is essentially absent. As noted by Clapham and Brownell (1996), assertions regarding interspecific competition are rarely well defined or ecologically based.

3.2 North Pacific Right Whale (*Eubalaena japonica*)

As discussed (see Section 2.2.2), right whales once ranged throughout the entire North Pacific north of latitude 35ºN (Braham and Rice 1984, see also Perry *et al*. 1999).

3.2.1 Reproduction

Little is currently known about the rate of reproduction for North Pacific right whales. There have been very few confirmed sightings of calves in the eastern North Pacific this century. The only available reports are of: (1) a relatively small whale in a group of four in the Bering Sea in 1996 (Goddard and Rugh 1998); (2) the sighting of a calf in the Bering Sea in summer 2002 (LeDuc 2004); and (3) a sighting of three calves among a group of 24 whales in the Bering Sea in the summer of 2005 (Wade *et al*. 2006). Several of the right whales seen in the past few years appear to be subadults (Shelden and Clapham 2006) which indicate they were probably born after the last of the Soviet takes in the early 1960s. Calves have been reported in the western North Pacific (Omura 1986; Brownell *et al.* 2001), but calculation of meaningful reproduction rates remain impracticable. Right whales elsewhere in the world are known to calve every three to four years on average, although in recent years an increase in the interbirth interval to more than five years has been reported for the North Atlantic right whale (Kraus and Knowlton 2001).

3.2.2 Mortality

Very little is known about natural mortality in this species. It is probably reasonable to assume that rates of natural mortality are similar to those for right whales in other oceanic populations. In studies of western North Atlantic right whales, Kraus (1990) used photo-identification data to calculate an average mortality rate of 17 percent per year in first-year right whales, while second-through fourth-year whales had an average mortality rate of 3 percent per year. Including all

sources of mortality, both natural and anthropogenic, neonatal mortality, 27 percent of all western North Atlantic right whales die before reaching four years of age (Kraus 1990). However, the high rate of mortality from anthropogenic factors (notably ship strikes and entanglements) in the North Atlantic may not make that population a good proxy for right whales elsewhere. Nothing is currently known regarding rates of mortality (natural or anthropogenic) for North Pacific right whales.

3.2.3 Feeding and Prey Selection

Right whales are skimmers; they feed by continuously filtering prey through their baleen while moving, mouth agape, through a patch of zooplankton. The few existing records of right whale feeding habits indicate that right whales feed almost entirely on copepods (IWC 1986). Analyses of stomachs from whales caught in 1956 along the Japanese coast revealed concentrations of copepods *Neocalanus plumchrus, N. cristatus* and *C. finmarchicus* with a small quantity of euphausiid larvae *Euphausia pacifica* (Omura 1958). It should be noted that *C. finmarchicus* in the North Pacific is now recognized as C. *marshallae* (see Shelden *et al*. 2005). Elsewhere, right whales fed on the following copepod species: *N. plumchrus* in the Gulf of Alaska, *N. cristatus* north of the eastern Aleutian Islands, and *N. plumchrus* and *Metridia* sp. in the Okhotsk Sea (Omura *et al*. 1969; Omura 1986). Recently, *C. marshallae* was the dominant copepod species in zooplankton samples collected in 1997 near right whales on the middle shelf domain of the southeast Bering Sea, followed by *Pseudocalanus newmani* and *Acartia longiremis* (Tynan 1999; Tynan *et al.* 2001). Similarly, *C. marshallae* dominated two samples collected in July 1999 along a transect where right whales had been seen during aerial surveys (Coyle 2000). However, the claim of Tynan *et al.* (2001) that right whales in the North Pacific have "changed their diet" to this zooplankter is an inappropriate extrapolation from insufficient sample sizes (Shelden *et al*. 2005).

3.2.4 Competition

Nothing is known about possible competition between North Pacific right whales and sympatric species. Bowhead whales (*B. mysticetus*) are similar in anatomy and could conceivably be competitors. Since most bowheads migrate out of the Bering Sea each spring and spend the summer in the Beaufort Sea (Moore and Reeves 1993) at the time when right whales might be in the Bering Sea, there is unlikely to be much overlap in range. Bowhead prey consists of copepods (e.g., *C. glacialis*) and euphausiids (e.g., *Thysanoessa raschii*)(Lowry 1993), although more than 60 species of invertebrates have been recorded in their diet.

4. Distribution and Abundance

Right whales historically have occurred in all the world's oceans from temperate to subarctic latitudes. Right whales prefer shallow coastal waters, but their distribution is also strongly correlated to the distribution of zooplankton prey. In both northern and southern hemispheres right whales are observed in low latitudes and in nearshore waters during winter where calving takes place.[7] During the summer and fall months right whales tend to migrate to the high latitudes where their distribution is likely linked to the patchy distribution of their principal zooplankton prey (Winn *et al.* 1986, Perry *et al.* 1999).

4.1 North Atlantic Right Whale (*Eubalaena glacialis*)

4.1.1 Distribution

Prior to extensive exploitation,[8] the North Atlantic right whale was found distributed in temperate, subarctic, coastal and continental shelf waters throughout the North Atlantic Ocean rim (Perry *et al*. 1999). The post-exploitation distribution is largely limited to the western North Atlantic Ocean (i.e., Florida to Canada). Based on whaling records, it appears that right whales in the eastern North Atlantic migrated along the coast from northern Europe to northwest Africa. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are currently rare (Best *et al.* 2001).

In the western North Atlantic, right whales migrate along the North American coast from Nova Scotia to Florida. Considerable data exist documenting utilization of areas in the western North Atlantic Ocean where right whales presently occur. Data have revealed five major habitats or congregation areas for right whales in the western North Atlantic: Georgia-North Florida coast; the Great South Channel and northern edge of George's Bank; Massachusetts Bay and eastern Cape Cod Bay; the Bay of Fundy; and the southeastern Scotian Shelf (Browns and Baccaro Banks) (Winn *et al.* 1986). The Georgia-Florida region is used in winter largely as a calving area. The other four areas are recognized as important feeding areas.

Right whales have been observed from the Mid-Atlantic Bight northward through the Gulf of Maine during all months of the year. Foraging right whales (and their habitat) appear to be concentrated in New England waters. In New England, peak abundance of right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring (May), peak right whale abundance occurs in Wilkinson Basin to the Great South Channel (Kenney *et al.* 1995). In late June and July, right whale distribution gradually shifts to the northern edge of Georges

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[7] The specific location of the calving grounds of Pacific right whales is not known at this time.

[8] Right whales were the first whale species exploited for commercial purposes. Basque whalers began harvesting eastern North Atlantic right whales in the Bay of Biscay in the 1100s (Aguilar 1986). Exploitation continued through the early 1900s (Perry et al. 1999).

Bank. In late summer (August) and fall, much of the population is found in waters in the Bay of Fundy and around Roseway Basin (Winn *et al.* 1986, Kenny *et al.* 1995, Kenny *et al.* 2001). Variation in the abundance and development of suitable food patches appears to modify the general patterns of movement by reducing peak numbers, stay durations and specific locales (Brown *et al.* 2001, Kenny 2001). In particular, large changes in the typical pattern of food abundance will dramatically change the general pattern of right whale habitat use (Kenny 2001). Known wintering areas for this population occur along the southeastern U.S. coast where calving occurs from December through March (Winn 1984, Kraus *et al*. 1986, IWC 1986). In the North Atlantic it appears that not all reproductively active females return to the calving grounds each year (Kraus *et al.* 1986; Payne 1986). Right whales are observed in New England waters throughout the winter months. The location of the majority of the population during the winter months remains unknown (NMFS 2005).

Knowlton *et al*. (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland; in addition, recent resightings of photographically identified individuals have been made off Iceland, arctic Norway and in the old Cape Farewell whaling ground east of Greenland. The Norwegian sighting (in September 1999) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Similarly, records from the Gulf of Mexico (Moore and Clark 1963, Schmidly *et al*. 1972) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States (Waring *et al*. 2004).

4.1.2 Abundance and Trends

The current distribution and migration patterns of the eastern North Atlantic right whale population are unknown. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare. Based on a census of individual whales identified using photo-identification techniques and the assumption that whales not seen for 7 years are dead, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al.* 1994); an updated analysis using the same method gave an estimate of 299 animals in 1998 (Kraus *et al.* 2001). Because this was a nearly complete census, it is assumed that this represents a minimum population size estimate. However, no estimate of abundance with an associated coefficient of variation has been calculated for this population. Calculation of a reliable point estimate is likely to be difficult given the known problem of heterogeneity of distribution in this population. An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al.* 2001).

The population growth rate reported for the period 1986-1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12[9]), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) has suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990's. The decline was statistically significant. Additional work conducted in 1999 was reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001). The workshop concluded, based on several analytical approaches, that survival had indeed declined in the 1990's. Although heterogeneity of capture could negatively bias survival estimates, the workshop concluded that this factor could not account for the entire observed decline, which appeared to be particularly marked in adult females. NMFS convened another workshop in September 2002. After reviewing several approaches to survival estimation, that workshop reached similar conclusions regarding the decline in this population (Clapham 2002).

With regard to the western North Atlantic population, the IWC workshop report also stated the following:

> "Whereas it may have increased since protection in 1935... and may still be increasing at a modest rate (about 2.5 percent) in the 1980s (Knowlton *et al.* 1994), more recent data (near-failure of calf production from 1993-95, increased calving interval, and a relatively large number of human-induced mortalities) suggest that this modest recovery rate (by comparison to the Southern Hemisphere) may not have continued in the 1990s. North Atlantic parous females show an increase between 1985 and 1997 but with an apparent long-term oscillation in recruitment. These features together with the lack of significant increase in calving rates, support the need for age-structured models to account for the complexity of this population's dynamics. It is now unclear whether the population is declining, stationary or increasing and the best estimate of current population size is only 300 animals."

[9] In contrast, southern right whale populations (those off Argentina, Australia and South Africa) are increasing at annual rates on the order of 7-8 percent (IWC 1998).

Caswell *et al* (1999) found that these rates decreased from about 0.99 per year in 1980 to about 0.94 in 1994, and that population growth rate declined from about 5.3 percent in 1980 to a negative 2.4 percent in 1994 (Caswell *et al*. 1999). This model suggested that the population was headed for extinction with an upper bound on the expected time to extinction of 191 years (Caswell *et al.* 1999).

4.2 North Pacific Right Whale (*Eubalaena japonica*)

4.2.1 Distribution

Historically, right whales occurred across the entire North Pacific Ocean from the western coast of North America to the Russian Far East (Scarff 1986; Brownell *et al.* 2001, Clapham *et al.* 2004, Shelden *et al.* 2005). Sightings in the twentieth century were from as far south as central Baja California, Mexico and the Yellow Sea, and as far north as the Bering Sea and the Okhotsk Sea (Goddard and Rugh 1998; Brownell *et al.* 2001). A recent comprehensive summary of all 20th century records of right whales in this ocean reported a total of 1,965 sightings, 741 catches and 13 strandings or entanglements (Brownell *et al.* 2001). Details for each sighting are provided for both the western (Brownell *et al*. 2001) and eastern (Brownell *et al*. 2001) populations. Clapham *et al.* (2004) plotted these data by month and discussed apparent seasonal movements (see below). Shelden *et al.* (2005) also plotted 20th century records and attempted to characterize the habitats used by this species.

In the last two decades, right whale sightings have been so rare in the eastern and central North Pacific that single sightings have often resulted in scientific publications (e.g., Rowntree *et al.*. 1980; Herman *et al*. 1980; Carretta *et al.* 1994; Rowlett *et al*. 1994; Goddard and Rugh 1998; Gendron *et al*. 1999; Salden and Mickelsen 1999, Waite *et al.* 2003). It is evident that there are markedly fewer sightings since 1964, which is now known to be due to large illegal Soviet catches of this species in the early 1960s (Doroshenko 2000). The current paucity of sightings of right whales in the eastern North Pacific is apparent despite high levels of survey effort in the region, notably from Japanese sighting surveys (Miyashita and Kato 1998). Recent summer sightings of right whales in the eastern Bering Sea (Goddard and Rugh 1998; Tynan 1998, 1999; Moore *et al.* 2000; LeDuc *et al.* 2001; Tynan *et al.* 2001, Wade *et al.* 2006) represent the first reliable observations of associated groups in the eastern North Pacific since the 1960s.

Sightings of right whales have been made with greater regularity in the western North Pacific, notably in the Okhotsk Sea, Kuril Islands and adjacent areas (Brownell *et al.* 2001)(see section 4.2.2). It is clear that abundance here is significantly larger than in the eastern North Pacific although there is no agreement on current abundance. In the western North Pacific Ocean, feeding areas occur in the Okhotsk Sea and adjacent waters along the coasts of Kamchatka and the Kuril Islands (IWC 2001a). Historical concentrations of sightings in the Bering Sea together with some recent sightings indicate that this region, together with the Gulf of Alaska, was an important summer habitat for eastern North Pacific right whales (Scarff 1986; Goddard and Rugh 1998; Brownell *et al*. 2001, Clapham *et al.* 2004, Shelden *et al.* 2005).

Little is known regarding the migratory behavior of either the western or eastern North Pacific whales. 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). During summer, whales were found in the Gulf of Alaska, along both coasts of the Kamchatka Peninsula, the Kuril Islands, the Aleutian Islands, the southeastern Bering Sea and in the Okhotsk Sea. Fall and spring distribution was 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 were found in the Ryukyu Islands (south of Kyushu, Japan), the Bonin Islands, the Yellow Sea and the Sea of Japan. The current distribution patterns and migration routes of these whales are not known.

Right whales are frequently found in coastal or shelf waters. Such sightings, however, may be partially a function of survey effort, and thus may not reflect current or historical distribution. Sighting records also indicate that right whales occur far offshore, and movements over abyssal depths are known (Scarff 1986; Mate *et al.* 1997). Clapham *et al.* (2004) plotted 20th century records together with data summarized from 19th century whaling catches. These plots show that right whales had an extensive offshore distribution in the 19th century, and were common in areas where few or no right whales occur today. Seasonal movements of right whales were apparent in the data, and were characterized by a general northward migration in spring from lower latitudes and major concentrations above 40^{o} N in summer. Sightings diminished and occurred further south in autumn, and very few animals were recorded anywhere in winter. Whalers never reported winter calving areas in the North Pacific and where calving occurs remains unknown (Scarff 1986, Clapham *et al.* 2004). Overall, these analyses confirmed that the size and range of the right whale population is now considerably diminished in the North Pacific relative to the situation during the peak period of whaling for this species in the 19th century.

Tynan *et al.* (2001) suggested that right whales had changed their distribution in the last 50 years. These researchers reached this conclusion based on the frequency of recent sightings in one area of the southeastern Bering Sea (known as the "Box"). Contrary to the assertion in their paper, the major whaling period for this species was not the 1940s to 1960s, but from 1835 to the 1850s, and the reduction in both numbers and range is evident in sightings and catch data (Clapham *et al.* 2004, Shelden *et al*. 2005). The population underwent slow recovery in the 20th century, but was decimated again by the illegal Soviet whaling noted above. By focusing on only the recent hunting history, Tynan *et al.* (2001) mistakenly concluded that a habitat shift has occurred when in reality the whales they found on their surveys were in a small (but historically well-documented) portion of their former range.[10] Furthermore, Tynan *et al.*'s survey coverage was not adequate to document any absence of whales from other historic habitats. This was further reinforced by the discovery in the summer of 2004 of some 24 right whales (the largest concentration observed in the eastern North Pacific in decades) outside the "Box" (Wade *et al*. 2006) and again in October 2005 when about 12 right whales were observed just north of Unimak Pass (NMML unpublished data).

[10] It appears that these authors were unaware of the large number of right whales killed in the 1960s by Soviet whaling operations on the Bering Sea Shelf (see Doroshenko 2000).

4.2.2 Abundance and Trends

Recently released information (Yablokov 1994; Doroshenko 2000; Brownell *et al.* 2001) indicates that Soviet whalers caught 372 right whales in the Bering Sea, Aleutian Islands and Gulf of Alaska, mostly over a three-year period in the 1960s. The continued illegal exploitation of North Pacific right whales further reduced abundance in the eastern North Pacific. Despite high levels of survey effort in the region, most notably from Japanese sighting surveys (Miyashita and Kato 1998) right whale sightings in the eastern North Pacific have been rare and geographically scattered (Perry *et al*, 1999). Recent sightings of right whales in the eastern Bering Sea during the summer (Goddard and Rugh 1998; Tynan 1998, 1999; Moore *et al.* 2000; LeDuc *et al.* 2001; Tynan *et al* 2001; Wade *et al*. 2006) represent the first reliable observations of aggregations of right whales in the eastern North Pacific since the 1960s. Although a few calves have recently been documented in the eastern North Pacific (Goddard and Rugh 1998; LeDuc 2004; Wade *et al.* 2006), these were the first such sightings in over a century (Brownell *et al.* 2001).

From sighting data collected during minke whale surveys, Miyashita and Kato (1998) an abundance estimate of 900 right whales for the western North Pacific. These surveys covered only a small portion (50-56°N, 143°E, Kamchatka Peninsula) of the historic range in the western North Pacific. The associated confidence limits of these estimates were large (404 to 2,108) and it is likely that this number will be revised. Given this, and levels of recent sightings in the western North Pacific (Brownell *et al.* 2001), it is clear that abundance is significantly larger than that in the eastern North Pacific. Calves have been observed with some regularity in the western North Pacific (Miyashita and Kato 1998, Brownell *et al.* 2001), which appears large enough to sustain reproduction.

5. Analysis of Demographic Risks

5.1 North Atlantic Right Whale (*Eubalaena glacialis*)

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. Females give birth to their first calf at an average age of nine years (Best *et al.* 1998; Hamilton *et al.* 1998a). Standard reproductive rates for the western North Atlantic population have yet to be calculated. The magnitude and severity of demographic risks depend on two critical aspects of a population: population size and trends in population size. The right whale life history characteristics (e.g., long-lived, late age of sexual maturity) increase their vulnerability to threats.

As discussed (section 3.1.1), the calving interval for right whales is between 2 and 7 years, with means ranging from 3.12 (95% CI 3.05-3.17) to 3.67 years (95% CI 3.3-4.1) (Knowlton *et al.* 1994; Best *et al.* 2001; Burnell 2001; Cooke *et al.* 2001). In the western North Atlantic, there was a significant increase in the calving interval from 3.67 years for the period 1980 to 1992 (Knowlton *et al.* 1994) to 5.8 years for the period 1990 to 1998 (Kraus *et al.* 2001).[11] The increase in the calving interval is of particular concern and, together with other perplexing biological parameters, may suggest the population is under rather unusual biological, energetic, or reproductive stress.

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Hamilton *et al* 1998a, Best *et al*. 2001), which may reflect low recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to unstable age structure or to decreased reproduction due to aging (i.e., reproductive senescence) on the part of some females (Waring *et al*. 2004).

The size of the western population of North Atlantic right whales at the cessation of whaling is unknown, but generally it is believed to have been very small. Such a reduction of population size may have resulted in a loss of genetic diversity that could affect the ability of the current population to successfully reproduce (e.g., decreased conceptions, increased abortions, increased neonate mortality). Studies by Schaeff *et al*. (1997) and Malik *et al*. (2000) indicate that the western population of North Atlantic right whales is less genetically diverse than southern right whales. However, several apparently healthy populations of cetaceans, such as sperm whales and pilot whales, have even lower genetic diversity than observed in the western North Atlantic right whales (IWC 2001b).

[11] As noted in section 3.1.1, most recently (2001-2005), a dramatic increase in North Atlantic right whale calving (23 calves per year) may have decreased the interval to levels more similar to that of the southern right whale (Kraus et al. in press).

The western population of North Atlantic right whales remains at very low levels of estimated population size making it vulnerable to demographic risks posed by continued human-induced mortalities. The North Atlantic right whales' association with shallow coastal areas along the highly populated coast of North America and the number and distribution of major shipping lanes and fishing grounds that occur throughout the right whales' range increase the probability of interactions between right whales and ship traffic and fishing gear.

Fujiwara and Caswell (2001) concluded that the death of female whales, particularly reproductive females, appears to pose the greatest demographic risk of extinction. The mortality of mature, reproductive females results in declines in population growth rate, life expectancy and the mean lifetime number of reproductive events (Fujiwara and Caswell 2001).

The available evidence strongly suggests that the western population of North Atlantic right whale cannot sustain the number of deaths that result from vessel and fishing gear interactions. If the impact of these activities continue at current rates, the extirpation of the western population of North Atlantic right whales is likely. Given the low population size of right whales in the eastern Atlantic Ocean, the extirpation of right whales in the western Atlantic Ocean would render the entire species effectively extinct.

5.2 North Pacific Right Whale (*Eubalaena japonica*)

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. Until recently, it was thought that the right whale had been extirpated from the eastern North Pacific Ocean. Recent sightings suggest that the abundance in the eastern North Pacific is indeed very small, perhaps in the tens of animals.

The life history characteristics and habitat requirements of this species make it extremely vulnerable to environmental variation and demographic stochasticity at such low numbers. Right whale life history characteristics make them very slow to adapt to rapid changes in their habitat (see Reynolds *et al.* 2002). They are also feeding specialists that require exceptionally high densities of their prey (see Baumgartner and Mate 2003, Baumgartner *et al.* 2003). Zooplankton abundance and density in the Bering Sea has been shown to be highly variable, affected by climate, weather, and ocean processes and in particular ice extent (Napp and Hunt 2001, Baier and Napp 2003).

In 2002, the ratio of females to males biopsied in the Bering Sea was 1:9. In 2004, biopsy results indicated a considerably improved ratio of 7:16. Excluding the two male calves from the sample and assuming all other whales were adults, a 1:2 ratio of females to males can be estimated, with a possible effective abundance of 21. At such low numbers, the potential for North Pacific right whales to find viable mates or even mates at all may be severely reduced. The presence of two calves during the 2004 season in the Bering Sea (Wade *et al.* 2006) is encouraging. However, to

date, there is no evidence of reproductive success (i.e., young reared to independence) of animals that return to the eastern North Pacific for feeding.

Commercial whaling very likely reduced the genetic variability of North Pacific right whales. The small, remnant populations that survived commercial whaling likely lost genetic variability because of genetic drift and inbreeding, further confounding recovery efforts. For example, genetic analysis of North Atlantic right whales suggests that inbreeding depression is slowing the recovery of this population, compared to southern right whales which exhibit greater genetic variation (Schaeff *et al*. 1997). North Pacific right whales may be experiencing similar problems. Low diversity potentially affects individuals by depressing fitness, resistance to disease and parasites, and adaptability to environmental changes, and it affects populations by decreasing growth rates, resilience, and adaptability over the long-term (Lacy 1997). Marine mammal populations with an effective population size of a few dozen individuals are usually sufficiently large to avoid most of the deleterious consequences of inbreeding (Lande 1991). It has also been suggested that if the number of reproductive animals is fewer than 50, the potential for impacts associated with inbreeding depression increases substantially (IUCN 2003).
Given that the population is extremely small and little current information is available, recovery is not anticipated in the foreseeable future (e.g., several decades or longer). The basic life history parameters and census data, including population abundance, growth rate, age structure, breeding ages, gender ratios and distribution remain 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 knowledgeable and informed decisions by applying specific criteria to address the survival and recovery of this species.

6. Analysis of ESA Section 4(a)(1) Factors

The ESA defines an endangered species as any species in danger of extinction throughout all or a significant portion of its range. It defines a threatened species as any species likely to become endangered within the foreseeable future. Section 4(b)(1)(a) of the ESA requires that determinations of whether a species is threatened or endangered be based solely on the best scientific and commercial data available and after taking into account those efforts, if any, being made to protect the species. Section 4(a)(1) of the ESA explicitly states that the Secretary of Commerce shall determine whether a species is endangered or threatened because of any of the following five factors:

1. The present or threatened destruction, modification, or curtailment of habitat or range;
2. Overutilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms;
5. Other natural or manmade factors affecting its continued existence.

Each of these five factors is examined in the following sections for its historic, current and/or potential impact on the North Atlantic right whale (*E. glacialis*) and North Pacific right whale (*E. japonica*). It should be noted that past and current impacts and potential threats, along with current species distribution and abundance, demographic trends, and life history traits, determine present vulnerability to extinction.

6.1 North Atlantic Right Whale

6.1.1 The present or threatened destruction, modification, or curtailment of its habitat or range

Habitat loss or degradation is not believed to be a causal factor in placing the North Atlantic right whale in danger of extinction at this time or in the foreseeable future. Unlike many terrestrial species, right whales and other cetaceans do not compete directly with human populations for space (Clapham *et al*. 1999). However, right whales are dependent on coastal waters adjacent to highly developed coastline; habitat degradation may adversely affect this species. Consequently, threats to right whales may arise from onshore and near shore activities.

Right whales frequent coastal waters where dredging and dredge spoil disposal occur on a regular basis, such as along the southeastern U.S. coast (Perry *et al*. 1999). Dredging of harbors and port channels occurs in a number of locations in or near areas where right whales aggregate. Noise, increased ship traffic, disposal of dredge material, and related activities may all contribute to degrade right whale habitat. It is unknown to what extent these activities affect right whales (Perry *et al*. 1999). It appears that more information is needed to determine specific habitat impacts, if any, from these activities. Increased ship traffic associated with dredging activities

may increase the risk of ship strikes of right whales resulting in serious injury and mortality (see section 6.2.5). At present, efforts made to reduce adverse effects on right whales include posting observers on ships transporting dredge spoils to reduce the risk of ship strikes.

One of the most direct potential sources of habitat degradation for baleen whales is oil pollution. General concerns with regard to oil pollution are ingestion of contaminated prey, potential irritation of skin and eyes, inhalation of toxic fumes, and abandonment of polluted feeding habitat (Geraci and St. Aubin 1980, Geraci 1990). However, data on the effects of oil pollution on cetaceans are inconclusive, and the large baleen whales appear to be generally unaffected by oil per se (Geraci 1990, Loughlin 1994). Offshore oil and gas exploration activities have been proposed off the U.S. Atlantic coast. At the present time however, there are no known plans for oil exploration in the major habitats of the western North Atlantic right whale, but the possibility remains for the future. In addition to oil and gas exploration and production, the undersea exploration and development of techniques for mining minerals deposits could threaten North Atlantic right whales and their habitat (Perry *et al*. 1999).

The effect on critical behavior (e.g., foraging, mating, nursing) of noise pollution from shipping or oil and gas development is unclear, although various observations suggest that marine mammals can habituate well to even quite high levels of sound (Geraci and St. Aubin, 1980, Richardson *et al*. 1995). Playback experiments on gray and bowhead whales indicate that whales will actively avoid a very loud sound source (Malme *et al*. 1983), but whether real-life sources (such as drilling platforms) negatively impact behavior to the point that it diminishes reproductive success and population productivity is unclear. It appears that right whale sensitivity to noise disturbance and vessel activity is related to the behavior and activity in which they are engaged in at the time (Watkins 1986, Perry *et al*. 1999).

Some studies suggest increased recreational boat traffic can disrupt behavior (e.g., in humpback whales (Glockner-Ferrari and Ferrari 1990)). For example, fast power boats, jet skis and parasails may disrupt and disturb right whales and pose a threat to whales even if their operators are not intentionally observing the animal itself. Pleasure boat traffic exists in various coastal areas with little regulation or enforcement; however, its impact on right whale is unknown.

An additional potential source of habitat degradation for right whales is contaminants. The impact of pollution on right whales is debatable. O'Shea and Brownell (1994) conclude that there is currently no evidence for significant contaminant-related problems in baleen whales. Although more research is needed, the existing data on mysticetes support the view that the lower trophic levels at which these animals feed should result in lower levels of contaminant accumulation than would be expected in many odontocetes, which typically show concentrations that differ from those of baleen whales by an order of magnitude (O'Shea and Brownell 1994). However, the manner in which pollutants negatively impact animals is complex and difficult to study, particularly in taxa (such as large whales) for which many of the key variables and pathways are unknown (Aguilar, 1987; O'Shea and Brownell 1994). A more plausible potential problem is that of transgenerational accumulation (Colborn and Smolen 1996), but this remains unstudied in right whales or any other cetacean species.

6.1.2 Overutilization for commercial, recreational, scientific, or educational purposes

Right whales have not been the target of commercial hunting in the North Atlantic since 1935, and relatively few catches were made in the 20th century prior to that date. Historical whaling activities are responsible for the extirpation of the eastern population of the North Atlantic right whale and the current severely depleted numbers of individuals remaining in the western population. The small population size of North Atlantic right whales is probably the largest threat to continued existence because small populations are subject to extinction from a variety of threats that would not seriously effect a larger population. The North Atlantic right whale is in danger of extinction throughout its range because of historical whaling. Unlike right whales in the North Pacific, there is no evidence of the illegal harvest of right whales by the USSR or any other nation in the western North Atlantic.

An estimate of pre-exploitation population size is not available. Basque whalers may have taken substantial numbers of right whales at times during the 1500's in the Strait of Belle Isle region (Aguilar 1986), and the stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600's (Reeves and Mitchell 1987). A modest but persistent whaling effort along the coast of the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, Reeves and Mitchell (1987) could conclude only that there were at least some hundreds of right whales present in the western North Atlantic during the late 1600's. In a later study (Reeves *et al.* 1992), a series of population trajectories using historical data and an estimated present population size of 350 were plotted. The results suggest that there may have been at least 1,000 right whales in this population during the early to mid-1600's, with the greatest population decline occurring in the early 1700's. The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by the time international protection for right whales came into effect in 1935 (Hain 1975, Reeves *et al.* 1992, Kenney *et al.* 1995). However, too little is known about the population dynamics of right whales in the intervening years to state anything with confidence.

An intense period of whaling in the eastern North Atlantic between 1902 and 1967 (including harvest off the Shetlands, Hebrides and Ireland in the years 1906-1910) was particularly catastrophic for the eastern North Atlantic right whale population. Since that time, there have only been sporadic sightings of right whales in the eastern North Atlantic (Best *et al.* 2001). In two recent winter surveys of Cintra Bay, no evidence was found to suggest that right whales still use the area; this absence of evidence also corresponds to a lack of recent observations in northern European waters (Reeves 2001). Based on the paucity of sighting information, current distribution and migration patterns of the eastern North Atlantic right whale population are unknown.

With respect to recreational and educational use, problems may arise from boats whose operations are directed at the whales themselves (i.e., whale watching from either commercial or

recreational vessels). These activities have the potential to disturb right whales or disrupt their activities and behavior such as feeding, courtship and nursing. The impact of such harassment on the reproductive success of individuals has not been studied and is unknown. Currently, federal regulations prohibit the close approach by vessels within 500 yards of North Atlantic right whale in U.S. waters. This activity is allowed in Canadian waters.

Scientific research on right whales frequently involves close approaches to the animals for the purpose of photographic, genetic, or behavioral sampling. These activities are controlled by permits in both U.S. and Canadian waters, and the potential adverse impact on the animals is considered during the permitting process. Efforts are needed to ensure coordination of research activities between the U.S. and Canada, as well as among U.S. researchers themselves to minimize any potential adverse impact to right whales.

6.1.3 Disease or predation

Disease and predation are not believed to be factors causing the North Atlantic right whale to be in danger of extinction. Unlike in some dolphin and pinniped (i.e., seals and sea lions) species, there have been no recorded epizootics in baleen whales. The occurrence of skin lesions on the bodies of North Atlantic right whales has been documented in recent years, with an apparent increase in frequency culminating in a peak in 1995 when they were observed on 24 percent of photographed individuals (Marx *et al*. 1999). The origins and significance of these lesions are unknown, and further research is required to determine whether they represent a topical or systemic health problem for the affected animals.

In October 2006, NMFS declared an unusual mortality event (UME) for humpback whales in the Northeast United States. At least 17 dead humpback whales have been discovered since March 2006. There has also been a documented bloom of *Alexandrium sp*., a toxic dinoflagellate that causes red tide from Maine to Massachusetts. Prior to the most recent UME, there had been only three other known cases of a mass mortality involving large whale species along the east coast: 1987-1988, 2003 and 2005. Geraci *et al*. (1989) provide strong evidence that these deaths resulted from the consumption of mackerel whose livers contained high levels of saxitoxin, a naturally occurring red tide toxin the origin of which remains unknown. It has been suggested that the occurrence of a red tide event is related to an increase in freshwater runoff from coastal development, leading some observers to suggest that such events may become more common among marine mammals as coastal development continues. There is currently no conclusive evidence linking red tide toxins to the deaths or chronic health problems in right whales. Doucette et al (2006) assessed the occurrence of paralytic shellfish poisoning (PSP) toxins in right whales and in co-occurring zooplankton assemblages dominated by *C. finmarchicus*, the primary food of the North Atlantic right whale. Samples of right whale feces collected from at least 11 different whales by these researchers in the Bay of Fundy tested positive for PSP toxins. These results suggest that trophic transfer of marine algal toxins may be a factor inhibiting the recovery of the North Atlantic right whale.

Predation of right whales by killer whales and large shark species is likely to occur, but the level is not documented. North Atlantic right whales bearing scars thought to be from killer whale attacks have been photographed (Kraus 1990), but the number of whales killed by this predator is unknown (Perry *et al*. 1999). Mehta (2004) more recently concluded that scars recorded on the flukes and bodies of North Atlantic right whales are more consistent with harassment by some smaller cetacean, possibly pilot whales (*Globicephala* spp). and do not originate from killer whales.

6.1.4 The inadequacy of existing regulatory mechanisms

Right whales are protected under both U.S. and Canadian law, and internationally by the IWC. Death and serious injury resulting from ship strikes and entanglement in fishing gear are significant factors that, at current rates, place the North Atlantic right whale in danger of extinction throughout its range. As discussed in Chapter 7 (Current Conservation Efforts) there are numerous ongoing conservation efforts to reduce the impact of ship strikes on the survival and recovery of the species. These efforts involve federal, state, local, conservation, academic and industry agencies and organizations. The NMFS, in cooperation with other state, federal, industry and private groups and organizations, is developing a plan to implement a broad Ship Strike Reduction Strategy designed to reduce the threat posed by vessel interactions to the survival of the North Atlantic right whale.

The Ship Strike Reduction Strategy consists of both regulatory and non-regulatory components. The ship strike reduction conservation efforts have been implemented, in large part, under the statutory authority of the ESA and the MMPA. Certain details of the Strategy are still under development. As part of efforts to implement the Ship Strike Reduction Strategy, NMFS published an advanced notice of proposed rulemaking (ANPR) in June 2004 (69 FR 30857) and proposed regulations in June 2006 that contain speed restrictions and routing measures to reduce the likelihood of collisions between vessels and endangered North Atlantic right whales (71 FR 36299).

The NMFS has implemented a number of measures to reduce the threat posed to right whales from fishing gear interactions and entanglements (see Chapter 7). The NMFS, with the assistance of the Atlantic Large Whale Take Reduction Team (ALWTRT), developed the Atlantic Large Whale Take Reduction Plan (ALWTRP). The goal of this plan is to reduce the level of serious injury and mortality of three strategic stocks of large whales, including North Atlantic right whales in commercial gillnet and trap/pot fisheries. In general, the ALWTRP consists of a combination of regulatory and non-regulatory programs, including broad gear modifications, time-area closures, expanded disentanglement efforts, extensive outreach efforts in key areas, gear research, and an expanded right whale surveillance program to supplement the Mandatory Ship Reporting System.

Since its implementation in 1997, the ALWTRP has been modified on several occasions in response to the serious injury and mortality of large whales in gillnet and lobster trap/pot gear. Recent amendments to the ALWTRP have included restrictions to the Southeast Atlantic gillnet

fishery (67 FR 59471; 68 FR 19464). Other amendments to the ALWTRP include additional gear modifications for lobster trap/pot gear in particular management areas and changes to the lobster trap/pot and gillnet take reduction technology lists (67 FR 1300; 67 FR 15493), a Seasonal Area Management (SAM) program (67 FR 1142; 67 FR 65722), and a Dynamic Area Management (DAM) program (67 FR 1133; 67 FR 65722) and implementation of gear modifications determined to sufficiently reduce the risk of entanglement to right whales (68 FR 10195; 68 FR 51195).

The NMFS continues to work with the ALWTRT to evaluate the ALWTRP and determine whether additional modifications are necessary to meet the goals of the MMPA and the ESA. In June 2003, NMFS published a Notice of Intent (NOI) in the *Federal Register* to announce the agency's intent to prepare an Environmental Impact Statement (EIS) to analyze the impacts of alternatives for amending the ALWTRP (68 FR 38676). In June 2005, NMFS also published a proposed rule in the *Federal Register* that details how modifications to the ALWTRP will be implemented. At this time, the final EIS and rule are expected to be available in the near future.

Despite previous efforts, ship strikes and fishing gear interactions remain a serious threat to the continued existence and recovery of the species. As the new conservation measures discussed above are implemented, the frequency of ship strikes and fishing gear interaction will need to be monitored to assess the effectiveness of measures to reduce these threats to the species. Based on the efficacy of these measures, it may be necessary to continue or enhance existing regulations, or promulgate new regulations to reduce or eliminate these threats.

6.1.5 Other natural or manmade factors affecting its continued existence

Ship collisions and fishing gear entanglements are the most common anthropogenic causes of mortality in western North Atlantic right whales, and place the species in danger of extinction throughout its range.

Vessel Collisions

Collisions with ships are the single largest cause of right whale mortality in the western North Atlantic. Of 45 confirmed deaths of western North Atlantic right whales between 1970 and 1999, 16 are known to have been caused by ship strikes and two additional collisions were possibly fatal (Knowlton and Kraus 1998). There were two known ship strike right whale deaths in 2001, one in both 2002 and 2003, and two in 2004. The low incidence (7 percent) of photographically identified whales showing scars and wounds from ship propellers compared to the high rate of ship propeller wounds on stranded carcasses indicates that a high proportion of interactions between ships and whales are fatal to the whale (Kraus 1990). It should be noted that with improved reporting and more thorough necropsies in recent years, the rate of detection and confirmation of ship-strike deaths has probably increased. This may confound efforts to determine trends in the frequency of collisions.

As discussed, concern has been raised over the possible adverse effects of whale-watching and scientific research activities on right whale aggregations, particularly in the western North Atlantic (i.e., Cape Cod Bay and lower Bay of Fundy). Recent minimum distance regulations (i.e., 500-yard no approach regulations for right whales) are designed to reduce the potential to disturb right whales or disrupt their activities and reduce the threat of vessel collision. However, collisions between whale-watching boats and a humpback (2001) and a minke whale (1998) indicate that much more serious consequences, e.g., death or serious injury, are also possible. In addition, the number of high-speed (capable of speeds >28 knots) whale-watch vessels, ferries, and other craft has increased recently in areas where right whales occur. Consequently the threat of collisions has potentially grown. It may be necessary to examine the effects of whale watching in the vicinity of right whales and issue additional regulations and/or guidelines regarding the number of vessels, and their speed, manner and distances of approaches near whales. In February 1997 an interim final rule (62 FR 6729) was published that prohibits both boats and aircraft from approaching any right whale closer than 500 yards.

Fisheries Interactions

The exact magnitude and nature of fisheries interactions on right whales is not known. Kraus (1990) estimated that 57 percent of right whales in the western North Atlantic bear scars and injuries indicating fishing gear interaction. More recent analysis estimated that 61.6 percent of right whales exhibit evidence of fishing gear entanglement (Hamilton *et al*. 1998b). The 1998 North Atlantic Stock Assessment Report (Waring *et al.* 1999) indicated NMFS-monitored fisheries showed a mean annual mortality of 1.0 right whale from 1992 through 1996. Sources of interaction mainly lie with gillnets, lobster pots, seine nets[12] and fish weirs (NMFS 1991), which, with the exception of gillnet fisheries, are largely not monitored. Gear entanglement was estimated to account for 7 percent of the known mortality in right whales in the western North Atlantic from 1970 through early 1993 (Kenney and Kraus 1993). There were at least two additional entanglement deaths between late 1993 and 1999 (Knowlton and Kraus 2001). Since 2001 there has been at least one additional mortality due to entanglement. These mortalities involved entanglements with fixed fishing gear. Of 45 known deaths between 1970 and 1999, three were directly linked to entanglements and eight were suspected to have been linked to entanglements. Entanglements may be responsible for more deaths than indicated by the stranding and necropsy data. It is possible that fishing gear was responsible for some of the deaths for which a cause could not be determined. In addition, some whales may become entangled, drowned, and fail to resurface. Injuries and entanglements that are not initially lethal may result in a gradual weakening of entangled individuals, making them more vulnerable to some other direct cause of mortality (Kenney and Kraus 1993). For example, entanglement may reduce a whale's ability to maneuver, making it more susceptible to ship strikes. Entanglement-related stress may decrease an individual's reproductive success or reduce its life span. This may in turn depress population growth.

[12] There was one documented instance of a Danish seine killing a right whale off of Newfoundland.

6.2 North Pacific Right Whale (*Eubalaena japonica*)

6.2.1 The present or threatened destruction, modification, or curtailment of its habitat or range

One potential source of habitat degradation for baleen whales is spilled oil. Data on the effects of oil pollution on cetaceans are inconclusive (Geraci 1990, Loughlin 1994). General concerns with regard to oil pollution are ingestion of contaminated prey, potential irritation of skin and eyes, inhalation of toxic fumes, and abandonment of polluted feeding habitat (Geraci and St. Aubin 1980, Geraci 1990). Although there is currently no oil exploration or production underway in known right whale habitat in offshore areas of the Bering Sea or Gulf of Alaska, the possibility remains that there will be lease sales in these areas in the future. Furthermore, large amounts of oil are transported by ship along the western North American coast through areas that have been used by right whales in the past, and where they have been occasionally seen recently (Brownell *et al*. 2001).

Offshore oil and gas leasing has occurred in the northern range of the North Pacific right whale, in both the Gulf of Alaska and Bering Sea. No discoveries have been announced, and most leases have proven to be absent of commercially-significant deposits. No oil spills have resulted from oil and gas exploratory activities to date. At present, there are no offshore oil and gas activities underway in the Bering Sea or eastern North Pacific waters. The Mineral Management Service (MMS) proposed an Outer Continental Shelf leasing plan for 2007-2012. The MMS' proposed leasing plan called for conducting lease sales for the North Aleutian Basin (in the southeast Bering Sea) in 2010 and 2012. The proposed lease sales were withdrawn by Presidential Executive Order. It is unknown to what extent these activities may disturb or otherwise affect right whales. In addition to oil and gas exploration and development, undersea exploration and development of mineral deposits may affect the habitat of the North Pacific right whale.

Development of oil fields off the Sakhalin Islands is occurring within habitat of the western North Pacific population of right whales

As discussed above (see Section 6.1.1), the effect of noise pollution on critical behaviors of marine mammals (e.g. foraging, mating, nursing) is unclear. Richardson *et al.* (1995) provides a review of the impacts of noise on marine mammals. It is unclear whether activities, such as oil exploration and development and shipping, adversely affect critical behaviors such as reproductive success, population productivity and feeding activity. Some observations suggest that marine mammals can habituate to high levels of sound (Geraci and St. Aubin 1980). However, playback experiments on gray and bowhead whales indicate these whales actively avoid very loud sources of noise (Malme *et al*. 1983).

While certain species of large whales have shown behavioral changes to anthropogenic noise in the marine environment, there have been few studies of the effects of anthropogenic noise on

right whales specifically. In right whales, the level of sensitivity to noise disturbance and vessel activity appears related to the behavior and activity in which they are engaged at the time (Watkins 1986; Mayo, Watkins, and Kraus personal communication, as cited in NMFS 1991; Kraus and Mayo unpubl. data as cited in NMFS 1991). In particular, feeding or courting right whales may be relatively unresponsive to loud sounds and, therefore, slow to react to approaching vessels or even oblivious to them. In general, the impact of noise from shipping or industrial activities on the communication, behavior and distribution of right whales remains unknown.

As discussed (see Section 6.1.1), chemical contaminants are an additional potential source of habitat degradation for right whales. The impact of chemical contaminants on right whales is uncertain. O'Shea and Brownell (1994) conclude that there is currently no evidence for significant contaminant-related problems in baleen whales. Although additional research is needed, existing data on mysticetes indicates that the lower trophic levels that these animals feed at should result in smaller contaminant burdens than would be expected in many odontocetes, which typically show burdens that differ from those of baleen whales by an order of magnitude (O'Shea and Brownell 1994). However, the manner in which pollutants negatively impact animals is complex and difficult to study, particularly in taxa (such as large whales) for which many of the key variables and pathways are unknown (Aguilar, 1987; O'Shea and Brownell, 1994). The transgenerational accumulation of containments (Colborn and Smolen 1996) is perhaps a more likely source for concern, but this remains unstudied in right whales or any other cetacean.

6.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

As discussed, North Pacific right whales were heavily exploited by commercial whalers during the 19th and 20th centuries. The IWC estimates 15,451 right whales were taken in the North Pacific between 1840 and 1909 (Brownell *et al.* 1986). There were 741 recorded catches of right whales in the North Pacific in the 20th century (411 in the eastern unit and 330 in the western unit) (Brownell *et al*. 2001). According to Estes (1979) and Congdon *et al*. (1993), long-lived organisms have limited abilities to respond to chronic increases in juvenile mortality and even less ability to respond to increased mortality through commercial hunting of juveniles and adults. 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 overexploitation. Commercial whaling very likely reduced the genetic variability of North Pacific right whales. The small, remnant populations that survived commercial whaling likely lost genetic variability because of genetic drift and inbreeding, further confounding survival and recovery efforts.

Currently, the IWC has assigned "Protected Stock" status to all stocks of right whales (IWC 1995). The catch quota for these whales is therefore set at zero for all signatory nations at the IWC. The Soviet Union killed right whales illegally for commercial purposes in the Okhotsk Sea/Kuril Islands (reported as Ahundreds@ by Yablokov 1994, although this is known to include

bowhead whales). Furthermore, the Soviets killed 372 right whales in the eastern North Pacific (notably in the Bering Sea and Gulf of Alaska) in the 1960s (Doroshenko 2000). These catches presumably occurred primarily during summer.

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 probably insignificant. We have no information on aboriginal harvests for the western North Pacific. However, given the current status of this species, the North Pacific right whales could not tolerate even a very low level of commercial or aboriginal hunt.

There are no known 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 could be a large response from whale watching operations trying to observe the whale.

Scientific studies of right whales may involve close approaches to the animals for the purpose of photographs, genetic sampling, or tagging. These activities are controlled by permits in both U.S. and Canadian waters, and potential negative impact on the animals is considered in the permitting process. While the potential for disturbance or harassment exists for scientific research, the overall impact from this activity on North Pacific right whales is likely minimal, and the information gained in this research may play a critical role in helping manage and recover the species.

6.2.3 Disease or predation

Very little is known about disease in, or predation on, North Pacific right whales. As discussed above (see Section 6.1.3) there have been no recorded epizootics in baleen whales. Reeves *et al*. (2001) considered five possible factors including disease as explanations for the decline in North Atlantic right whales. The information reviewed and summarized, along with associated caveats at this NMFS workshop are likely applicable to other balaenids (see Reeves *et al*. 2001).

The only two known cases of mass mortalities of baleen whales involved humpback whales (*Megaptera novaeangliae*) in the Gulf of Maine in 1987-1988 and in 2003. Geraci *et al*. (1989) provide strong evidence that, in the former case, these deaths resulted from consumption of mackerel whose livers contained high levels of saxitoxin, a naturally occurring red-tide toxin originating with dinoflagellate (*Alexandrium* spp). It has been suggested that red tide phenomena are related to increased freshwater runoff from coastal development, leading some observers to suggest that such events may become more common among marine mammals as coastal development increases. There is currently no evidence linking red tide toxins to deaths or chronic health problems in North Pacific right whales anywhere.

It is not known whether right whales suffer from stress-induced bacterial infections similar to those observed in captive cetaceans (Buck *et al*. 1987). Studies of bowhead whales killed in the Alaskan native hunt have provided information on bacterial, mycotic and viral infections, but not on the level to which they contribute to mortality and morbidity (Philo *et al*. 1993). Skin lesions,

found on all the hunted bowhead whales, were not malignant or contagious. However, potentially pathogenic microorganisms inhabit these lesions and may contribute to epidermal necrosis and the spread of disease (Shotts *et al*. 1990). Exposure of these roughened areas of skin to environmental contaminants, such as petroleum products, could have significant effects (Albert 1981, Shotts *et al*. 1990); although, Bratton *et al*. (1993) concluded that such encounters were not likely to be hazardous. The occurrence of skin lesions on North Atlantic right whales has been documented in recent years (Marx *et al*. 1999, Pettis *et al*. 2004). The origins and significance of these lesions are unknown, and further research is required to determine whether they represent a topical or systemic health problem for the affected animals. The system developed by Pettis *et al*. (2004) to assess health and body condition of North Atlantic right whales is currently being applied to photographs of North Pacific right whales.

As discussed (see Section 6.1.3), predation of right whales by killer whales and large shark species is likely to occur, but the level is not documented and no attacks have been observed. North Atlantic right whales bearing scars from killer whale, *Orcinus orca*, attacks have been photographed (Kraus 1990), but the number of whales killed by this predator is unknown (Perry *et al*. 1999). More recently, Mehta (2004) concluded that scars recorded on the flukes and bodies of North Atlantic right whales are more consistent with harassment by some smaller cetacean, possibly pilot whales, *Globicephala* spp. and do not originate from killer whales.

Of 195 bowhead whales examined during the Alaskan subsistence hunt (1976-92), 8 had been wounded by killer whales (George *et al*. 1994). Seven of the eight bowhead whales were greater than 13 m in length, suggesting either that scars are accumulated over time, or young animals do not survive a killer whale attack. Hunters on St. Lawrence Island reported two small (<9 m) bowhead whales found dead as a result of killer whale attacks (George *et al*. 1994). Bowhead whales are pagophilic ("ice-loving"), unlike right whales, and ice-covered waters may provide some protection from killer whale attacks. The frequency of attacks is unknown and killer whale distribution in the North Pacific has not been well documented (George *et al*. 1994).

6.2.4 The inadequacy of existing regulatory mechanisms

Right whales are protected under both U.S. and Canadian law, and internationally by the IWC. At present, there is no information to indicate that existing regulatory mechanisms are inadequate, resulting in activities having adverse effects on North Pacific right whales. If additional studies reveal that significant impacts are occurring, it may be necessary to enhance existing laws or promulgate new regulations to reduce or eliminate these threats.

6.2.5 Other natural or manmade factors affecting its continued existence

Vessel Collisions

The role vessel interactions play in the mortality of North Pacific right whales is not known. In the North Atlantic, ship collisions and fishing gear entanglements are the most common direct

known causes of mortality in North Atlantic right whales (Kraus 1990; Knowlton and Kraus 1998; Gillespie and Leaper 2001), but little is known of the nature or extent of this problem in the North Pacific. The area where right whales have been seen in recent surveys is not in a major vessel traffic lane. However, the proximity of the other known right whale habitats to shipping lanes (e.g. Unimak Pass) suggests 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.

Fisheries Interactions

The eastern Bering Sea supports extensive fisheries and therefore fishery interactions with right whales are possible. Types of gear that most frequently entangle North Atlantic right whales include pots and gillnets. Gillnet fisheries in the eastern Bering Sea occur in nearshore waters (state waters) not associated and generally not overlapping with known North Pacific right whale distribution. Pot fisheries occur in offshore waters, but are often prosecuted during seasons when right whales are not known to be present (i.e., winter).

Entanglements in fishing gear appear to be uncommon. Perry *et al*. (1999) reported two fishery-related mortalities due to fishing gear entanglement from Russian waters (sources: Kornev (1994) and the 1991 Final Recovery Plan for the Northern Right Whale (NMFS 1991)). On review of the original records in the Platforms of Opportunity Program database, one of the encounters was actually a sighting and not an entanglement. Therefore, only one case of entanglement is known from the western North Pacific (Brownell *et al*. 2001), though the occurrence of right whales near trap fisheries in the Bering Sea creates a potential for interactions. Several cases of entanglements of bowhead whales have been recorded during the Alaska Native subsistence hunt (Philo *et al.* 1992). These reports included three bowheads killed in the hunt with scars attributed to rope entanglements, one bowhead found dead entangled in ropes similar to those used with fishing gear in the Bering Sea, and one bowhead with ropes on it that were attributed to rigging from a commercial offshore fishing pot, most likely a crab pot. There have been two other recent reports of bowheads with gear attached or marks that likely were from crab gear (J. C. George, North Slope Borough, Barrow, AK, personal communication.). 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 is planned.

Injuries and entanglements that are not initially lethal may result in a gradual weakening of entangled individuals, making them more vulnerable to some other direct cause of mortality (Kenney and Kraus 1993). Entanglement-related stress may decrease an individual's reproductive success or reduce its life span, which may in turn depress population growth. Studies of scarring rates have been conducted in the North Atlantic to determine the frequency of right whale entanglements with fishing gear (see Kraus 1990 and Hamilton *et al*. 1998b). Studies of scarring rates among North Pacific right whales would be difficult due to the extreme rarity of this species, but may provide significant insight into the extent of this problem in the North Pacific Ocean.

7. Current Conservation Efforts

Section 4(b)(1)(A) of the ESA requires the Secretary to take into account efforts being made by any state or foreign nation to protect a species when making listing determinations. In March 2003, NMFS and the FWS (the Services) published the final policy for evaluating conservation efforts (PECE)(68 FR 15100). The PECE provides guidance on evaluating current protective efforts identified in conservation agreements, conservation plans, management plans, or similar documents (developed by federal agencies, state and local governments, Tribal governments, businesses, organizations, and individuals) that have not yet been implemented, or have been implemented but have not yet demonstrated effectiveness.

The PECE establishes two basic criteria for evaluating current conservation efforts: (1) the certainty that the conservation efforts will be implemented, and (2) the certainty that the efforts will be effective. The PECE provides specific factors under these two basic criteria that direct the analysis of existing conservation efforts.

The PECE identifies a number of factors to consider when evaluating the certainty an effort will be implemented. These include whether the necessary resources (*e.g.*, funding and staffing) are available; the necessary agreements have been formalized such that the required authority and regulatory mechanisms are in place; there is a schedule for completion and evaluation of the stated objectives; and (for voluntary efforts) the necessary incentives are in place to ensure adequate participation.

The evaluation of the certainty of an effort's effectiveness is made on the basis of whether the effort or plan: establishes specific conservation objectives; identifies the necessary steps to reduce threats or factors for decline; includes quantifiable performance measures for the monitoring of compliance and effectiveness; incorporates the principles of adaptive management; and is likely to improve the species' viability at the time of the listing determination.

The PECE identifies several important stipulations. Satisfaction of the criteria for implementation and effectiveness establishes a given conservation effort as a candidate for consideration, but does not mean that the effort will ultimately change the risk assessment. The PECE policy stresses that just as listing determinations must be based on the viability of the species at the time of review, they must also be based on the state of protective efforts at the time of the listing determination. There are circumstances where threats are so imminent, widespread, and/or complex that it may be impossible for any agreement or plan to include sufficient efforts to result in a determination that listing is not warranted.

Right whales in the North Pacific and the North Atlantic have been listed under the ESA for many years and numerous conservation measures have been implemented in order to protect and conserve the species. The following section discusses current conservation efforts intended to ensure the survival and recovery of the species.

7.1 Current conservation efforts for the North Atlantic Right Whale (*Eubalaena glacialis*)

As discussed (see above), right whale populations historically were severely depleted by commercial whaling. Right whales were protected by the 1931 Convention for the Regulation of Whaling, which took effect in 1935. Since 1949, they have been protected from commercial whaling by the IWC and its implementing convention. In U.S. waters, right whales are protected by the MMPA and the ESA.

More recently, direct and indirect impacts from human activities, mostly vessel collisions and fishing gear entanglements, represent significant factors affecting the survival of the species and almost certainly have contributed to a lack of recovery. The ESA provides authority to the Secretary of Commerce for protecting most endangered marine species, including right whales.[13] The NMFS has lead responsibility for developing and implementing a recovery program for this species. Currently, NMFS is working with state, federal, private and industry groups to address these two overarching factors affecting the continued survival of the species.

7.1.1 Fishing Gear Entanglement

Death and serious injury resulting from entanglement in fishing gear are significant factors affecting the survival and recovery of North Atlantic right whales. Under the MMPA, NMFS is required to develop a List of Fisheries (LOF) that classifies all U.S. commercial fisheries into one of three categories based on the level of marine mammal deaths and serious injuries that occur incidental to the fishery. The categorization of a fishery in the LOF determines whether participants in that fishery may be required to comply with certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements.

The Atlantic Large Whale Take Reduction Team

Numerous actions and activities have been implemented to reduce the threat posed by gear entanglement to the survival and recovery of the species. Under the 1994 amendments to the MMPA, NMFS is required to establish take reduction teams (TRT) to develop and implement take reduction plans (TRP). The principle goal of the take reduction team process is to reduce the levels of mortality and serious injury of strategic stocks of marine mammals in Category I and II fisheries (i.e., those with frequent or occasional mortality and serious injury of marine mammals). In general, the purpose of the TRT is to provide recommendations and assist NMFS in developing management measures as part of the take reduction planning process. Take reduction teams are composed of representatives from the fishing industry, fishery management councils, state and federal resource management agencies, the scientific community and conservation organizations. After a plan is implemented, the TRT provides NMFS with recommendations on implementation activities, feedback on the effectiveness of current management measures, and strategies for modifying the plan as necessary.

[13] This authority has been delegated by the Secretary to NMFS.

The Atlantic Large Whale Take Reduction Team (ALWTRT) was initially established in 1996 to discuss large whale interactions with the Northeast sink gillnet fishery, the Northeast/Mid-Atlantic American lobster trap/pot fishery, the U.S. Mid-Atlantic gillnet fishery, and the Southeastern U.S. Atlantic shark gillnet fishery. The Southeast Atlantic coastal gillnet fishery, as well as the Atlantic mixed species trap/pot (e.g., hagfish, Jonah crab, red crab, shrimp, black sea bass, and conch/whelk) northeast anchored float gillnet, and northeast drift gillnet fisheries, were recently proposed to be regulated under the Atlantic Large Whale Take Reduction Plan (ALWTRP).

The Atlantic Large Whale Take Reduction Plan

The NMFS, with the assistance of the ALWTRT, developed the Atlantic Large Whale Take Reduction Plan (ALWTRP) to reduce the level of serious injury and mortality of three strategic stocks of large whales including North Atlantic right whales in commercial gillnet and trap/pot fisheries. In general, the ALWTRP consists of a combination of regulatory and non-regulatory programs, including broad gear modifications, time-area closures, expanded disentanglement efforts, extensive outreach efforts in key areas, gear research, and an expanded right whale surveillance program to supplement the Mandatory Ship Reporting System.

Since its implementation in 1997, the ALWTRP has been modified on several occasions to address the serious injury and mortality of large whales in gillnet and lobster trap/pot gear. Recent amendments to the ALWTRP have included restrictions to the Southeast Atlantic gillnet fishery (67 FR 59471; 68 FR 19464). Other amendments to the ALWTRP include additional gear modifications for lobster trap/pot gear in particular management areas and changes to the lobster trap/pot and gillnet take reduction technology lists (67 FR 1300; 67 FR 15493).

In addition, a Seasonal Area Management (SAM) program was implemented (67 FR 1142; 67 FR 65722), which identified two management areas based on annual predictable aggregations of right whales. The SAM program also requires gear modifications for lobster trap/pot and anchored gillnet gear in these areas on a seasonal basis.

A Dynamic Area Management (DAM) program (67 FR 1133; 67 FR 65722) was also implemented to protect unexpected aggregations of right whales that met an appropriate trigger by temporarily restricting lobster trap/pot and anchored gillnet fishing in a designated DAM area. Subsequent to the introduction of the DAM program, gear modifications determined to sufficiently reduce the risk of entanglement to right whales and, therefore, deemed acceptable for fishing in DAM zones were implemented (68 FR 10195; 68 FR 51195).

NMFS reconvened the ALWTRT in 2003 to help evaluate the ALWTRP and discuss additional modifications necessary to meet the goals of the MMPA and the ESA. Particular emphasis was placed on those options designed to reduce the potential for entanglements and minimize adverse impacts if entanglements occur.

On June 20, 2003, NMFS published a Notice of Intent (NOI) in the *Federal Register* to announce the agency's intent to prepare an Environmental Impact Statement (EIS), that would analyze the impacts of alternatives for amending the ALWTRP (68 FR 38676). On June 21, 2005, NMFS also published a proposed rule in the *Federal Register* that discussed how modifications to the ALWTRP will be implemented. The final EIS and rule are expected to be available in the near future.

Disentanglement Efforts

The 1991 right whale recovery plan called for establishment of a marine mammal disentanglement program. NMFS established a team of scientists from the Center for Coastal Studies and the New England Aquarium to respond to all marine mammal entanglements, with an emphasis on right and humpback whale entanglements. The current disentanglement effort consists of one primary team and basic field support in the Bay of Fundy, Gulf of Maine, the mid-Atlantic and Georgia/Florida. The program covers nearshore disentanglement events along the eastern seaboard, although the team has the capability to be deployed in some offshore locations. There are, however, limitations; for example, the northern Gulf of Maine/Bay of Fundy field stations are operational only when biologists are conducting seasonal whale research and even then disentanglement response relies on the timely transfer of the team and its equipment to the entanglement site. In the southeast U.S., trained biologists are available to assist and disentanglement equipment caches have been established at key locations.

7.1.2 Vessel Interactions

As discussed, ship strikes are responsible for the majority of human-caused right whale mortalities (Jensen and Silber 2003). Ship strikes continue to occur and are a primary cause of the delay in recovery of the species.

The ESA provides authority to the Secretary of Commerce to establish implementation teams to, among other things, review recovery activities and provide recommendations to NMFS on actions necessary for the survival and recovery of the species. Two such teams have been formed: one in the southeastern U.S., the second in the northeastern U.S.. Although both Teams have addressed a variety of right whale conservation issues over the years, both Teams have evolved over time to focus on issues related primarily to the reduction of ship strikes of right whales.

Southeastern U.S. Implementation Team (SEIT)

In August 1993, the Southeastern U.S. Right Whale Implementation Team (SEIT) was formed. The team consists of representatives from federal, state and local agencies as well as other private organizations. Since its inception, the SEIT has met regularly and has been active in a number of areas related to ship strike mitigation. Among other things, the SEIT was instrumental in developing a system of aircraft surveys and communication systems that alert mariners to the presence of right whales in the southeast United States (SEUS) in real time. Two

agencies represented on the SEIT, the Georgia Department of Natural Resources and the USCG, implemented a local Notice to Mariners broadcast about right whale calving grounds. Additionally, the USCG and the Georgia Department of Natural Resources have developed and implemented procedures for broadcasting right whale locations over NAVTEX (the USCG international communication system). The SEIT has also coordinated a number of efforts to educate mariners about the threat of ship strikes, including development and distribution of brochures, pamphlets and posters. In addition, the SEIT provides recommendations to NMFS regarding measures to reduce the possibility of ship strikes, development of safe operating procedures for large vessels transiting right whale habitat, minimum vessel approach distances, research needs and measures necessary to reduce fishing gear interactions in right whale calving areas.

Northeast U.S. Implementation Team (NEIT)

The Northeast Implementation Team (NEIT) was established in 1994 and is coordinated by the NMFS, Northeast Regional Office. The NEIT was originally created to implement recovery tasks for both the North Atlantic right whale and the humpback whale. The NEIT and its committee of technical advisors was initially comprised of a diverse group of individuals representing major federal and state agencies, the Canadian Department of Fisheries and Oceans (DFO), NGOs, academics and other interested parties. Some accomplishments of the original NEIT include completion of a status report and plan of activities for protecting right and humpback whales in Massachusetts and Cape Cod Bays and implementation of a monitoring program for one of the largest waste water treatment plants in the U.S. The NEIT has two Technical Advisory Groups, a scientific group and a shipping industry group. The scientific group provides expertise on the biology and behavior of whales while the shipping industry group provides guidance on vessel and port operation. The NEIT also established two subcommittees, one on ship strikes and one on habitat. The Ship Strike Subcommittee produced outreach materials including an avoidance training/education video targeted at merchant mariners. In addition, the Ship Strike Subcommittee has addressed the issue of the threat posed by the increasing numbers of high-speed vessels operating off New England and potential interactions with whales. The team also has provided input and expertise on potential regulatory measures to reduce the risk of ship strikes.

The NEIT's responsibilities have evolved since its inception in 1994. Initially the NEIT's focus was the mitigation of the threat of right whale and fishing gear interactions. More recently the NEIT's charge has shifted to focus primarily on issues related to ship strike reduction. The NEIT Ship Strike Subcommittee assisted in the development of NOAA's Ship Strike Reduction Strategy. The NEIT most recently has been reorganized to function as a continuation of the former Northeast Large Whale Recovery Plan Implementation Team's Ship Strike Committee. The goal is for the NEIT to assist, where possible, with various ship-strike reduction-related strategies.

Ship Strike Reduction Strategy

The NMFS, in cooperation with other state, federal, industry and private groups and organizations has developed a broad ship strike reduction strategy designed to reduce the threat posed by vessel interactions to the survival of the North Atlantic right whale. The Ship Strike Reduction Strategy (Strategy) is an Atlantic coast initiative consisting of both regulatory and non-regulatory components. The ship strike reduction conservation efforts have been implemented, in large part, under the statutory authority the ESA and the MMPA. Certain details of the Strategy are still under development. The Strategy consists of five elements: (1) Establishment of new operational measures for the shipping industry, including consideration of routing measures and speed restrictions; (2) Negotiation of a Right Whale Conservation Agreement with the Canadian Government to address the issue of ship strikes; (3) Development and implementation of ship strike education and outreach programs; (4) Initiation of Section 7 consultations under the Endangered Species Act with all federal agencies that have vessels operating in waters inhabited by right whales; and (5) Continuation of ongoing research and conservation activities.

Ship Strike Reduction Strategy Advanced Notice of Proposed Rulemaking

Certain regulatory measures are being considered, and in this regard NMFS published an advanced notice of proposed rulemaking (ANPR) in June 2004 (69 FR 30857) and proposed regulations in June 2006 that contain speed restrictions and routing measures to reduce the likelihood of collisions between vessels and endangered North Atlantic right whales (71 FR 36299).

Mandatory Ship Reporting System

In 1998, the USCG, on behalf of the U.S. Government, submitted a proposal developed by NOAA with the assistance of the Marine Mammal Commission and the International Fund for Animal Welfare to the International Maritime Organization (IMO). The proposal requested approval of two mandatory ship reporting system. The proposal received IMO endorsement and systems became operational in 1999. The system obligates all commercial ships 300 gross tons and greater entering areas designated as right whale critical habitat to call into a shore-based station. The systems provide information directly to mariners as they enter right whale habitat on right whales, their vulnerability to ship strikes and steps that can be taken to reduce the chance of collision. They also provide a means to obtain information on ship traffic volume and routes to assist in identifying measures to reduce future ship strikes. The systems are jointly funded by the USCG and NMFS, and administered primarily by the USCG.

Aerial Surveys

In 1993, the SEIT developed a system to help alert area ship traffic to the presence of right whales, thereby reducing the possibility of ship strikes. The central feature of the system has been a jointly funded aerial survey program designed to obtain accurate, current information on the locations of whales. Aerial surveys were initiated in 1993 in the waters off the SEUS and

have continued each year since. Continuously updated right whale sighting information from survey teams is immediately relayed to area mariners via centralized communication systems operated by the USCG and Navy. Information is provided through a number of real time media, including USCG Broadcast Notice to Mariners, NAVTEX and NOAA Weather Radio. Among other measures, vessels are advised to proceed at reduced speeds to reduce the likelihood of serious injury or death if a collision occurs. However, even in very good sighting conditions not all whales are detected. Therefore, whales may be present but not always reported to mariners.

In 1997, an aerial survey program was initiated in waters off the northeastern U.S. These efforts focused on Cape Cod Bay (CCB) and the Great South Channel (GSC) in late winter and early spring. From 1997 to present, aerial surveys supported by NMFS and the State of Massachusetts have been conducted to cover peak abundance periods, principally between January and March in CCB, and in the GSC between March and early July. Aerial surveys have been recently expanded in the Gulf of Maine, and waters of Rhode Island, New York and New Jersey.

Sightings from aerial survey platforms, right whale researchers, and multiple sources are reported to NMFS' Northeast Fisheries Science Center (NEFSC). These data are plotted using a GIS with sightings grouped and 'circled' with a buffer zone. Right whale sighting advisories, or 'alerts', are disseminated to notify mariners of the presence of right whales via a number of mechanisms. The USCG issues Broadcast Notices to Mariners and via NAVTEX. NOAA Weather Radio provides geographic and positional data on the sightings periodically. The Cape Cod Canal Traffic Controllers contact ships and provide positions and a radius for each sighting.

Notifications to individual ships, commercial fishing and military vessels are made by voice from the aircraft when observed vessels are transiting close to a whale. In addition, these surveys have provided sightings of entangled and floating right whales, and provide photo identification data for numerous studies. Current plans are to continue the surveys into the foreseeable future. While dedicated aircraft surveys may be the best available means to attempt to alert mariners about the presence of right whales, these programs have a number of limitations. For example, aerial surveys are costly to implement. It is possible that these resources could be better spent on other activities. Also, the surveys are limited by weather and can be conducted only in daylight and under the best of survey conditions. In addition, it is likely that, even under good conditions, many whales are missed by observers, especially since only those whales at or near the surface can be seen. Nonetheless, until effective alternatives are identified, the surveys are expected to continue.

Vessel Approach Regulations

In February 1997 an interim final rule (62 FR 6729) was published that prohibits both boats and aircraft from approaching any right whale closer than 500 yards. Exceptions for closer approach are provided for emergency situations and where certain authorizations are provided.

Updating Navigational Publications

The National Ocean Service publishes and periodically updates nautical charts and a series of regional books called *U.S. Coast Pilots*. These are basic references on regional environmental conditions, navigation hazards and rules. In U.S. waters, Captains of ships greater than 1200 gross tons are required to carry *Coast Pilots*. Information contained in the *Coast Pilots* covering the entire eastern United States has been updated to include information on the status of right whales, the times and areas that they occur, the threats posed to whales by ships and advice on measures mariners might take to avoid hitting right whales. Also, updated information regarding right whale critical habitat and regulations about approaching right whales are published on nautical charts when they are re-printed.

Educational Materials and Outreach

A number of agencies and organizations have collaborated on developing brochures, pamphlets and informational papers to educate mariners about the vulnerability of right whales to ship strikes. NMFS has published magazine articles directed to the shipping industry. Also, as noted above, a video on this subject was prepared and is being distributed to the shipping industry. The SEIT and NEIT are developing a comprehensive education and outreach strategy and have played a key role in past education and outreach efforts. These efforts include implementation of training courses at mariner academies and local marinas.

Boston Harbor Ship Routing Measures

Part of NOAA's Ship Strike Strategy includes consideration of ship traffic routing measures including shifting the Boston Traffic Separation Scheme (TSS). In 2006, NOAA developed a proposal that was submitted by the USCG on behalf of the US government to the International Maritime Organization (IMO) to move the northern leg of the Boston TSS 12 degrees to the north to redirect shipping traffic through areas with lower densities of right whales and other baleen species. The shift is expected to have a significant reduction in risk of ship strikes. The IMO is expected to make a decision on the proposal by December 2006; if endorsed by the IMO, the U.S. will implement the change in 2007.

Canadian Ship Routing Measures

In July 2003, with approval from the IMO, Canada moved shipping lanes in the Bay of Fundy four nautical miles to the east to protect the feeding whales from ship collisions. During summer and early fall, right whales aggregate to feed in the Bay of Fundy, between New Brunswick and Nova Scotia, Canada. During this time the whales are exposed to heavy vessel traffic in major shipping channels that pass through the area.

Coordination of Federal agency recovery activities under the ESA

Under section 7(a)(1) of the ESA all federal agencies, in consultation with and with the assistance of the Secretary of Commerce, are required to use their authorities in the furtherance

of the Act by carrying out programs for the conservation of endangered and threatened species listed pursuant to section 4 of the Act. Under Section 7(a)(2) of the ESA, all federal agencies are required to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of endangered or threatened species or destroy or adversely modify their critical habitat. These agencies must consult with NMFS on any action that may affect listed species or critical habitat for species under NMFS' jurisdiction (including right whales). As a result of these consultations, NMFS issues either a letter of concurrence that the activity is not likely to adversely affect a species or critical habitat, or a Biological Opinion for activities likely to adversely affect a species or critical habitat. A Biological Opinion indicates if the activity is likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of critical habitat and, if so, provides reasonable and prudent alternatives to the activity. In those cases where NMFS concludes that an action (or implementation of any reasonable and prudent alternatives) and the resultant incidental take of listed species is not likely to jeopardize the continued existence of listed species, NMFS specifies reasonable and prudent measures necessary and appropriate to minimize effects of the action on the species of concern.

NMFS has consulted with the USCG and the U.S. Navy on several occasions for a variety of activities under section 7(a)(2) of the ESA. Consultations on NMFS' fishery management plans have also been conducted.

Canadian Recovery Efforts

In 2000, the Canadian DFO published a recovery plan for the North Atlantic right whale (*E. glacialis*). The recovery plan proposes five broad recovery strategies for the North Atlantic right whale: 1) reduction of vessel collisions; 2) reduction of the impacts of encounters with fishing gear; 3) reduction of disturbance from human activities; 4) reduction of exposure to contaminants and habitat degradation; and 5) population monitoring and research.

Summary

As discussed, current North Atlantic right whale recovery and conservation efforts in the North Atlantic are extensive. These efforts reflect a cooperative collaboration between numerous state and federal agencies, industry groups, conservation organizations, academic institutions and other interested parties and individuals. These efforts are vital to the survival and recovery of the North Atlantic right whale.

Current ongoing conservations efforts have resulted in the implementation of a number of regulatory and non-regulatory measures that have enhanced the survival of the species, particularly fishing gear modifications and ship strike reduction strategies. Moreover, a number of conservation measures being developed and/or considered (as discussed above) will further reduce the threats posed by fishing gear interactions and vessel interactions (e.g., ANPR). However, it must be noted that despite these ongoing efforts to mitigate threats to the species, right whales have continued to suffer serious injury and mortalities due to vessel and fishing gear

interactions. The North Atlantic right whale continues to persist at a very low level of population abundance that makes it particularly vulnerable to threats and the risk of extinction.

7.2. Current conservation efforts for the North Pacific Right Whale (*Eubalaena japonica*)

There are no current conservation efforts by the federal government in place at this time specifically targeted towards the North Pacific right whale in the North Pacific Ocean. The Marine Conservation Alliance has developed an outreach program and informational brochures to be distributed throughout the commercial fishing industry to alert fishermen to the presence of right whales, and to take proactive measures to avoid interaction. This Alliance is also coordinating with commercial shipping interests to extend this network so that it might reach the commercial cargo vessels that transit the North Pacific. The effectiveness of such voluntary measures has not been determined.

The Canadian DFO has prepared a draft National Recovery Strategy for the North Pacific right whale (*E. japonica*) in Canadian waters in the Pacific Ocean. At this time the document has not been finalized.

8. Extinction Risk Analysis

The ESA defines an endangered species as any species in danger of extinction throughout all or a significant portion of its range. It defines a threatened species as any species likely to become endangered within the foreseeable future. Section 4(b)(1)(a) of the ESA requires that determinations of whether a species is threatened or endangered be based solely on the best scientific and commercial data available and after taking into account those efforts, if any, being made to protect the species. The Secretary shall determine whether any species is endangered or threatened because of any of the following factors in ESA section 4(a)(1):

1. The present or threatened destruction, modification, or curtailment of habitat or range;
2. Overutilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms;
5. Other natural or manmade factors affecting its continued existence.

8.1. North Atlantic Right Whale (*Eubalaena glacialis*)

As discussed, sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare and that the eastern population of North Atlantic right whales may, in fact, be functionally extinct (Best *et al.* 2001). Based on the current population size of the western population of North Atlantic right whale (i.e., approximately 300 animals), the continued human-caused threats to the species and the whale's life history, the North Atlantic right whale is in significant danger of extinction throughout its range. There is reason for serious concern about the future of the North Atlantic right whale. Because the right whale is a long-lived species, extinction may not occur in the near future, but the possibility of biological extinction in the next century is very real.

Best *et al.* (2001) estimated the number of western North Atlantic right whales as of 1998 was probably around 300 (+/- 10%). Data collected in the 1990s suggested that right whales were experiencing a slow but steady recovery (Knowlton *et al.* 1994). However, Caswell *et al.* (1999) used photo-identification data and modeling to estimate survival and concluded that right whale survival decreased between 1980 and 1994. The model further suggests that, under current conditions, the population is headed for extinction and an upper bound on the expected time to extinction is 191 years. Modified versions of the Caswell *et al.* (1999) model as well as several other models were reviewed at the 1999 IWC workshop (Best *et al.* 2001). Despite differences in approach, all of the models indicated a decline in right whale survival in the 1990s relative to the 1980s with female survival, in particular, apparently affected (Best *et al.* 2001; Waring *et al.* 2002).

Since 1999, a total of 125 right whale calves have been observed including a record calving season in 2000-2001 with 31 right whale births (B. Pike, New England Aquarium, personal communication). Calving numbers have been sporadic, with large differences among years. The

three calving years (1997-2000) prior to the record year in 2000-2001 provided low recruitment with only 10 calves born. The last five calving seasons (2001-2005) have been substantially better (31, 21, 19, 16, and 28 calves, respectively). Despite improved calving rates over the last several years, mortalities of calves, juveniles and adults have continued.

In 2002, NMFS' NEFSC hosted a workshop to review right whale population models to examine: (1) potential bias in the models, and (2) changes in the subpopulation trend based on new information collected in the late 1990s (Clapham *et al.* 2002). Three different models were used to explore right whale survivability and to address potential sources of bias. Although biases were identified that could negatively affect the results, all three modeling techniques resulted in the same conclusion; survival has continued to decline and seems due to female mortalities (Clapham *et al.* 2002).

Section 4(a)(1) of the ESA requires that any determination of whether a species is endangered or threatened be based on any of the following factors: (A) the present or threatened destruction, modification or curtailment of a species habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation factors; (D) the inadequacy of existing regulatory mechanisms; (E) other natural or manmade factors affecting its continued existence. Based on the review of the section 4(a)(1) factors, the North Atlantic right whale is in danger of extinction throughout its range because of the following factors:

Factor B - *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*: Historically, North Atlantic right whale populations were severely depleted by commercial whaling. While North Atlantic right whales have been protected since 1931 under the Convention for the Regulation of Whaling and more recently by the IWC (Circa 1949) and in U.S. waters under the MMPA (1972) and the ESA (1973) the North Atlantic right whale is in danger of extinction throughout its range because of past whaling and has not exhibited signs of recovery from the effects of commercial whaling.

Factor D - *The Inadequacy of Existing Regulatory Mechanisms*: While regulatory mechanisms have provided increased protection to right whales in the North Atlantic, human activities still result in serious injuries to and mortalities of right whales that are a factor in causing them to be in endanger of extinction throughout its range. In particular, it may be necessary to enhance existing regulations, or promulgate new regulations to reduce or eliminate the threat of ship strikes and fishing gear entanglement.

Factor E - *Other Natural or Manmade Factors Affecting Its Continued Existence*: The most significant factor placing the North Atlantic right whale in danger of extinction remains human-related mortality, most notably, ship collisions and entanglement in fishing gear. The available evidence strongly suggests that the western population of North Atlantic right whale cannot sustain the number of deaths that result from vessel and fishing gear interactions. If the impact of these activities continue at current rates, it is likely to result in the extirpation of the western population of North Atlantic right whales. Given the low population size of North Atlantic right whales in the eastern Atlantic Ocean, the extirpation of right whales in the western Atlantic

Ocean would render the entire species effectively extinct. No natural factors are known to be threatening the continued existence of the North Atlantic right whale at this time.

Conclusion

Based on an analysis of the best scientific and commercial data available the North Atlantic right whale is a separate species, *Eubalaena glacialis*. Based on the best available scientific and commercial data and after taking into consideration current population trends and abundance, demographic trends and life history traits affecting the continued survival of the species and ongoing conservation efforts it is clear that the North Atlantic right whale is in significant danger of extinction throughout its range because of (1) overutilization for commercial, recreational scientific, or educational purposes; (2) the inadequacy of existing regulatory mechanisms; and (3) other natural and manmade factors affecting it continued existence.

8.2 North Pacific Right Whales (*Eubalaena japonica*)

To date, the largest number of North Pacific right whale individuals identified in the Bering Sea is 23 (based on genetic sampling), while abundance in the western North Pacific appears to number fewer than 1,000 individuals (with a minimum estimate near 400). Abundance estimates and other vital rate indices in both the eastern and western North Pacific are not well established. Where such estimates exist, they have very wide confidence limits. Despite this, NMFS finds the continued anthropogenic threats and other factors discussed below demonstrate a high risk of extinction for the North Pacific right whale throughout its range, into the foreseeable future.

The basic life history parameters and census data, including population abundance, growth rate, age structure, breeding ages, and distribution remain undetermined for North Pacific right whale. While these data are necessary to perform quantitative population analyses or to develop surrogate models to evaluate the risk of extinction, there are a number of factors that put North Pacific right whales at considerable risk of extinction. These include, but are not limited to, the following:

- *Life history characteristics such as slow growth rate, long calving intervals, and longevity*

Although there are no data for the North Pacific, studies of other right whale populations suggest calving intervals of 3-6 years, lifespans of up to 70 years, and growth rates that are likely dependent on feeding success (see Reynolds *et al.* 2002, Kenney 2002). Long-lived organisms have limited abilities to respond to chronic increases in juvenile mortality and even lesser abilities to respond to increased mortality through commercial harvest of juveniles and adults (Congdon *et al.* 1993). 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 overexploitation. This likely explains the paucity of sightings in the North Pacific following the illegal kills by Soviet whalers in the 1960s.

- *Distorted age, size or stage structure of the population and reduced reproductive success*

Thus far photogrammetric data in the Bering Sea have been collected primarily for adult animals (LeDuc *et al.* 2001). Of the 12 whales for which lengths were determined (range: 14.7-17.6m), none were smaller than the smallest length estimate for sexually mature right whales (13-16m: see Kenney 2002). Length measurements for two whales observed off California suggest at least one of these whales was not yet sexually mature (12.6m: Carretta *et al.* 1994). The presence of two calves during the 2004 season in the Bering Sea (Wade *et al.* 2006) is encouraging. However, to date, there is no evidence of reproductive success (i.e., young reared to independence) in the eastern North Pacific. No data are available for the western North Pacific though abundance appears to be large enough to sustain reproduction.

- *Strong depensatory or Allee effects*

The Allee effect has been defined as the impact of reduced social interactions and loss of mating opportunities in a small population. Marine mammal populations with an effective population size of a few dozen individuals are usually sufficiently large to avoid most of the deleterious consequences of inbreeding (Lande 1991). Theoretically, during a rapid decline in population size nearly all (i.e., >95 percent) of the diversity in a population is maintained in an effective population of 10 individuals, and more than 99 percent of the diversity in a population is maintained in an effective population of 50 individuals (Ralls *et al.* 1983). However, it has been suggested that if the number of reproductive animals is fewer than 50, the potential for impacts associated with inbreeding depression increases substantially (IUCN 2003). In 2002, the ratio of right whale females to males biopsied in the Bering Sea was 1:9. In 2004, biopsy results indicated a considerably improved ratio of 7:16. Excluding the two male calves from the sample and assuming all other whales were adults, a 1:2 ratio of females to males can be estimated, with a possible effective abundance of 21. At such low numbers, the potential for North Pacific right whales to find viable mates or even mate at all may be severely reduced. Although there is some evidence of mating success in the western North Pacific population, this has not been quantified. Because the most likely abundance estimate for the North Pacific right whale is well above these threshold numbers, and because NMFS presently has little data regarding the extent of exchange between eastern and western populations, we cannot assign high significance to possible Allee effects.

- *Habitat specificity or site fidelity*

Other large whale populations such as humpback whales (*Megaptera novaeangliae*) appear to utilize common breeding grounds with a "maternally directed site-fidelity to specific feeding grounds" (Baker *et al.* 1990, 1994; Palsbøll *et al.* 1995, 1997; Larsen *et al.* 1996). Genetic sampling revealed similar patterns in western North Atlantic right whales (*E. glacialis*), indicating this population probably occupies a single breeding area but segregates into distinct, maternally-linked subpopulations during migration to isolated nursery areas (Schaeff *et al.* 1993). There is some suggestion of site fidelity among right whales found in the Bering Sea. Of the whales observed between 1997 and 2004, at least five were photographed and five were biopsied over multiple years. It is possible that similar site fidelity is occurring in the western

North Pacific. It is not known where these animals overwinter, nor if they share a common wintering area. This is a critical gap in understanding dynamics of right whales in the North Pacific Ocean.

- *Habitat sensitivity*

Right whale life history characteristics make them very slow to adapt to rapid changes in their habitat (see Reynolds *et al.* 2002). They are also feeding specialists that require exceptionally high densities of their prey (see Baumgartner and Mate 2003, Baumgartner *et al.* 2003). Zooplankton abundance and density in the Bering Sea has been shown to be highly variable, affected by climate, weather, and ocean processes and in particular ice extent (Napp and Hunt 2001, Baier and Napp 2003). The largest concentrations of copepods occurred in years with the greatest southern extent of sea ice (Baier and Napp 2003). 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. No data are available for the western North Pacific.

Section 4(a)(1) of the ESA requires that any determination of whether a species is endangered or threatened be based on any of the following factors: (A) the present or threatened destruction, modification or curtailment of a species habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation factors; (D) the inadequacy of existing regulatory mechanisms; (E) other natural or manmade factors affecting its continued existence. Based on the review of the section 4(a)(1) factors (see section 6) the following factors are responsible for the current status of North Pacific right whales and create the danger of extinction for this species.

Factor B - *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*: Currently there is no legal harvest of North Pacific right whales. Historically, North Pacific right whale populations were severely depleted by commercial whaling. The North Pacific right whale has been protected since 1931 under the Convention for the Regulation of Whaling and more recently by the IWC (Circa 1949) and in U.S. waters under the MMPA (1972) and the ESA (1973). In addition to historic commercial whaling, more recent illegal takes by Soviet whalers are responsible for the current severely depleted status of this species.

Factor E - *Other Natural or Manmade Factors Affecting Its Continued Existence*: While manmade factors (e.g. vessel collisions and fishing gear entanglements) have the potential to affect the continued existence of the North Pacific right whale, NMFS has not identified these to be causative factors for ESA listing of the North Pacific right whale. No natural factors are known to be threatening the continued existence of the North Pacific right whale at this time.

Conclusion

Based on an analysis of the best scientific and commercial data available and after taking into consideration current population trends and abundance, demographic trends, and life history characteristics affecting the continued survival of the species, and ongoing conservation efforts,

we conclude that the taxonomy of the North Pacific right whale should be recognize these whales as a new species, *Eubalaena japonica*, and that this species is in significant danger of extinction throughout its range.

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