BEFORE THE SECRETARY OF COMMERCE

CENTER FOR BIOLOGICAL DIVERSITY; and MARINE BIODIVERSITY PROTECTION CENTER Petitioners	))))))))))))	PETITION TO DESIGNATE CRITICAL HABITAT FOR THE BERING-CHUKCHI-BEAUFORT STOCK OF THE BOWHEAD WHALE (BALEANA MYSTICETUS) UNDER THE ENDANGERED SPECIES ACT

February 22, 2000

EXECUTIVE SUMMARY

This petition seeks the designation of critical habitat for the Bering-Chukchi-Beaufort Sea Stock of the bowhead whale, *Baleana mysticetus,* under the Endangered Species Act. The Bering-Chukchi-Beaufort Sea Stock is the largest and most viable of five extant bowhead stocks, yet it is simultaneously the most threatened by human activity. Large scale industrial development and the associated vessel traffic of the oil and gas industry have proliferated within the bowhead's proposed critical habitat since the late 1970's. No fewer than five massive offshore projects are currently in operation or in the planning stages in the Beaufort Sea, and an additional four onshore facilities produce at least some of their oil from offshore. The bowhead is threatened by loud industrial noises and the corresponding rise in the ambient noise level in the ocean, disturbance due to oil spills and other substances, and from collisions with vessels.

The bowhead whale, *Baleana mysticetus*, is the northernmost and one of the least well known of the baleen whale species. It was hunted almost to extinction in the 19th Century, and has been on the federal endangered species list since 1970. The bowhead receives protection primarily under the Endangered Species Act, 16 U.S.C. §§1531 *et seq*., the Marine Mammal Protection Act, 16 U.S.C. §§1361 *et seq.*, and from the International Whaling Commission.

Critical habitat is at the heart of the Endangered Species Act, which was enacted to protect endangered species and the ecosystems upon which they depend. Critical habitat is defined as the area most essential for the survival and recovery of the species that may require special management considerations. The area that best meets this definition in the case of the bowhead is the area in the U.S. Exclusive Economic Zone from 158° W (just east of Point Barrow) to the Canadian Border, from the mean high tide line to approximately 170 km offshore. The proposed critical habitat boundary is illustrated in Exhibit A and described in more detail in this petition.

Critical habitat provides important protections to listed species. Federal agencies must ensure that any action authorized, carried out, or funded by them will not destroy or adversely modify critical habitat, in addition to ensuring that any action authorized, carried out, or funded will not jeopardize the continued existence of the species. Protecting the ecosystem upon which a species depends through the designation of critical habitat is a vital part of the Endangered Species Act. This protection for the arctic marine habitat of the bowhead is doubly important because so little is known about the bowhead's biology, natural history, and ability to withstand industrial development of its habitat.

This petition reviews the biology and natural history of the bowhead, the threats faced by the species, and the factors the NMFS must consider in designating critical habitat.

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The above petitioners formally requests that the National Marine Fisheries Service (NMFS) designate critical habitat for the Bering-Chukchi-Beaufort Sea Stock of the bowhead whale (*Baleana mysticetus)* under the federal Endangered Species Act, 16 U.S.C. §§1531-1544. This petition is filed under 5 U.S.C. §553(e) and 50 C.F.R. part 424.14. NMFS has jurisdiction over this petition. This petition sets in motion a specific process as defined by 50 C.F.R. part 424.14, placing definite response requirements on the NMFS.

The Center for Biological Diversity is a non-profit environmental organization dedicated to the protection of native species and their habitats in the Western Hemisphere. The Center for Biological Diversity submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the bowhead whale and its habitat.

The Marine Biodiversity Protection Center is a non-profit environmental organization whose mission is to advocate for imperilled and threatened marine organisms. The Marine Biodiversity Protection Center submits this petition on its own behalf and on behalf of its members and staff with an interest in the continued existence of the bowhead whale and its habitat.

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I. INTRODUCTION

The most northerly of the baleen whales, the bowhead, *Baleana mysticetus*, historically ranged through all arctic waters of the Northern Hemisphere. Pre-exploitation populations of the bowhead are thought to have exceeded 50,000 whales, but with the rise of commercial whaling in the 19th Century the bowhead was hunted to near extinction to fuel the demand for whale oil, whale blubber, and baleen for the fashion industry. (NMFS 1999a).

The bowhead whale was listed as a federal endangered species on June 2, 1970 (35 Fed. Reg. 8495), and received further protection with the passage of the Endangered Species Act of 1973 ("ESA"). Subsistence hunting by the Native Peoples of Alaska, Canada, and Russia continues, though quotas have been imposed by the International Whaling Commission ("IWC") since 1978. (NMFS 1999a). The IWC recognizes the historical and current existence of five distinct stocks of the bowhead whale: the Bering-Chukchi-Beaufort Sea (hereafter Bering Sea) Stock, Spitsbergen Stock, Davis Strait Stock, Hudson Bay Stock, and Okhotsk Sea Stock. (IWC 1992).

Recovery of the bowhead stocks since 1970 has been exceedingly slow, where it has occurred at all. The Bering Sea Stock is the healthiest, with current population estimates around 7500 individuals (NMFS 1999a), as compared to a historical population estimate of 14,000-27,000 (Breiwick and Brahm 1990). None of the other four stocks of bowheads has an estimated population greater than 400 whales, with some as low as a few tens, though historically these four stocks accounted for over half of the total population of bowheads. (NMFS 1999a).

Today the bowhead whale, especially the Bering Sea Stock, is imperiled by the large scale industrial development of the oil and gas industry in Alaskan coastal waters. The bowhead has yet to receive the additional protections of critical habitat, a recovery plan, or the designation of a recovery team afforded by the ESA. The Center for Biological Diversity now petitions the National Marine Fisheries Service for critical habitat under the ESA for the Bering Sea stock of the bowhead whale. The Bering Sea Stock, for the reasons described below and throughout the petition, will benefit most from the area proposed as critical habitat.

Surprisingly little is known about the mysterious ice-dwelling bowhead. (See "Methodological Note," below). The lack of knowledge about such crucial subjects as bowhead reproduction, life history, and hearing processes, combined with the lack of knowledge about many aspects of the interactions between oil and gas development and the arctic environment, present special management challenges. The jeopardy standard established by Section 7 of the ESA mandates that projects not be approved if they are likely to jeopardize the continued existence of the species. The NMFS has not issued a jeopardy opinion on any oil and gas development approved in the 1990's. Yet it is clear that the cumulative effects of oil and gas development are harmful to the bowhead whale.

The designation of critical habitat will require NMFS to consider whether development activities will adversely modify that habitat. Adversely modifying critical habitat includes impairing the value of that habitat for the survival ***or recovery*** of the species. This means that NMFS will have to consider whether development activities are impairing the recovery of the bowhead, a different standard than analyzing the likelihood of extinction. Providing this additional protection to species through protection of their habitats was the intent of Congress in its 1978 and 1982 amendments to the ESA. The bowhead whale is experiencing a proliferation of habitat modifying activities in the Beaufort Sea where critical habitat is proposed. The added protection to the whale and its habitat provided by the designation is of critical importance at this time.

II. METHODOLOGICAL NOTE

Despite the intense flurry of research effort on the bowhead whale spurned by the desire to exploit oil and gas resources within its range in the Beaufort and Chukchi Seas, the puzzling fact is that very little is known about the natural history of the bowhead. The reasons for this lack of important information have been summarized as follows:

> The research efforts on behavior of bowhead whales have been somewhat different from work on right whales and other whales. Part of this is due to the remoteness of bowhead whales from human habitation, often necessitating airplane-based observations of whales far from land, or long over-ice treks to open-water leads. Part of it is due to the funding sources for bowhead studies. ***These organizations provided contracts to obtain information directly useful for management decisions regarding potential disturbance of whales through oil and gas industry activities***; and for attempts to evaluate numbers and distribution of whales by aerial, ice-based visual, and ice-based acoustic censusing of migrating animals. As a result, behavioral studies have usually been brief, on the order of one month at a time, and intense, taking advantage of a short fair weather season, extensive research logistics and support, and very directed research questions. This is quite unlike the long-term studies on right whales in southern Argentina..., for example, where researchers observed whales from small boats and from cliffs for many months (and years) in order to describe aspects of behavior, including acoustic activities and their meanings (Payne 1980). As well, behavioral work on bowhead whales generally has not resulted in graduate degrees, due to the usual contract nature of the work; whereas dozens of graduate degrees have been awarded for long-term, detailed analyses of behavior patterns of right, humpback, gray, fin, blue, and minke whales....(Würsig and Clark 1993:157-158, emphasis added).

The contract nature of bowhead research, and the fact that research is primarily funded by the oil industry and state and federal agencies that administer the oil and gas industry, is readily apparent in a review of the literature. The vast majority of studies seem geared almost exclusively towards counting individuals to the exclusion of more sophisticated hypothesis testing or behavioral studies. The result is a disappointing lack of analysis. Articles and reports discussing behavioral responses to industrial noise, for example, tend to consist of a laundry list of obvious avoidance responses by bowheads to industrial noise, followed by the conclusion that the long term effect of industrial noise on bowheads is unknown. (See, e.g., Richardson and Malme 1993).

The quality of bowhead literature is inferior to that for other species, such as the humpback, and has been acknowledged as such. (See, *e.g.* Würsig and Clark 1993). The state of bowhead research suffers from an additional problem, which is the large degree of reliance on industry to report bowhead observations and interactions. One would not expect the oil and gas industry to encourage their employees, on any level, to prioritize the recording and reporting of bowhead observations, especially where those observations indicate that bowheads are being disturbed by industrial activities. This problem of course is related to the additional problem that "take" of bowheads is extremely difficult to monitor or enforce in the remote, harsh environment of the Beaufort and Chukchi Seas. These factors are additional and important reasons why management agencies should take the most conservative approach towards bowhead management. Unfortunately, this has not been the case, and is one reason why the designation of critical habitat for the bowhead is even more vital.

III. STATUS OF THE BOWHEAD WHALE

A. NATURAL HISTORY AND BEHAVIOR

1. Physical Description

The bowhead whale, *Baleana mysticetus,* is in the Balaenidae family, suborder mysticeti, order Cetacea. The bowhead's closest relative is the right whale, *Eubalaena glacialis*, the only other member of the Balaenidae family besides the fossil relatives of these two whales. (McLeod, et al. 1993).

The bowhead grows up to 18 meters in length, and weighs up to 48 metric tons. (NMFS 1999b).

Mysticetes are baleen whales, obtaining their food by gulping or skimming water and then expelling it through baleen plates, straining out their tiny prey in the process. The bowhead is highly adapted to this behavior, with a total adult body size of twelve to sixteen meters , 2/7-1/3 of which is composed of a massive head and skull supporting a huge jaw and mouth apparatus. (Haldiman and Tarpley 1993). Bowheads have longer baleen plates, a larger tongue (bowhead tongues can measure up to 5.5 m long and 3 m wide), larger mouth cavity, and a more highly arched jaw than other mysticetes, relative to body size. (Haldiman and Tarpley 1993, Lowry 1993). The skull is enormous to support the massive jaws and baleen plates, but the brain cavity itself is dwarfed by the mouth apparatus. (Haldiman and Tarpley 1993).

Bowheads spend more time than any other whale in water with a temperature of 0 degrees celcius or below. (Würsig and Clark 1993). Virtually the only time they are in warmer water is during brief feeding forays to the warmer water of river mouths. (Würsig and Clark 1993). Bowhead blubber (dense white fibrous connective tissue arranged perpendicular to the outer skin surface interspersed with large deposits of adipose tissue) is 5.5 to 28 cm thick. (Haldiman and Tarpley 1993). The blubber provides excellent insulation and may also allow the bowhead to go long periods of time without eating. (Würsig and Clark 1993).

Bowheads are relatively stocky whales, with adult females slightly larger than males. Coloration is mainly black, with white splotches on the chin, eyelids, flipper insertions, and sometimes several other places as well. (Haldiman and Tarpley 1993). Unique coloration patterns can be used to identify whales when conducting surveys or tracking studies. Bowheads have a broad back, no dorsal fin or hump, and broad, paddle shaped flippers. (Haldiman and Tarpley 1993). Both sexes have genital grooves, and females have mammary clefts. Eyes are placed low on the side of the head and covered with movable lids. Bowhead ears have a 4 mm diameter external opening. The bowhead has a pair of protruding blowholes with tactile hairs between them. The blowholes are passively closed by a cover of fibrous connective and adipose tissue. (Haldiman and Tarpley 1993). The bowhead uses its protruding blowhole to break through sea ice to breathe. Bowheads have a four chambered stomach. Two of the chambers, the fundic chamber and the pyloric chamber, are connected by a tube that is only 3.8 cm in diameter. (Haldiman and Tarpley 1993).

2. Feeding

a. Prey Species

Stomach sampling from whales taken by modern subsistence hunters indicates that the dominant food source of the bowhead is crustacean zooplankton, mainly copepods and euphausiids. (Lowry 1993). Epibenthic organisms such as mysids and gammarid amphipods were also found regularly, sometimes in great numbers. (Lowry 1993). These prey species may be taken incidentally or intentionally. (Hazard and Lowry 1984). Other prey types that were found were soft-bodied plankton, infauna, and fish, though these occur infrequently and are assumed to be taken only incidentally. (Lowry 1993).

Concentrations of zooplankton are associated with areas of upwelling that bring nutrient-rich waters to the surface and support enormous phyto-plankton blooms in spring and summer. (Moore and Reeves 1993, Niebauer and Schell 1993). These areas of upwelling generally occur as physical discontinuities, or fronts, which can be anywhere from tens of meters to tens of kilometers wide. (Moore and Reeves 1993). The variation in bowhead distribution, abundance, and movement is probably related to the dynamic nature of these fronts. (Moore and Reeves 1993). Some research has been done in the Eastern Beaufort Sea, especially around the Mackenzie River plume, however, a conceptual model linking wind regimes, plume movements, and whale numbers has not yet been formulated or tested. (Moore and Reeves 1993). Nor has remote sensing of oceanographic fronts been attempted in conjunction with aerial surveys in the central Beaufort Sea. (Moore and Reeves 1993).

b. Feeding Methods

There are three different feeding methods used by the bowhead. The first, which is directly observable, is surface feeding where whales swim dorsum up with their lower jaw open, usually at a 30-40 degree angle, and skim prey (predominantly copepods) into their mouth. (Würsig and Clark 1993). The massive bowhead tongue then moves the food from the baleen plates where it has been caught to the esophagus. (Lowry 1993). Sometimes bowheads will also swim on their side with their mouths open and skim food this way as well. (Würsig and Clark 1993). Sometimes bowheads feed alone, but it is more common for groups of two to twenty-five animals to feed together, often in echelon formation. (Würsig and Clark 1993). Echelon formation is a staggered row or v-formation of whales spaced approximately 8 meters apart which creates a barrier from which prey are not likely to escape. (Würsig and Clark 1993). This likely facilitates prey capture, since euphausiids exhibit rapid evasive movements when they are pursued by sampling nets. (Würsig and Clark 1993).

Scientists presume bottom feeding from external evidence such as mud streaming from the mouths of surfacing whales and the presence of bottom dwelling prey in stomach samples. (Würsig and Clark 1993). It is presumed that bowheads skim the substrate for prey such as mysids and gammarid amphipods. (Würsig and Clark 1993).

Researchers also assume water column feeding when whales are observed diving repeatedly for 15-30 minutes per dive, surfacing just long enough to breathe, and diving again. (Würsig and Clark 1993). When this diving pattern is observed, it is often accompanied by a high incidence of defecations during surfacing and high incidence of raised flukes indicating steep dives, and where surveys have been done in these areas, concentrations of copepods have been found at various depths. (Würsig and Clark 1993).

To date it has been impossible to predict either within a given year or between years when and where each feeding pattern will occur. (Würsig and Clark 1993). Feeding behaviors generally appear to continue in a given location for one day up to a week or more. (Würsig and Clark 1993).

c. Bowhead Energetics

A major gap in knowledge of the natural history of the bowhead is that it is unknown how, when, and where the bowhead meets its nutritional requirements. It is unknown whether feeding occurs in the Bering Sea wintering grounds. (Lowry 1993). Feeding has been documented during the spring migration, despite the fact that a large proportion of stomachs from bowheads landed in the spring have been empty. (Lowry 1993). The spring lead system may be an important feeding area in some years. (Sheldon and Rugh 1995). It is assumed that bowheads spend a large proportion of their time feeding in the summer in the western Beaufort sea off the coast of Canada, and it is also possible that some whales summer off the coast of Alaska, feeding for four months or more in the Alaskan Beaufort Sea. (Lowry 1993). Feeding has been documented extensively during the fall migration, and this may be a particularly important time energetically as bowheads gulp their last meals before a partial or complete winter fast. (Würsig and Clark 1993).

Several different authors have attempted estimates of bowhead caloric requirements, prey density, and required feeding times. (Brodie 1981, Lowry and Frost 1984, Thomson 1987). These three studies used widely different parameters and methods and all suffered from the drawback that there was exceptionally little known about bowhead feeding to begin with. (Lowry 1993). Brodie and Thomson estimated that bowheads would need to consume 100 mt and 95 mt of crustaceans per year, respectively. (Lowry 1993). Lowry and Frost found that bowheads would need to feed for 1,720-2,513 hours out of a possible 3,120 hours in a 130 day feeding season. (Lowry 1993). All three results indicated that bowheads would need to feed in areas of extremely high prey concentration, higher concentrations, in fact, than are usually found during sampling efforts. (Lowry 1993). The main lessons to be drawn from these studies are (1)bowheads appear to be more efficient at finding their prey than human researchers; (2)much more needs to be learned about bowhead feeding efficiency, location, and timing before bowhead energetics can be truly understood; and (3)much more needs to be known about bowhead energetics, nutrition, and feeding strategies before the effects of human activities in bowhead habitat can be accurately assessed.

d. Trophic Relationships

Because so little is known about bowhead feeding, the analysis of trophic relationships between bowheads and other species in the arctic is preliminary and simplified. (Lowry 1993). Bowheads are on the third trophic level of the food web, as they eat almost exclusively primary consumers which feed on primary producers. Humans are the main predator of bowheads, though killer whales do sometimes attack bowheads as well. (Lowry 1993).

The potential trophic competitors of bowheads are the arctic cod, which eats mostly copepods, and the ringed seal, which eats mainly euphausiids and arctic cod. The ringed seal may feed on two different trophic levels, and hence Lowry (1993) posits that the arctic cod is the most likely competitor with the bowhead. However, this effect may be minimized by the fact that bowheads and arctic cod appear to eat different size copepods, which in turn feed upon various diatom species in different proportions. It is unknown whether food for consumers such as bowheads, arctic cod, or ringed seals is plentiful or limited in the Beaufort Sea. Lowry (1993) points out that humans utilize all major vertebrate species in the Beaufort Sea and therefore may effect bowheads in a variety of ways that are as yet unknown. (Preceding from Lowry 1993).

3. Reproductive Parameters

Very little is known about bowhead life history relative to other baleen whales. (Koski *et al.* 1993). This is the result of four factors: "(1)bowheads live in an environment that makes them difficult to study; (2)they are long-lived, slow-growing, and late-maturing animals that reproduce infrequently; (3)the bowhead population is partially segregated by age and possibly sex at certain times, and results of many life history studies have been confounded by sampling biases; and (4) a confirmed aging technique has not been developed for bowhead whales...." (Koski *et al.* 1993 (internal citations omitted)). Because of the fourth factor, reproductive parameters, when available, are given in terms of length, rather than age. (Koski *et al.* 1993).

a. Calving Areas

Researchers believe that calves are born primarily in April, May, and June, though newborn calves have been observed as late as August. (Koski *et al.* 1993). This suggests that calves may be born anywhere along the migration route from the Bering Sea to the eastern or even northern Beaufort Sea. It is highly probable, though not yet documented, that at least some percentage bowhead calves are born within the proposed critical habitat area. Beyond this very broad frame, when and where bowheads calve is unknown. (Moore and Reeves 1993).

b. Sex Ratio

Very little information is available on the sex ratio of bowhead whales.

c. Age/Length at Sexual Maturity

Because so little is known about the life history of the bowhead, the data that exists for length at sexual maturity cannot yet be confidently translated into age at sexual maturity. One author has suggested bowheads may be as old as 20 before they reproduce. (Sheldon and Rugh 1995).

Harvest data indicate that all or nearly all female bowheads are sexually mature by the time they reach 14.2 meters in length. The youngest sexually mature female recorded was 12.3 meters long, though other whales in the 12.0-14.2 meter range have been found to be sexually immature. Aerial photogrammetric studies of mothers and calves indicate that most females are probably sexually mature by the time they reach 13.0-13.5 meters long. (Koski *et al.* 1993).

Virtually nothing is known of the length at sexual maturity for males, as few male whales harvested have been examined for this purpose. One male measuring 12.7 meters long was deemed sexually mature due to the presence of sperm in the urine. (Koski *et al*. 1993). However, knowledge of bowhead reproduction is still quite sparse and more research is needed before these numbers can be verified. (Koski *et al.* 1993).

f. Lactation and Association with the Mother

Bowhead calves are presumed to be nursing when the calves submerge nose first near the genital-teat region of the mother's abdomen. Calves typically submerge for less than one minute at a time, followed by one blow upon surfacing, and repeat this sequence several times, sometimes alternating sides of the mother's body. This nursing behavior has been observed throughout the summer in the Beaufort Sea, though the exact time to weaning is unknown. (Preceeding from Würsig and Clark 1993).

Calves up to two months old tend to practice assisted locomotion, riding just behind the mid-point of the mother's back where the back slopes down to meet the tail. Small calves move their tail very little or not at all. No reports of this type of "piggyback" movement have been made past July, suggesting that only the youngest calves travel this way. Bowhead mothers nearly always stop their forward motion when presumed to be nursing. (Preceding from Würsig and Clark 1993).

It appears that calves remain closely associated with the mother through summer and fall. (Koski *et al.* 1993). However, by the time they migrate past Point Barrow the following spring, it appears that almost no yearlings are associated with their mothers. (Koski *et al.* 1993).

g. Gestation

Nerini (1984) has suggested that the gestation period for bowhead whales is 12 months, but this is not known for certain. (Würsig and Clark 1993). Koski *et al.* (1993) believe the most likely gestation period to be between 13 and 14 months. It is likely that most calves are born in late winter to early spring, due to the presence of small calves seen during the spring migration, but this has not been verified. (Würsig and Clark 1993). These suppositions are corroborated by the fact that several near term fetuses have been found in bowheads killed in the spring, as well as the fact that fetuses only a month or two advanced have been found in bowheads killed in the spring. (Würsig and Clark 1993). Very small (13-38 cm.) fetuses have also been found in the spring while those found in the fall have measured 390-434 cm. (Koski *et al.* 1993). The relatively small range of fetus lengths suggests that the actual implantation period (and presumably mating period) is relatively short, and that most implantations occur in late winter or early spring. (Koski *et al.* 1993). There is as yet no evidence that delayed implantation occurs in bowheads, though the sampling size has been too small to be certain. (Koski *et al.* 1993).

4. Acoustic Communication

It has long been assumed that acoustics plays an important role in bowhead behavior. (Würsig and Clark 1993). Increases in acoustic recording and monitoring efforts in the late 1970's showed that "bowheads possess remarkable vocal abilities, equal to, if not surpassing, the right whales, and even humpbacks." (Würsig and Clark 1993). Most sounds produced by bowheads are in the 80 to 400 Hz frequency range.[1] (Würsig and Clark 1993). Calls emitted by bowheads in spring have been measured

[1]Sound is a wave of pressure variation that is measured in Hertz (Hz), or the number of cycles that the tone completes in a second. A sound with a high frequency has a high tone or pitch, many cycles per second, and each oscillation (cycle) travels a short distance. A sound with a low frequency has a low tone or pitch, few cycles per second, and each oscillation travels a long distance. Middle C on a piano is about 400 Hz. (U.S. Navy 1999).

as high as 180-189 dB re 1 µPa at 1 m,[2] but the average dB level of a typical 100 Hz bowhead call in spring has been measured as 151 ±9.5 dB re 1 µPa at 1 m. (Würsig and Clark 1993). Principles of underwater sound will be discussed at greater length below.

The bowhead acoustic repertoire can be divided into two general categories (1)blow, slap and other miscellaneous sounds, and (2)vocalizations, or calls. (Würsig and Clark 1993). Bowheads make blow sounds both above water and below. Below water, these sounds are associated with feeding and social behavior. Bowheads make different slap sounds, including one termed a "gunshot" by Würsig and Clark (1993) associated with breaches, tail slaps, and flipper slaps. The communicative value of these sounds is unknown. (Würsig and Clark 1993).

Würsig and Clark (1993) further divide the call category into simple, low-frequency FM calls and complex calls. There have been some limited studies attempting to associate different calls and call types with particular bowhead activities, which have not shown any significant correlation. (Würsig and Clark 1993). However, this is not surprising as the studies were extremely limited by such factors as uncertainty as to which group of whales the sounds were emanating from, how far away the sounds could be heard, and what behaviors the whales were actually exhibiting while under observation. (Würsig and Clark 1993).

Bowheads also produce songs, which differ from calls in that the song notes are longer in duration and cover a greater frequency range. Average song length is one minute, but songs can last up to several hours. Singing bowheads have yet to be observed visually, so the age and sex of the singing animals is unknown, as well as the purpose of the songs. Comparisons to humpback whales lead researchers to hypothesize that bowhead singers are male, engaged in courtship or mating activity, but this remains speculative. (Würsig and Clark 1993).

Some studies have linked the level and frequency of bowhead calling to factors such as ice coverage and season. (Würsig and Clark 1993). However, these studies have so far been unable to prove the communicative value of bowhead acoustics, as different bowhead sounds could be merely an effect of context and not a communication technique. (Würsig and Clark 1993). However, there is extremely convincing anecdotal evidence that bowhead whales do communicate acoustically.

In one example, a mother and calf became separated and loud FM calls were heard as the two rejoined. Significantly, once the two were together, the calls stopped. Bowhead whales also produce signature calls, calls with similar acoustic characteristics, which may be produced from 3 minutes up to 5

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[2]The "loudness" of sound is measured in decibels (dB), which state the ratio between a measured pressure value and a reference pressure value. One micro pascal (1 µPa) is the standard reference pressure for underwater sound, and one meter is simply the distance from the source at which the sound was measured. For comparisons of loudness of sound, the standard reference pressures and distances must be consistent. (U.S. Navy 1999).

hours or longer. (Würsig and Clark 1993). Würsig and Clark (1993) have suggested these signature calls can serve to (1)maintain herd cohesion, (2)allow members of the herd to keep track of other individuals, (3)allow the herd to monitor changes in the ice conditions in the area. Finally, there is the hypothesis that bowheads use sound to navigate through leads in the pack ice, strongly supported by the fact that the reverberations from open water and new ice thin enough for bowheads to break through and breathe are identical. (Würsig and Clark 1993).

5. Natural Morbidity and Mortality

Human induced mortality will be addressed in the section "Threats to the Bowhead Whale," below. So little is known about natural bowhead morbidity and mortality that it has been stated that the existing knowledge should be used primarily as a basis for further research. (Burns et al. 1993). One reason so little is known is that the vast majority of whales that die of natural causes are never seen by humans. At least thirty-six whales were recorded between 1964 and 1989 as having died from unknown causes. Some of these certainly died from unsuccessful harvest attempts, but the actual number is unknown. Major known and presumed causes of natural morbidity and mortality are discussed below. (Philo *et al*. 1993).

Skin lesions and associated microbes that have been associated with mortality in other captive and free-ranging cetacean species have frequently been found in harvested bowhead whales. These include the genera *Staphylococcus, Streptococcus, Clostridium, Vibrio, Pseudomonas,* and *Candida*. It is unknown what the actual effects of these microbes on bowhead individuals and stocks is, however one concern is that bowheads may be subject to stress induced bacterial infections as are some captive cetaceans. (Preceding from Philo *et al*. 1993).

Evidence of calcivirus infections has been found in whales landed near Barrow. Calcivirus infections could contribute to natural mortality in bowheads and could also cause reproductive impairment. There is concern that calciviruses, as well as the bacteria and fungi discussed below, could be harmful to humans if infected bowhead meat is consumed. (Preceding from Philo *et al*. 1993).

Tumors are relatively rare in cetaceans, and only one bowhead lipoma has been found, which appeared to be benign. (Philo *et al*. 1993). Researchers have concluded that tumors are unlikely to be a major cause of bowhead mortality. (Philo *et al*. 1993). However, reports such as that from Martineau *et al*. (1988) where five tumors were found in four of thirteen beluga whales (*Delphinapterus leucas*) stranded near a polluted stretch of the St. Lawrence River, lead to questions whether this will remain true in the future.

Almost all bowheads have some amount of skin abnormalities. These seem to be benign and self-limiting, however the significance to individual bowheads or bowhead stocks is unknown at this point. (Preceding from Philo *et al*. 1993).

Orca (*Orcinus orca)* (Killer) whales are known to attack bowheads. Bowheads may be particularly vulnerable to attack because they swim slowly, but they may also be able to achieve some level of protection by swimming under ice. The impact of Orca whale predation on the Bering Sea stock is unknown. (Philo *et al.* 1993).

There are historical accounts of ice entrapment causing bowhead mortality, though it is not known if the bowheads died as a direct result of the entrapment or merely because the entrapment allowed hunters to then kill the whales. It is possible however, that in unusually heavy ice years bowheads may be excluded from preferred feeding grounds. (Philo *et al.* 1993).

Bowheads appear to ingest some foreign substances, such as wood fragments and baleen pieces, without harmful results. It has been suggested, however, that baleen hairs could combine with weathered oil in the event of an oil spill and create a mass that could block bowhead stomachs or intestines. (NMFS 1999a)

B. DISTRIBUTION AND MOVEMENT

1. Winter

Scientists believe that most of the Bering Sea stock overwinters from November to March in polynyas on the edge of the pack ice in the Bering Sea. Bowheads appear to occupy a large winter range which is strongly influenced by ice cover. (Moore and Reeves 1993). Bowheads have been observed as far south as the Pribiloff Islands and Cape Kronsky on the Kamchatka Coast in years of heavy ice cover, and have been seen north of the Bering Strait in years of light ice cover. It appears that bowheads are always associated with the marginal ice zone, no matter where that zone is located in a particular year. (Moore and Reeves 1993). No winter density or population counts are available, but bowheads do seem to concentrate near St. Mathew Island and south and west of St. Lawrence Island. (Moore and Reeves 1993). These areas also appear to be "staging" areas for the spring migration. Average group size on the winter range appears to be almost three times as large as that in the Chukchi or Beaufort Seas. (Moore and Reeves 1993).

2. Spring Migration

Between April and June, most bowheads migrate from the Bering Sea to the Eastern Beaufort Sea. (Moore and Reeves 1993). The spring migration appears to pass mainly to the west side of St. Lawrence Island, go northward and slightly east through the Bering Strait and up to Point Hope, hug the coast from Point Hope through the Western Chukchi Sea to Point Barrow, and then veer offshore through the Central Beaufort into the Eastern Beaufort Sea. (Braham et al. 1980, Moore and Reeves 1993). There are anecdotal reports that some bowheads also swim north along the coast of Siberia before heading east towards the Beaufort Sea. (Moore and Reeves 1993). It is also possible that not all whales continue all the way to Canadian waters in the Eastern Beaufort; some bowheads may summer in the Alaskan waters of the Central Beaufort. (Moore and Reeves 1993).

Bowheads generally pass St. Lawrence Island in late March and early April, Point Barrow from mid-April to early June (though some have been sighted as early as March) and arrive in the Eastern Beaufort from early June through July. (Moore and Reeves 1993). From studies done at Point Barrow, Moore and Reeves (1993) conclude that bowheads tend to move steadily past Point Barrow at approximately 4 km/hr. However, there have been cases of resightings of whales in the same vicinity within 1-5 days of a sighting at Point Barrow. There was also a case in 1985 where a group of sixty whales was observed feeding extensively near Point Barrow from May 26 to June 6. (Carroll *et al*. 1987, Moore and Reeves 1993).

Alaska Natives agree that the spring migration occurs in waves led by juveniles and followed by large adults and cows with calves. (Braham et al. 1980, Moore and Reeves 1993). Surveys at Point Barrow have confirmed that the migration is pulse-like, with peaks in the daily sighting rates separated by 7-9 days. (Moore and Reeves 1993). Interestingly, Russian Eskimos also report that the spring migration occurs in waves, but maintain it is led by adults and cows with calves and that juveniles follow. (Moore and Reeves 1993). It is likely, though so far not confirmed, that the spring migration is segregated by sex and age classes.

The exact distribution of bowheads during the spring migration is hard to determine, especially in the Beaufort Sea which is largely frozen at the time. (Braham et al. 1980). It is believed that bowheads follow a route far-offshore (Braham et al. 1980), though the lack of spring sightings closer to shore may be unreliable due to the difficulty in surveying because of the pack ice. (NMFS 1999a). One important feature of the spring migration (as well as the fall migration, discussed below) is that it concentrates virtually the entire Bering Sea stock of the bowhead into an extremely small spatial and temporal area. In one year, 665 bowheads passed Point Barrow within four days, and in another year 90% of migrating bowheads passed through an area only 4 km wide. (NMFS 1999a).

The spring migration occurs largely in, and appears to be strongly influenced by, the system of leads (cracks) and polynyas (open areas) occurring at the margin of the pack ice. (Moore and Reeves 1993). Würsig and Clark (1993) have described the bowhead's movement through the lead system. Bowheads will surface at the beginning of a lead and swim through the open water at the surface, breathing as they go. When they reach the end of the lead they sometimes appear to wait at the edge of the ice to finish breathing as much as they need to before diving. They then dive and either resurface at the beginning of another lead up to several kilometers away, or return to the original spot if their search for open water was unsuccessful. They will then dive again and search slightly to the north or south looking for the beginning of the next lead.

Bowheads can break through ice at least 18 cm. thick and perhaps up to 60 cm. thick to breathe. (George *et al*. 1989, Würsig and Clark 1993). By pressing their blowholes against the underside of the ice, they create hummocks and breathe through the cracks that are created. (George *et al*. 1989).

It is not known with certainty how bowhead whales find the open water. Several different theories have been advanced. Several authors have suggested that bowheads rely largely on vision, surfacing at the areas of greatest light which will be at cracks in the ice or where the ice is thinnest or has recently refrozen. (George *et al*. 1989, Würsig and Clark 1993). George *et al*. 1989 described an incident where a bowhead created a breathing hummock in the center of a recently created snowmachine track where the compressed snow had melted, allowing additional light to penetrate the sea ice. Alternatively, Würsig and Clark (1993) postulate that the pulse-like nature of bowhead migration, along with their frequent emission of low frequency sounds, suggests they are following each other through the best routes in the open ice. There is anecdotal evidence that whales communicate with each other while exploring for open leads. (Carroll and Smithisler 1980). It is also possible that the thickest, multi-year ice, which may hang over 12 meters below the surface, is detected by reverberations of the bowheads' low-frequency sounds, and then avoided. (Ellison et al. 1987, George *et al*. 1989, NMFS 1999). This theory is supported by the fact that the reverberations from new year ice are identical to the reverberations from open water. Native hunters have suggested that bowheads leave bubble trails which others can follow, and it is also possible that a chemical trail is left behind. (Würsig and Clark 1993).

3. Summer

It is believed that the majority of the Bering Sea stock summers in the Eastern Beaufort Sea and Amunsden Gulf, off the coast of Canada, until late August or early September. (Moore and Reeves 1993). Whales have been spotted in August in the Alaskan Beaufort Sea (Moore *et al*. 1989), swimming without a clear direction to their movement, indicating that they were not actively migrating at the time. (Moore and Reeves 1993). There are also reports that some bowheads summer along the Chukchi Peninsula. (Moore and Reeves 1993). It is possible that some whales do not summer in the eastern Beaufort, but remain in the western Beaufort or eastern Chukchi Seas throughout the summer. More research is needed to confirm this possibility.

The actual distribution of whales in the eastern Beaufort and Amunsden Gulf is not well known. Data from surveys conducted in the southeastern Beaufort Sea from the Canadian border to Cape Bathurst, where most survey efforts have been focused, suggest that the entire population does not summer in this area. (Moore and Reeves 1993). It is possible that large numbers of bowheads occur west of Banks Island and in Amundsen Gulf, where there have been few survey attempts. (Moore and Reeves 1993). It is also possible that current survey methods are inaccurate. (Moore and Reeves 1993).

4. Fall Migration

From September through November, bowheads migrate from the eastern Beaufort Sea back to their wintering grounds in the Bering Sea. (Moore and Reeves 1993). The fall migration occurs much closer to shore and through much less ice cover than the spring migration, with most bowheads migrating within 100 km of shore along Alaska's Beaufort Sea coastline. (Moore and Reeves 1993). Bowhead distribution does extend out to 170 km. (Moore and Reeves 1993). Bowheads have been observed just off the barrier islands on Alaska's North Coast. (Moore and Reeves 1993, Treacey 1990).

Bowheads begin migrating across the central Beaufort Sea in early September, and most whales pass Alaska's north coast from mid-September to early October. (Moore and Reeves 1993). The fall migration, like the spring, occurs in pulses, with peaks in daily sighting rates separated by 5-10 days. Eskimo whalers contend that juveniles migrate first, followed by adults and cows with calves. The latest sighting ever reported for the Beaufort Sea was October 30. (Moore and Reeves 1993).

The Northstar Biological Opinion for the Bowhead Whale (NMFS, 1999a) summarizes available data on distribution during the fall migration:

> Fall surveys show that the median water depth at bowhead whale sightings (1982-1995) between 141ºW to 146ºW longitudes is 138 ft (42 m). During fall migration, whales are found close inshore east of Barter Island and from Cape Halkett to Point Barrow, generally in water depths less than 164 ft (50 m). Bowheads take about 2 days to travel from Kaktovik to Cross Island, reaching the Prudhoe Bay area by late September. From Cross Island it takes the whales another 5 days to reach Point Barrow. Inupiat believe that whales follow the ocean currents carrying food organisms. If the currents go close to Cross Island, whales migrate near there. In the region immediately east of the project area, bowheads reportedly travel on the inshore side of Cross Island. ***It has also been reported that whales are seen inside the barrier islands near Cross Island practically every year and are sometimes seen between Seal Island and West Dock***. During years when a fall storm pushes ice up against the barrier islands in the Beaufort Sea, bowheads may migrate on the shoreward (lagoon) side of Cross Island, the Midway Islands, and No Name Island. Also, crews looked for whales inside the barrier islands during the years of commercial whaling. However, aerial surveys from 1980 to 1995 have not documented that bowheads migrate inshore of Cross Island.
>
> Bowhead whales may swim very close to shore on some occasions. Bowheads have been observed feeding not more than 1,500 ft (457 m) offshore in about 15 to 20 ft (4.6 to 6 m) of water. Smaller whales may swim in water depths of 14 to 18 ft (4.3 to 5.5 m). Inupiat whaling crews have noticed that whale migration appears to be influenced by wind patterns, moving when winds start up and stopping when they are slow. From Point Barrow, whales migrate back southward through the Chukchi Sea to wintering grounds in the Bering Sea.
>
> Fall surveys conducted in the Northstar project area from 1979 through 1995 recorded the occurrence of bowheads from the barrier islands to about 75 miles (120 km) offshore, with most sighted 6.2 to 37.2 miles (10 km to 60 km) offshore in water depths of 33 to 328 ft (10 to 100 m). In general, bowhead whales seemed to migrate closer to shore in light ice years and farther offshore in heavy ice years, with distributions peaking at 19 to 25 miles (30 to 40 km) and 37 to 43.5 (60 to 70 km), respectively. From 1979 to 1986, Ljungblad et al. (1987:136-137) observed that fall migration extended over a longer period,

> and sighting rates were larger and peaked later in the season in years of light ice cover compared to years of heavy ice cover. (NMFS 1999a: 8-9, internal citations omitted, emphasis added.)

The migration appears to be influenced by ice cover and opportunities for feeding. (Moore and Reeves 1993). However, the relationship between ice cover, prey availability, and survey results is not well understood. (Moore and Reeves 1993). For example, whales may be observed feeding less frequently in years of heavy ice cover because the ice obscures the view of surveyors, or they may be observed feeding less frequently in years of heavy ice cover because the ice makes prey less available. Researchers do not currently know which factor or combination of factors is responsible for survey data. Würsig *et al.* (1993) has suggested that fall feeding opportunities may be particularly important in the bowhead energetic regime.

Once past Point Barrow, it appears that bowhead distribution is less well defined in the Chukchi Sea than in the Beaufort. (Moore and Reeves 1993). It is believed that most bowheads swim southwest across the Chukchi Sea, crossing to the coast of Chukotka. However, some sightings suggest that some percentage of the population takes a more northerly route across the Chukchi Sea. (Moore and Reeves 1993). Bowheads are believed to pass through the Bering Strait from the end of October through the beginning of November. (Moore and Reeves 1993).

C. POPULATION ABUNDANCE ESTIMATE

Some authors estimate the Bering Sea stock at 7,500 whales; 95% confidence interval 6,400-9,200. (NMFS 1999c, Zeh et al. 1993). Other authors estimate the stock at 8,200 animals with a 95% confidence interval of 7,200-9,400. (Hill and DeMaster 1998, NMFS 1999a).

Historical estimates for the size of the Bering Sea stock in 1848 (the date of the onset of commercial whaling) range from 10,000-23,000 (Woodby and Botkin 1993) to 14,000-27,000 (Breiwick and Brahm 1990) to 12,000-18,000 (Eberhardt and Breiwick 1992).

Until recently, the Bering Sea Stock was estimated to be increasing at 3.1% per year. (Hill and Demaster 1998, NMFS 1999a). The most current information indicates the increase is much smaller, perhaps 1.5% per year. (NMFS 1999c).

The Potential Biological Removal (PBR), defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor, is 77. (Hill and DeMaster 1998). The recovery factor used for the bowhead is .5, as opposed to the normal recovery factor of .1 used for endangered species, because the Bering Sea stock is increasing. (Hill and DeMaster 1998). This results in a PBR five times larger than it would normally be.

D. THREATS TO THE BOWHEAD WHALE

Threats to the bowhead whale that are independent of threats to its critical habitat are discussed in this section; threats to the bowhead's critical habitat are discussed below.

1. Subsistence Whaling

Eskimos in Alaska and Russia have hunted bowhead whales for at least 2,000 years. (Hill and DeMaster 1998). The International Whaling Commission (IWC) has been regulating the subsistence take of bowheads since 1977. The potential biological removal (PBR=the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor) is 77. (Hill and DeMaster, 1998). However, the PBR is calculated for bowheads with a recovery factor of 0.5, as opposed to the normal factor of 0.1 used for endangered species, because the population is thought to be increasing despite known take. (Hill and DeMaster, 1998). This results in a PBR that is five times what it would normally be for an endangered species. Without the change in the recovery factor, the PBR for bowheads would be just over 15.

Since 1977, the Alaskan Native community has killed between 14 and 72 bowheads per year. The number of whales killed in 1994, 1995, 1996, and 1997 was 46, 57, 44, and 60, respectively. (Hill and DeMaster, 1998, NMFS 1999a). The current IWC subsistence whaling quota is 67 strikes per year with a five year limit of 280. (NMFS 1999a). Whales that are struck and lost are counted in the quota, though it is possible that some of these animals survive. (NMFS 1999a).

2. Fisheries Bycatch

Whales with ropes caught in their baleen and scarred from rope entanglement have been reported. (NMFS 1999a). The number of fisheries interactions with bowheads is believed to be rare, and Hill and DeMaster (1998) report the estimated annual mortality rate incidental to commercial fisheries to be zero. The overall effect of fisheries bycatch on the Bering Sea stock is unknown.

3. Climate Change

Evidence shows there has been a shift in regional weather patterns over the last 10-15 years in the Arctic. (Hill and DeMaster 1998). Climate change will probably affect high northern latitudes more than any other region, and bowhead whales may be sensitive to changes in the arctic weather, water temperature, or ice extent. (Hill and DeMaster 1998). So far there has been no reliable prediction of the effect of climate change on bowhead whales. (Hill and DeMaster 1998).

IV. THE BOWHEAD WHALE NEEDS CRITICAL HABITAT

A. CRITICAL HABITAT IS BENEFICIAL TO LISTED SPECIES

Critical habitat is defined by Section 3 of the ESA as:

> (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
>
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. §1532(5).

The designation and protection of critical habitat is one of the primary ways in which the fundamental purpose of the ESA, "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved," (16 U.S.C. §1531(b) (emphasis added)) is achieved.

Critical habitat receives additional protection through Section 7 of the ESA. The Section 7 consultation requirements provide that no action authorized, funded, or carried out by any federal agency will "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical habitat]" 16 U.S.C. §1536(a)(2) (emphasis added). "Destruction or adverse modification" is further defined in the implementing regulations as an "alteration [of habitat] that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." 50 C.F.R. §402.02. This prohibition is separate and distinct from, and in addition to the prohibition against actions which "jeopardize the continued existence of" a species. "Jeopardize the continued existence of" is defined as "to reduce appreciably the likelihood of both the survival and recovery of a species by reducing the reproduction, numbers, or distribution of that species." 50 C.F.R. §402.02.

Critical habitat designation offers an added layer of protection to ensure that a listed species' habitat - the loss of which is widely recognized to be the primary reason for most species' decline - will not be harmed. Without critical habitat designation, a listed species' protection under Section 7 of the ESA is effectively limited to avoiding "jeopardy" to the species in its occupied habitat, without separate consideration of the potential for "destruction or adverse modification" of habitat or suitable unoccupied habitat which may be essential to the species' recovery. This distinction was nicely summarized by the U.S. Fish and Wildlife Service in the Final Rule designating critical habitat for the northern spotted owl:

> The Act's definition of critical habitat indicates that the purpose of critical habitat is to contribute to a species' conservation, which definition equates to recovery. Section 7 prohibitions against the destruction or adverse modification of critical habitat apply to actions that would impair survival and recovery of the listed species, thus providing a regulatory means of ensuring that Federal actions within critical habitat are considered in relation to the goals and recommendations of a recovery plan. As a result of the link between critical habitat and recovery, the prohibition against destruction or adverse modification of the critical habitat would provide for the protection of the critical habitat's ability to contribute fully to a species'

recovery. ***Thus, the adverse modification standard may be reached closer to the recovery end of the survival continuum, whereas, the jeopardy standard traditionally has been applied nearer to the extinction end of the continuum.*** (57 Fed. Reg. 1796 at 1822) (emphasis added)).

This added protection will be implemented through the issuance of a biological opinion under 16 U.S.C. §1536(b)(3)(A), which must suggest reasonable and prudent alternatives by which a finding of jeopardy or adverse modification may be avoided.

Critical habitat designation also protects species by helping to define the meaning of "harm" under Section 9 of the ESA which prohibits unlawful "take" of listed species, including harming the species through habitat degradation. Although "take" through habitat degradation is not expressly limited to harm to "critical habitat," it is practically much easier to demonstrate that the significance of the impact to a species' habitat where that habitat has already been deemed "essential," or "critical," to the species' continued survival. (*See* Palila v. Hawaii Department of Land and Natural Resources, 852 F. 2d 1106 (9th Circ. 1988)).

Critical habitat also helps species by providing for agency accountability through the citizen suit provision of the ESA. The citizen suit provision permits members of the public to seek judicial review of the agency's compliance with its mandatory statutory duty to consider the habitat needs of imperiled species. Also, the designation of critical habitat provides valuable information for the development of recovery plans which identify actions, including habitat protection, necessary for the recovery of the species. At present their is no recovery plan for the bowhead, nor has a recovery team been designated. (NMFS 1999c).

Additonal benefits of critical habitat were described by NMFS in the Final Rule designating critical habitat for the northern right whale. "A designation of critical habitat provides a clearer indication to Federal agencies as to when consultation under section 7 is required, particularly in cases where the action would not result in direct mortality or injury to individuals of a listed species." 58 Fed. Reg. 29186 at 29187. "The critical habitat designation, describing the essential features of the habitat, also assists in determining which activities conducted outside the designated area are subject to section 7.....For example, disposal of waste material in water adjacent to a critical habitat area may affect an essential feature of the designated habitat (water quality) and would be subject to the provisions of section 7...." Id.

NMFS goes on to state that critical habitat also assists federal agencies in planning future actions because critical habitat establishes in advance those areas that will be given special consideration in section 7 consultations. Id. The idea is that conflicts between development and listed species can be identified and avoided early in the planning process. Id. NMFS also states that critical habitat provides a benefit to species by focusing federal, state, and private conservation and management efforts in areas designated critical habitat. Id. Recovery efforts can then address special considerations needed in critical habitat areas, including conservation regulations to restrict private as well as federal activities. Id. Finally, NMFS points out that there may be other federal, state, or local laws that provide special protection for areas designated as critical habitat.

The bowhead whale will benefit from the designation of critical habitat in all of these ways. The designation of critical habitat will be particularly important to the bowhead because it faces many threats that may seriously impair recovery of the population, but that are not necessarily fatal to individual whales. The added layer of protection provided by critical habitat will allow NMFS to designate reasonable and prudent alternatives to oil and gas development activities that are impeding recovery but not necessarily causing immediate jeopardy to the continued survival of the species. This is particularly important as the level of industrial activity in the bowhead's migratory corridor in the Chukchi and Beaufort Seas continues to grow. To give this type of protection to a species through the protection of its habitat was the clearly articulated intent of Congress in the 1978 and 1982 amendments to the ESA.

B. HABITAT CRITICAL TO THE BOWHEAD IS THREATENED

1. Oil and Gas Development

The Bering Sea Stock of the bowhead is now imperiled by the massive proliferation of industrial development off the north coast of Alaska, especially in the Beaufort Sea, where large-scale oil and gas leasing began in the 1970's. The first off shore oil lease in the Beaufort Sea was sold by the State of Alaska in 1964. In 1974, President Nixon established the federal Outer Continental Shelf (OCS) program against the recommendation of the Council on Environmental Quality, which cited inadequate knowledge of environmental consequences and the failure of the federal government to receive fair market value for the land. (Miller 1997). The entire offshore region of Alaska, with two exceptions,[3] is now open to oil and gas leasing. (Miller 1997). Areas within three miles of shore are administered by the State of Alaska, and areas beyond the three mile limit are administered by the Minerals Management Service (MMS) through the Federal Outer Continental Shelf (OCS) program. The north coast of Alaska along the Beaufort and Chukchi is 1,400 miles long (10,620 m). The entire offshore region is open for leasing, as is the entire coastal zone, with the exception of one 30 mile protected stretch and another 100 mile stretch that may be protected within the Arctic National Wildlife Refuge. (Miller 1997).

The State of Alaska has already leased 32 million acres for oil and gas development, both on shore and offshore. Approximately 2.32 million acres have been leased by one joint state-federal and six federal offshore leases in the Beaufort and Chukchi Seas. Thirty exploratory wells have been dug in the Beaufort Sea, and five exploratory wells in the Chukchi Sea since 1980. Five offshore oil fields are either proposed for or currently undergoing development in the Beaufort Sea: Northstar, Sandpiper, Hammerhead, Kuvlum, and Liberty. Four currently operating fields, Endicott, Point McIntyre, Milne Point, and Niakuk, produce

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[3]The two exceptions are Kachemak Bay State Wilderness Park and fishing grounds in Bristol Bay.

at least some of their reserves from offshore. (Preceding from Trustees for Alaska 1998). In addition to the permits issued for these nine fields, the NMFS has issued at least 18 Incidental Take Permits, Incidental Harassment Authorizations, and Letters of Authorization for the take of bowhead whales due to oil and gas related activities since 1982. [4]

a. Disturbance Due To Industrial Noise

Bowheads, like all other marine mammals, live in a sound environment influenced by both natural and man-made factors. The effect of man-made noise on bowheads must be assessed relative to the naturally occurring background noise level in the ocean. One study in the Beaufort Sea, conducted near the Northstar offshore drilling unit, found the ambient sound level in the absence of human activity to vary between 79 to 119 dB re 1 µPa, with hydrophones placed 12 to 13 meters below the surface. (NMFS 1999a). Half of the measured values in the 20 to 1,000 Hz range occurred at 95 dB or less. (NMFS 1999a). Ambient noise levels were dominated by wind activity, and increased as did wind speed. (NMFS 1999a). The highest noise levels, 112 to 123 dB re 1 µPa were produced by a storm with wind gusts up to 50 nautical miles per hour. (NMFS 1999a). This storm corresponds to "Sea State Seven," while "Sea State Zero," or calm, glassy seas, would generally result in ambient noise levels of less than 80 dB re 1 µPa. (NMFS 1999a).

An important acoustic principle is that decibel measurements, which state the ratio between a measured pressure value and a reference pressure value, are logarithmic. (U.S. Navy 1999). This means that each 10 dB increase is a ten-fold increase in pressure. (U.S. Navy 1999). The decibel level encountered by a whale from a give source depends on a number of factors including the source level, source frequency, whether the source is above or below the water and how far above or below, distance of the whale from the source, and propagation of the sound through the water- which in turn depends on water depth, temperature, salinity, topographical features and other factors. (Richardson and Malme 1993). The speed of sound in Arctic ocean water is approximately 1440 m/s. (Richardson and Malme 1993). Putting all these principles together, one can see, for example, that an industrial noise that raises the ambient noise level by 25 dB 1 km from the source will make the ambient noise level 300 times greater than it would normally be. (NMFS 1999a). The effect of the same noise at 10 km would be to make the ambient noise level 10 times greater than it would ordinarily be. (NMFS 1999a). Another important characteristic of underwater sound propagation is that sounds propagate better at greater depths, and therefore a bowhead whale will be more vulnerable to sound disturbance when deep underwater than when

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[4] *See*, *e.g.*, July 30, 1999 (64 Fed. Reg. 41384-01), September 21, 1998 (63 Fed. Reg. 50212), October 2, 1997 (62 Fed. Reg. 51637), July 17, 1997 (62 Fed. Reg. 38263), July 25, 1996 (61 Fed. Reg. 38715), October 1, 1993 (58 Fed. Reg. 51315), July 8, 1992 (57 Fed. Reg. 30201), July 18, 1990 (55 Fed. Reg. 29207), May 1, 1989 (54 Fed. Reg. 18565), May 15, 1986 (51 Fed. Reg. 17790), August 30, 1985 (50 Fed. Reg. 35286-02), March 8, 1985 (50 Fed. Reg. 9481), July 27, 1983 (48 FR 34092), July 12, 1983 (48 Fed. Reg. 31896), June 8, 1981 (46 Fed. Reg. 30375).

near the surface. (NMFS 1999a).

Assessing the effect of industrial noise on bowhead whales is complex. First, as discussed above, a source will have a different effect depending on how far away the whale is when the noise is encountered. Second, the effect of that noise on the whale depends on received sound level and frequency, whether the noise is pulsed or continuous, any tolerance or habituation experienced by the whale, the activity the whale is engaged in at the time the sound is encountered, and other factors. (Richardson and Malme 1993). Finally, to assess and analyze the effect of the noise on the whale requires a mastery of many disciplines including physical acoustics, anatomy and physiology, bioacoustics, psychoacoustics, and behavioral ecology. (NMFS 1999a). Added to this equation is the fact that very little is known about vital factors such as the auditory processes of bowheads, the importance of different call types to bowheads, and the importance of other natural sounds in the ocean. (Richardson and Malme 1993).

Despite the complexity of the science and the many unknown variables, it is clear that industrial noise associated with oil and gas development in the Arctic may effect bowheads in three major ways: avoidance, masking, and temporary or permanent hearing impairment. (Richardson and Malme 1993). Avoidance occurs when industrial noise causes whales to respond by changing their normal behavior and moving away from the noise, either temporarily or more permanently. Masking occurs when industrial noise raises background noise levels and interferes with bowheads' detection of sounds from other whales or from natural sources. (Richardson and Malme 1993). Temporary or permanent hearing impairment may be sustained from particularly intense noises. (Richardson and Malme 1993).

Of the three major ways industrial noise may affect bowheads, avoidance is by far the best described. This section will describe the four main sources of industrial noise encountered by bowheads as categorized by Richardson and Malme (1993): seismic exploration; other industrial activities including drilling; dredging and construction; ships and boats; and aircraft. Avoidance responses that have been recorded are summarized. A discussion of masking and hearing loss follows the discussion of the four major types of industrial noise.

i. Seismic Exploration

The energy generated by seismic vessels to map rock strata beneath the ocean floor creates the loudest noise within the range of the bowhead. (Richardson and Malme 1993). The total peak output of the airguns used in seismic exploration is 242-252 dB re 1 µPa, with a horizontal propagation level of 230-235 dB re 1 µPa. (Richardson and Malme 1993). There have been several studies of short term bowhead reactions to seismic vessels, some of which were opportunistic and some of which attempted to designate control groups. (Richardson and Malme 1993). Richardson and Malme (1993) summarized these studies as follows:

> Thus, most bowheads usually show strong avoidance when an operating seismic vessel is within 6-8 km, and there probably are some effects at greater distances. In three studies of

> bowheads and one of gray whales, surfacing-dive cycles have been unusually quick in the presence of seismic noise, with fewer breaths per surfacing and longer intervals between breaths. This pattern was evident among bowheads 6 km to at least 73 km from seismic vessels as well as during controlled tests at closer ranges. Besides these subtle effects, strong avoidance may occur infrequently at distances of 20 km or more, although active avoidance usually does not begin unless the seismic ship is closer than 8 km. (Richardson and Malme 1993:674, internal citations omitted).

Other effects from seismic exploration that have been observed are a reduction in bowhead calls and cessation of feeding. (NMFS 1999a, Richardson and Malme 1993). Eskimo whalers assert that the bowhead migration has been displaced from 16-48 km offshore by seismic survey activity, and that seismic activity has been directly responsible for several unsuccessful hunting years. (NMFS 1999a). An oil industry study found that the displacement of the migratory corridor due to seismic exploration alone was not statistically significant, but that the displacement of the migratory corridor due to all industrial noise was significant, and that "*The observed tendencies are consistent with the experience of bowhead hunters*". (NMFS 1999a:25 (emphasis in original)). Inter-year variability in the migration corridor due to seismic exploration disturbance is considered an open question. (NMFS 1999a, Richardson and Malme 1993).

Inter-year variability in the bowhead migration corridor is not fully understood, but undoubtedly depends on a large number of factors besides human activity, such as weather and ice conditions. In a study conducted to compare bowhead behavior at different distances from a single seismic vessel, however, the evidence was clear and unambiguous: "Ensonification of waters near the Northstar by seismic sounds apparently had one or both of the following effects: it reduced the number of calls emitted by an average bowhead per hour, and/or reduced the number of bowheads within a several kilometer distance of the recording unit off Northstar." (NMFS 1999a:25).

ii. Industrial Activity Including Drilling, Dredging, and Construction

There is a vast array of noises associated with offshore drilling and construction in the Arctic. Some of these activities include but are not limited to construction of artificial islands and associated dredging, drilling operations from artificial islands, drill ships, ice-breaking, and in-air noise from the operation of machinery like bulldozers, backhoes, compressors, generators, and pile drivers. (NMFS 1999a, Richardson and Malme 1993). Ice-breaking is the loudest single activity, (primarily due to propeller cavitation, not the actual sound of ice breaking) producing source noises between 191 and 196 dB. (Richardson and Malme 1993). Another very intense noise is produced from drill ships which have been measured at 185 dB re 1µPa. In general, noise produced by a combination of ongoing industrial activities tends to raise the ambient ocean noise level by about 25 dB re 1µPa at a distance of 1 km and by about 10 dB re 1µPa at a 10 km distance. (NMFS 1999). As discussed below, the combination of noise sources and total noise levels at any given time is not known.

One example of bowheads' response to a drill ship was reported from the Kuvlum Project in 1992.

A group of 49 bowheads swam in a large arc around the drill ship. The group began their deviation 32 km before the ship, and did not resume their normal route until 30.6 km beyond the ship. (NMFS 1999a). While it is always possible that variables other than the noise from the drilling may have contributed to the behavior, an analysis of the Kuvlum monitoring program concluded "bowheads were largely absent from the area surrounding the drilling unit at a range of approximately 12.4 miles (20 km), and that it was unlikely that a factor other than the drilling unit might explain this absence." (NMFS 1999a).

Other observations of bowheads within the range of drilling, dredging, and construction have been mixed. Whales have been observed exhibiting strong avoidance responses. In one observation of a suction dredging operation, whales exposed to noise levels of 122-131 dB re 1µPa, or 21-30 dB re 1µPa above the ambient noise level, stopped feeding and moved away. (Richardson and Malme 1993). Richardson and Malme (1993) also report seeing bowhead whales exhibiting normal behavior within 10-20 km of drill ships, and bowheads approaching one drill ship where the noise level was 11-20 dB re 1µPa above the ambient level. Habituation and variable responsiveness may be responsible for these seemingly conflicting results. (Richardson and Malme 1993).

Richardson and Malme (1993) conclude that summering whales are not likely to overtly react until industrial noises reaching them are greater than 20 dB re 1µPa above the ambient noise level. Whales during the fall migration appeared to be slightly more responsive. (Richardson and Malme 1993). One study conducted during the spring migration at Point Barrow involved exposing the bowheads to playbacks of drill ship noise. There was evidence that behavior of some whales was altered significantly when they were between 1-4 km from the projector, but many whales did approach within a few hundred meters. (Richardson and Malme 1993). On one day when the migration corridor passed within 200 m of the projector and there was no alternative lead available, whales continued migrating despite the fact they were exposed to high sound levels. (Richardson and Malme 1993). One has to wonder about the wisdom and ethical integrity of this particular experiment, as well as wonder if any of the whales had their hearing temporarily or permanently impaired.

Other factors may account for the mixed responses of bowheads to drilling activities. One factor is that the whales that have been observed close to drill sites are the animals least responsive to noise, and not representative of the bowhead population at all. (NMFS 1999a). These animals may have already have had their hearing impaired by exposure to industrial activity. Another factor is that tape recordings of drilling activities might not truly recreate the sound profile of an active drill site. (NMFS 1999a).

iii. Ships and Boats

Vessel noise is particularly important to the bowhead because vessels are numerous, they are widely distributed and have great mobility, and they produce strong underwater noise. The largest oil tankers serving the Trans-Alaska Pipeline at Valdez produce noise source levels louder than 205 dB re 1µPa when operating at full speed. These ships do not currently operate in the range of the bowhead whale, but may do so in the future. Most medium to large ships operating within the range of the bowhead produce source sound levels in the range of 165-175 dB re 1µPa, though some with source levels as high as 175-185 dB re 1µPa may occur. Smaller outboard and inboard motorboats used for subsistence whale hunting produce source levels generally less than 167 dB re 1µPa, however several small boats operating near each other may produce sound levels similar to that of a larger ship. (Preceding from Richardson and Malme 1993).

Some complications exist with determining whether observed bowhead behavior in the presence of ships and boats is due to the noise of the boat, the sight of the boat, or other factors. (Richardson and Malme 1993). However, due to the long distance over which ship noise propagates and the frequent reactions of all baleen whales to changes in engine and propeller speeds, it is likely that many reactions are attributable to noise. (Richardson and Malme 1993). Accounts of whales observed near ships are not evidence that whales do not exhibit avoidance behavior since there was no attempt to determine whether the whales tried to avoid the ship before the whales were close enough to be seen. (NMFS 1999a).

In general, bowheads react strongly and consistently to approaching ships by interrupting their normal behavior and swimming rapidly away. (Richardson and Malme 1993). Bowheads will attempt to outswim the vessel, and if overtaken will swim away from the vessel's path. (NMFS 1999a). Surfacing, respiration, and diving cycles are also affected. (Richardson and Malme 1993). The flight response often subsides by the time the vessel has moved a few kilometers away, and some bowheads will return to their original locations. (Richardson and Malme 1993). Most avoidance reactions occur within 1.9 km of an approaching vessel, though such reactions have been observed up to 4 km. (NMFS 1999a).

Responses including altered surfacing and respiration patterns occur even further from the ship, up to 9.3 km away in one instance. (NMFS 1999a). It should also be noted that these responses do not require produced noise levels much greater than the ambient noise level. (NMFS 1999a). An additional response to such noise noted by Fraker et al. (1982) is significantly increased dispersal indicated by increased distance between individual whales. This effect, which appears to last between one and two hours, makes it possible that other disruptive influences will exacerbate the effect of the initial disturbance before normal behavior is resumed. (NMFS 1983).

Ship traffic in the North Atlantic poses a major threat to the bowhead's closest relative, the northern right whale, by dispersing its food sources. (59 Fed. Reg. 28796). This effect of vessel traffic on the bowhead whale has apparently not been studied, and is apparently not considered by management agencies such as NMFS.

iv. Aircraft and Helicopters

Noise levels from aircraft are roughly related to aircraft size and closely related to power setting (e.g. take-off is louder than cruising which is louder than landing). Noise generated by a medium size aircraft at take-off will generally be near 115 dB re 1µPa at 300m, while noise at take-off from a smaller plane such as a Cessna 172 will be 5-10 dB lower. (Preceding from Richardson and Malme 1993).

Airborne noise, like that from aircraft, will enter the water when the angle of incidence is less than 13 degrees from the vertical. (Richardson and Malme 1993). Therefore, it is theoretically possible to avoid disturbing bowhead whales during aerial surveys by flying in a circle with a wide enough diameter around the whales. However, bowheads are commonly exposed to aircraft noise from aerial surveys when they are at the surface, and it is unknown whether they are able to detect airborne noise at the surface at wider lateral distances than under water. (Richardson and Malme 1993).

Bowheads seem particularly responsive to noise from aircraft when they are in shallow water and when they are resting. (NMFS 1999a, Richardson and Malme 1993). It is possible that some reactions are due to the shadow of the aircraft and not the noise. (NMFS 1999a). In general, bowheads reacted frequently to a circling piston-engine aircraft when it was at less than 305 m altitude, infrequently when it was at 457 m altitude, and rarely when it was at greater than 610 m. (NMFS 1999). Some rapid dive responses have been recorded. (Richardson and Malme 1993).

v. Masking and Hearing Impairment Effects

Bowheads are "undoubtedly subject to masking of calls and other important natural sounds by man-made and natural noise." (Richardson and Malme 1993). Masking is the phenomenon whereby background noise interferes with a whale's ability to hear another whale calling or detect reverberations from ice, etc. (Richardson and Malme 1993). The closer the frequency between the background noise and the call, the stronger will be the masking effect. (Richardson and Malme 1993). Most industrial noises have strong components in the range below 500 Hz, (thought to be the range most important to bowhead hearing and vocalization) leading to the conclusion that bowheads are particularly susceptible to masking effects. (NMFS 1999a).

It is not known how far from noise sources this masking effect will impair bowhead hearing (and presumably communication), nor is it known to what extent it will be impaired. (Richardson and Malme 1993). The uncertainty is due to a number of factors including the lack of knowledge about the importance of various types of whale calls and the absence of direct data on auditory processes. (Richardson and Malme 1993).

It is also possible that bowhead whales could experience hearing impairment as a result of seismic exploration noise. The temporary hearing impairment experienced by mammals when exposed to a strong noise is called a temporary threshold shift, or TTS. (Richardson and Malme 1993). TTS often occurs along with the masking phenomenon. (Richardson and Malme 1993). Hearing loss can also be permanent when the noise is particularly loud.

Bowhead whales are being exposed to an enormous amount of industrial noise in the Beaufort Sea. It is unknown at what level temporary or permanent hearing impairment may result. However, even assuming that hearing impairment is not likely to occur at levels below 189 dB re 1µ Pa (the loudest sound known to be produced by a bowhead whale), bowheads are now regularly exposed to noises louder than this level. (*See, e.g.,* Miller 1997, NMFS 1999a, Trustees for Alaska 1998).

vi. Cumulative Impacts

There is not much analysis in published literature, grey literature, or agency documents of the cumulative impacts to bowhead whales from industrial noise. This is a major gap as there may be a tipping point beyond which bowhead behavior may be permanently altered or auditory organs permanently damaged. Richardson and Malme (1993: 690) simply concluded "Despite exposure to industrial activities as well as an annual hunt, the Bering Sea stock of bowhead whales is not decreasing in size and is probably increasing. Thus, the Bering Sea population of bowheads apparently can tolerate the present cumulative level of exposure to human activities."

It is quite possible that bowheads are already suffering extreme masking effects that interfere with communication, and/or temporary or permanent hearing loss. There is simply no way to know whether these effects would be immediately reflected in population numbers, especially since the bowhead is a relatively long-lived species that reproduces slowly. It also seems unlikely that the current studies, which focus primarily on counting individuals, would identify behavioral changes that would indicate these effects.

Where there is evidence for the cumulative effects of industrial noise within studies, it is not emphasized in analysis. For example, one study analyzing the effect of seismic activity on bowhead migration concluded "*The tendency* [for the bowhead migration corridor to be displaced] *was not significant for seismic but was significant considering the larger sample of data for industrial activities in general. The observed tendencies are consistent with the experience of bowhead hunters*." (NMFS 1999a:25 (emphasis in original)).

The potential for the cumulative impacts of different industrial activities for increasing avoidance, masking, and hearing impairment effects of noise pollution is obvious, especially when one remembers that a 30 dB re 1µ Pa increase in the ambient noise level creates an environment *one thousand* times louder than it would ordinarily be. A very serious management consideration is that agencies do not necessarily even know what noise level they are permitting. For example, the biological opinion for the Northstar project states "NMFS cannot predict the extent and characteristics of the in-air or underwater noise fields that will be generated during construction or operations given the uncertainties of construction schedules, possible contributing noise sources, and propagation paths." (NMFS 1999: 23). There are already four other fields producing at least some oil offshore, and four more offshore fields that may be developed in the near future. It has been estimated that the ambient noise level in the oceans globally increased by 10 dB re 1µPa between 1950-1975 due to shipping traffic. (U.S. Navy 1999). While this statistic may not be directly applicable to the remote Beaufort Sea, the potential for large increases in the ambient noise level due to human activity is apparent.

The general problem of copious data with very little analysis is once again apparent. A review of the literature on bowhead responses to industrial noise shows a tendency towards a laundry list type recitation of bowhead avoidance responses to noise, often at phenomenal distances, along with a repetition of the statement that not enough is known to really assess the effects of industrial noise on bowheads. (*See, e.g.*, Sheldon and Rugh 1995, "...there is insufficient evidence about cumulative and long-term effects of anthropogenic noises." (Quoting Richardson and Malme 1993)). When dealing with scientific uncertainty, the precautionary principle dictates that the risk should not be borne by the species. As the Beaufort and Chukchi Seas are developed for oil and gas extraction, the risks of possible adverse effects have been borne each and every time by the bowhead whale.

b. Disturbance Due To Oil Spills and Spill Response

It is impossible to say for sure how much oil has already been spilled on the North Slope and into the Beaufort and Chukchi Seas, because oil spills are self-reported by the oil companies to the Alaska Department of Environmental Conservation (ADEC). As of 1990 the ADEC claimed that 4,096,348 gallons of oil had been spilled on the North Slope. (Trustees for Alaska, 1998). This figure continues to increase by many thousands each year; ADEC's database of oil spills from January 1, 1997 through March 31, 1998 lists over 26,000 gallons of oil and gasoline spilled. (Trustees for Alaska 1998). These figures do not include "other" substance spills, including acids, antifreeze, grease, drilling muds, and a variety of other substances. Spills of "other" substances occur regularly, often in huge quantities. (Trustees for Alaska 1998). It is widely acknowledged that the self-reporting system leads to rampant under-reporting of small and medium sized oil spills.

While there has not yet been a major marine oil spill in the Beaufort or Chukchi Seas, the development of the Northstar Project and future development of the Liberty, Badami, Hammerhead, Sandpiper, and Kuvlum fields dramatically increase the chances of a spill. It has been estimated that the Northstar Project creates a 23-26% of a major (greater than 1,000 barrels) spill over the 15 year life of the project.[5] (NMFS 1999a, U.S. Army Corps of Engineers 1998). The Northstar Project, if built, will rely on a 6 mile (9.6 km) long sub-sea pipeline buried just 7-9 feet (2.1-2.7 m) beneath the sea floor north of the barrier islands and only 6 feet (1.8 m) below the sea floor south of the barrier islands. (U.S. Army Corps of Engineers 1999). The pipeline could be damaged by sea ice gouging as pack ice moves over shallower waters and deep pressure ridges plough the sea floor. (U.S. Army Corps of Engineers 1999). Typical depths and recent rates of ice gouging are unknown, and even if the pipelines are buried deep enough to avoid gouging, the hot pipelines may melt unstable subsea permafrost and cause compaction that breaks the pipelines. (U.S. Army Corps of Engineers 1999).

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[5]After that study was released, British Petroleum hired a new consultant who produced a report revising the estimate downward significantly. Apparently the relevant agencies will use the new, lower estimates when permitting the project.

The ability to recover spilled oil in the Beaufort Sea depends on many factors including the location, type and amount of oil, availability of response equipment and personnel, and weather at the time of the spill. (NMFS 1999a). The worst conditions in which to recover oil are in broken ice conditions of 30-70% coverage, in which the possible recovery rate ranges from 8.5% to less than 1%. (NMFS 1999a). Recovery of oil in the fall is more difficult than in the spring because of shorter daylight periods. (NMFS 1999a).

Studies have attempted to model the likelihood that bowheads would encounter oil in the event of a spill into the Beaufort Sea. One such model found a 51.8% chance that at least one bowhead would encounter oil, and a 40% probability that 1-200 bowheads would encounter oil. (NMFS 1999a). Due to the fact that virtually the entire bowhead population funnels through a relatively narrow area in the Beaufort Sea twice per year, bowheads are more vulnerable to an oil spill here than anywhere else on their range. It is vital to understand that bowhead whales would not need to be present during an oil spill to be harmed. (NMFS 1999a). Some impacts could linger for up to four years. (NMFS 1999a).

One of the most serious potential consequences of an oil spill is the impacts from tar balls that appear in the late stages of an oil spill. (NMFS 1999a). Broken off baleen filaments coated with oil and tarballs could be ingested and cause blockage in the bowhead stomach, which is only 3.8 cm in diameter in one of the connecting tubes. (NMFS 1999a). Because this effect would likely be fatal, and because the tar can persist in the environment for upwards of four years, an oil spill has the potential to decimate the Bering Sea stock of the bowhead whale.

Bowhead whale eyes may be particularly vulnerable to damage from oil due to the unusually large conjunctival sac, the membrane that lines the inner surface of the eyelid and the exposed surface of the eyeball. (NMFS 1999a). It has been suggested that oil contacting the conjunctival sac could be transported deeper into the eye and cause damage. (NMFS 1999a).

Baleen whales are also subject to fouling of their baleen from oil. One laboratory study found that baleen filtering efficiency was reduced 5-10% by contact with Prudhoe Bay oil, and that the loss of efficiency lingered for approximately 30 days. (NMFS 1999a). Clearly, contact with oil during or prior to an important feeding time could have a serious impact on a whale’s ability to meet its nutritional requirements.

There is disagreement between scientists as to the likely effects of an oil spill on bowheads whales due to the lack of data on the bowhead metabolism and the inconclusive results of examinations of dead baleen whales found after major oil spills. However, the adverse effects of an oil spill include skin contact, baleen fouling, ingestion of oil, respiratory distress from hydrocarbon vapors, the contamination or elimination of food sources, and displacement from feeding areas. (NMFS 1999a). The Native community, as well as the conservation community, remain convinced that an oil spill in the Beaufort Sea would have severe consequences to the bowhead whale. (NMFS 1999a).

c. Disturbance Due To Other Discharges

Oil operations on the North Slope produce an enormous amount of wastewater. One example is ARCO's Sea Water Treatment Plant, which discharged 14.4 billion gallons of strained/filtered backwash between 1991 to 1996, 6.6 billion gallons of wastewater from the marine life bypass between 1991 and 1993, and 2.3 million gallons of sanitary and domestic wastes from 1991 to 1992. (Trustees for Alaska, 1998).

Information regarding the adverse effects on the bowhead of wastes associated with the oil industry, such as heavy metals, halogenated hydrocarbons, petroleum, and other complex materials is lacking. So little is known about cetacean metabolism that it is difficult to predict the effects of chemical residues on whales, and the extremely small samples sizes available for bowheads are particularly inadequate. Bratton et al. (1993) concluded that from the limited data available it appears that contaminants in the range of the bowhead do not currently pose a threat to the whales or the humans who eat them. However, much more work is required to understand the full significance of the residue levels to both whales and humans. (Bratton et al. 1993).

2. Shipping and Vessel Traffic

The concerns regarding noise due to shipping and vessel traffic are the same as those discussed above, and it should be noted that virtually all of the shipping traffic is associated one way or another with the oil industry. An additional threat to the bowhead not yet discussed is the potential for collisions with boats. Examinations of harvested bowheads have revealed scars consistent with boat collisions. (Philo et al. 1993). The actual rate of collisions between boats and bowheads, and the mortality rate therefrom, are not known. Collisions are virtually certain to increase as does vessel traffic. Mortality due to collisions with vessels is a major threat to the survival and recovery of the northern right whale, in its habitat in the North Atlantic Ocean. (59 Fed. Reg. 28796). Seven percent of right whales identified by NMFS prior to 1992 had scars from ship propellers. (59 Fed. Reg. 28796).

V. DESCRIPTION OF PROPOSED CRITICAL HABITAT

The area proposed for critical habitat designation is the migration corridor through the Chukchi and Beaufort Seas from just East of Point Barrow to the Canadian Border. (See Exhibit A). This area best fits the criteria specified at 50 CFR 424.12 and is most essential to the survival and recovery of the bowhead whale for these reasons: (1)virtually the entire population of the Bering Sea Stock of bowheads is spatially and temporally concentrated in this area twice per year, (2)the vast majority of threats to the survival and recovery of the bowhead occur in this area, and (3)feeding, sexual activity, and rearing of young all occur in this area.

As discussed throughout, the bowhead is subjected to myriad adverse affects from collisions with vessels to oil spills to harassment and possible permanent physical injury from industrial noise during the spring and fall migrations. During the spring migration, the bowhead is particularly vulnerable as the population is spatially and temporally concentrated in a narrow migration corridor just off of Point Barrow, and spatially concentrated in leads and polynyas throughout its migration across the Beaufort Sea to its summer feeding grounds. During the fall migration, the bowhead whale is even more vulnerable, as the migratory route tends to occur close to shore and in many of the exact areas where the highest concentration of exploration, construction, and drilling activities are occurring.

During both the fall and spring migrations, it is well documented that normal behavior patterns are disrupted by industrial activity. Disruptions in feeding, socializing, sexual behavior, communication, and cow/calf interactions have all been documented during these times. The long term effects of these disturbances and injuries is unknown. In the fall, any disruption of feeding could be particularly harmful to the bowhead in meeting its energetic requirements for the winter. Disruption of migration in the fall could also be disastrous if bowheads were delayed or blocked from reaching their wintering grounds on the Bering Sea before freeze-up. (NMFS 1983b). If trapped in the Beaufort or Northern Chukchi Seas, bowheads would certainly perish. (NMFS 1983b).

The factors that NMFS must consider when designating critical habitat are discussed in more detail below with reference to the proposed area.

A. CONSTITUENT ELEMENTS

1. Physical and Biological Features Essential to the Conservation of the Species that May Require Special Management Considerations

A focus of the critical habitat designation process must be the identification of the known physical and biological features necessary to the survival and recovery of the species that may require special management considerations. 58 Fed. Reg. 29187. The above sections have described in detail the biological and physical needs of the bowhead whale, and the threats to the bowhead throughout its range. This section will summarize the management considerations that warrant the designation of the proposed critical habitat area.

a. The Need to Protect Bowheads from the Harmful Effects of Industrial Noise

In the absence of human activity, the ambient noise level in the Beaufort Sea is generally between 78 dB re 1 µPa (less than Sea State Zero, or calm, glassy seas) and 120 dB re 1 µPa (Sea State Seven, or gale force winds). (Section IV.B.1.a, *supra*). An average 100 Hz bowhead call in the spring has been measured at 151 dB re 1 µPa, and the loudest call known to be produced by a bowhead was measured at 189 dB re 1 µPa. (Section III.A.4, *supra*)

This petition has reviewed the copious evidence of disturbance to bowhead feeding, sexual and social activity, migration, and presumed communication due to the noise associated with oil and gas development activities. In the area proposed for critical habitat designation, bowheads are routinely subjected to noise sources from seismic exploration (242-253 dB re 1 µPa), ice breaking (196 dB re 1 µPa), drilling and construction activities (185 dB re 1 µPa), vessel traffic (165-185 dB re 1 µPa), and aircraft (115 dB re 1 µPa). (Section IV.B.1, *supra*). All of these noise sources are known to cause behavior responses in bowhead whales ranging from short term avoidance, to cessation of calling, to separation of a mother and calf, to long-term displacement from food sources.

It is also possible that noises produced by human activity may cause short or long term hearing impairment in bowheads, which are presumed to rely heavily on their sense of hearing. The noise level and sound characteristics which may cause hearing impairment are unknown. However, even assuming that hearing impairment is unlikely to occur at sound levels equal to or less than sound levels which are produced by bowheads themselves, (189 dB re 1 µPa), bowheads are already being exposed to sounds from seismic exploration that are more than 100,000 times this level. (Since each 10 dB increase results in a 10 fold increase in noise level, a 249 dB re 1 µPa sound produced by a seismic exploration vessel is 100,000 times louder than the loudest sound known to be produced by a bowhead.)

The noise level in the Beaufort and Chukchi Seas has been steadily increasing since the 1970's and will likely increase dramatically with the development of the Northstar, Liberty, Badami, Hammerhead, Sandpiper, and Kuvlum fields. There is a great need for critical habitat designation for the bowhead whale to provide an added layer of protection for its survival and recovery. NMFS has consistently found insufficient evidence that the increased noise from each new oil and gas industry action would jeopardize the continued survival of the bowhead. However, with critical habitat in place, the industry would have to demonstrate that the additional noise produced by their actions would not adversely modify the bowhead's critical habitat, which includes hampering the ***recovery*** of the bowhead. This added protection is vitally needed by the bowhead to protect against very real, yet perhaps not fatal, biological threats posed by industrial noise.

b. The Need to Protect Bowheads from the Harmful Effects of an Oil Spill and other Marine Pollutants

The threat posed to the Bering Sea Stock of bowheads from oil spills in the area proposed as critical habitat is multiplied by the following factors: (1)the whales' narrow migratory corridor overlaps, especially in the fall, with the area where industrial activity is the densest and where spills are most likely to occur; (2)due to pack ice characteristics it is possible that a spill in the migratory corridor would be almost impossible to recover; and (3)oil can persist in the environment for upwards of four years. These factors make it particularly likely that bowheads will contact oil if a spill does occur in their migratory corridor.

The potential impacts of an oil spill on bowhead whales include fatal stomach blockage, eye damage, fouling of baleen plates resulting in loss of feeding efficiency, ingestion of oil, respiratory distress from the inhalation of hydrocarbon vapors, the contamination or elimination of food sources, and displacement from feeding areas. Similar problems may be posed by increasing marine pollution from industrial sources.

Projects which increase the chances of oil spills or other releases will be analyzed under a different standard once critical habitat is designated. Even if there is not sufficient evidence that the project is likely to jeopardize the continued existence of the bowhead due to the increased threat of oil spills, it may be that the increased risk of spills will impede the continued recovery of the species. The bowhead needs this protection in the face of proliferating offshore development activities.

c. The Need to Protect Bowheads from Vessel Collisions

Collisions between bowhead whales and ships are most likely to occur in the area proposed for designation of critical habitat. The likelihood of collisions is bound to increase as does development of the area. While the current mortality rate due to vessel collisions is unknown, it is known from observing propeller scars on harvested bowheads that collisions are occurring. Vessel collisions are considered a major threat to the northern right whale, the bowhead's closest relative.

d. The Need to Ensure that Bowheads are Able to Complete Their Migration

It is presumed that bowheads meet the majority of their caloric requirements at their summer feeding grounds in the Canadian Beaufort Sea, and therefore it is important that the whales be able to reach those areas. It is also important that the bowheads be able to complete their fall migration to reach the southern pack ice margin of the Beaufort Sea. If whales were trapped in the Beaufort or northern Chukchi seas in the fall, they would suffocate once the ice became to thick for them to break through and breathe. Any disruption of the migration, therefore, would have dire consequences for the population.

Increasing industrial activity within the migratory corridor of the bowhead makes it more likely that bowheads could face a catastrophic blockage of their migration route. Large oil spills under certain ice conditions could produce this effect. More likely, and potentially nearly as damaging, would be a situation where due to restrictive ice conditions whales were forced to swim through an area where they would contact oil, be exposed to damaging noise levels, have a likelihood of colliding with a boat, or other such event in order to complete their migration. Critical habitat designation is needed to protect the whales' migratory corridor from these threats.

2. Food, Water, Air, Light, Minerals, or Other Nutritional or Physiological Requirements

Bowheads are known to feed in the area proposed for critical habitat in both the spring and the fall, and it has been suggested that fall feeding may be particularly important to the bowhead for meeting its nutritional requirements. (Section I.A.2). Bowhead feeding behavior is known to be disrupted by seismic exploration, shipping vessels, exploratory drilling operations, and aerial surveys, among other things.

Bowhead food sources may also be dispersed by these activities, especially vessel traffic. Bowhead prey species may be adversely affected by oil spills and other contamination caused by oil and gas development in the area.

More industrial activity is already occurring in the migratory corridor proposed for critical habitat designation than anywhere else within the range of the Bering Sea Stock of the bowhead. The level of activity in this area is expected to increase in the future with the development of the Liberty, Badami, Hammerhead, Sandpiper and Kuvlum fields. The high level of threat to and the importance of the feeding areas (which of course are not spatially constant but depend upon concentrations of zooplankton) make it crucial that the migratory corridor be designated critical habitat.

The bowhead, like all marine mammals, needs clean water in which to live. The bowhead's proposed critical habitat in the Beaufort and Chukchi Seas is increasingly imperilled by massive wastewater discharges by onshore drilling facilities, future wastewater discharges at Northstar and other planned offshore facilities, and the inevitable oil spills that accompany vessel traffic and oil and gas development.

3. Cover or Shelter

Cover and shelter are apparently not relevant considerations for the designation of critical habitat for the bowhead.

4. Sites for Breeding, Reproduction, or Rearing of Offspring

Sexual activity is frequently observed in the proposed critical habitat area during the spring migration and infrequently observed during the fall migration. (Section III.A.3) Newborn calves have been observed during the spring and summer such that it may be presumed they were born within the proposed area. Newborn calves pass through the proposed area twice during their first year, and it is presumed that they are particularly vulnerable to separation from their mothers during their youngest months. Calves may also be more vulnerable to all the threats posed by human activities than adult bowheads.

Because so little is known about bowhead reproduction and rearing of young, it is impossible to identify precisely the relative importance of the proposed critical habitat area for these purposes relative to summering and wintering grounds, all other things being equal. However, since the vast majority of threats to the species occurs within the proposed area, and breeding, calving, and rearing of young are all known to occur in extremely close proximity to those threats, the proposed area is clearly vital for these purposes.

5. Habitats that are Protected from Disturbance or are Representative of the Historic Geographical and Ecological Distributions of the Species

In this case the benefit of protecting the proposed critical habitat from further degradation outweighs the benefit of providing additional protection to summering and wintering grounds, where bowheads do not face nearly the level of threats as in the migration corridor through the Beaufort Sea. In the future, should oil and gas or other harmful activities be proposed on a large scale for the Bering Sea, Chukchi Sea, or Canadian Beaufort Sea, the critical habitat designation may need to be adjusted accordingly.

6. Space for Individual and Population Growth and Normal Behavior

This petition has systematically reviewed the changes from normal behavior caused by oil and gas and other human activities in the proposed critical habitat area. It is already impossible for bowheads to maintain normal behavior through the migration corridor due to the high level of industrial activity. It is possible that conditions will soon be much worse due to the Northstar Project and other proposed offshore drilling sites. The narrowness of the migration corridor, especially near Point Barrow durng the spring when there may be only one navigable route through the pack ice, creates an enhanced danger that not only will *normal* behavior be impossible, but so will any behavior. That is, if an industrial activity such as seismic exploration, active drilling, or an oil spill is blocking the bowheads' migratory corridor, they may simply have no where to go. Whales could be forced to make a choice between swimming through an oil slick or past a sound source that will damage their sense of hearing, or not continuing on their migratory path at all. Any blockage of the fall migration could cause mass mortality. For all these reasons it is essential that the proposed area receive critical habitat designation.

B. DESCRIPTION OF PROPOSED CRITICAL HABITAT BOUNDARIES

For all the reasons described above, the Center for Biological Diversity petitions the NMFS to designate as critical habitat for the Bering Sea Stock of the bowhead whale the area of the U.S. Exclusive Economic Zone in the Chukchi and Beaufort Seas from 158º W to the Canadian Border from the mean high tide line to approximately 170 km offshore (closer at Point Barrow) as follows: from 158º W to 146º W from the mean high tide line to 72º 30' N, from 146º W to 142º W from the mean high tide line to 72º N, and from 142º W to the Canadian Border from the mean high tide line to 71º N. The proposed boundary is illustrated on Exhibit A.

VI. PROCESSING OF THIS PETITION

This petition is submitted under the provisions of the ESA 16 U.S.C. §§1531 et seq., 50 C.F.R. 424.14, and the APA, 5 U.S.C. §533. While there may be some confusion over applicable timelines for designation of critical habitat for species listed before 1978 (when Congress amended the ESA to require critical habitat designation concurrent with listing), the Center for Biological Diversity believes that the 90-day and 12-month deadlines imposed by Section 4 of the ESA are applicable here.

In 1990, NMFS received a petition to designate critical habitat for the northern right whale, and made the following statement in its 90-day finding:

> Within 90 days after receiving a petition a determination must be made concerning whether the petition presents substantial information indicating that the petitioned action may be warranted....Section 4 of the ESA requires that within 12 months of receipt of a substantial petition, the Secretary of Commerce make one of the following findings: (1) The petitioned action is not warranted; (2) the petitioned action is warranted; or (3) the petitioned action is warranted, but pending listing proposals preclude immediate proposal of a regulation to implement the action. A notice of finding must be published in the Federal Register and, in the case of (2) above, a proposed regulation to implement the action must be included. If a petition presents substantial information, a review is conducted to determine if critical habitat should be designated. 55 Fed. Reg. 28670

Clearly NMFS acknowledged that it was bound by the timelines outlined in Section 4 of the ESA.

However, NMFS *changed its official position and interpretation of the law* by 1997, stating in the 90-day finding for the Petition To Designate Critical Habitat for the Atlantic Green and Hawksbill Turtles: “Although the ESA does not require that the time frames outlined in section 4(b) of the ESA be followed for designation of critical habitat for species listed prior to 1982, NMFS will apply those time frames to the referenced petition, as a matter of policy, to the greatest extent practicable.” (62 Fed. Reg. 6934).

Because NMFS has acknowledged it is bound by the timelines outlined in Section 4, and still maintains a policy of applying Section 4 time frames “to the greatest extent practicable,” the Center for Biological Diversity and the Marine Biodiversity Protection Center expect this petition to be processed within these statutory time frames.

SIGNATURE PAGE

This PETITION TO DESIGNATE CRITICAL HABITAT FOR THE BERING/CHUKCHI/BEAUFORT SEA STOCK OF THE BOWHEAD WHALE (BALEANA MYSTICETUS) UNDER THE ENDANGERED SPECIES ACT is hereby submitted to the Secretary of Commerce.

Respectfully submitted this ____ day of February, 2000.

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