Reviews and recommendation supporting listing of the Cook Inlet population of Beluga whale

February 15, 2000

THE WILDLIFE SOCIETY
ALASKA CHAPTER
P. O. Box 72962
Fairbanks, AK 99707-2962

Alaska Department of Fish and Game
Division of Wildlife Conservation
P. O. Box 25526
Juneau, AK 99802-5526

ATTENTION: Dr. Wayne Regelin

Dear Dr. Regelin:

The Alaska Chapter of The Wildlife Society has prepared the enclosed comments and recommendations in response to a petition to list the Cook Inlet population of beluga whales (Delphinapterus leucas) as an endangered species under the Alaska Endangered Species Act (Alaska ESA). The Wildlife Society is an international nonprofit scientific and educational organization serving nearly 9,000 professionals in all areas of wildlife ecology, conservation, and management. Locally, the Alaska Chapter represents approximately 300 wildlife professionals employed by state and federal agencies, educational institutions, and private industry. Members of the Alaska Chapter share The Wildlife Society's mission to conserve diversity, sustain productivity, and ensure wise use of wildlife resources for the benefit of society. The Alaska Chapter thus is concerned with the current status and management of beluga whales in Cook Inlet and is qualified to offer professional advice for recovery of this diminished population.

The Executive Board of the Alaska Chapter, on behalf of the membership, recommends that the Alaska Department of Fish and Game formally list the Cook Inlet population of beluga whales as endangered under the Alaska Endangered Species Act. Our recommendation is based upon the enclosed detailed review of available information concerning the referenced population and review of literature bearing on the applicability of the Alaska Endangered Species Act to this population. The Executive Board further recommends that the Department work closely with the National Marine Fisheries Service to set population targets for recovery of the Cook Inlet beluga population so that the population may be removed from the Alaska endangered species list at the appropriate time using objective recovery criteria. We recommend that such criteria be based on analysis of the long-term carrying capacity of the population's historic range.

The Alaska Chapter of The Wildlife Society appreciates the invitation and opportunity to comment on the proposed listing of Cook Inlet beluga whales under the Alaska Endangered Species Act.

Sincerely,

Roger A. Post
President

Enclosure (Alaska Chapter Detailed Review and Recommendations)

cc: Mr. Frank Rue, Commissioner, Alaska Department of Fish and Game
Mr. Steve Pennoyer, Regional Administrator, National Marine Fisheries Service

bcc: Dr. Douglas DeMaster, Director, National Marine Mammal Laboratory
Mr. John Twiss, Executive Director, U. S. Marine Mammal Commission
Mr. Tom Franklin, Wildlife Policy Director, The Wildlife Society

Alaska Chapter of The Wildlife Society

Detailed Review and Recommendations Supporting Listing of the Cook Inlet Population of Beluga Whales under the Alaska Endangered Species Act

Applicability of the Alaska Endangered Species Act: Alaska Statute (AS) 16.20.180 established a program for "continued conservation, protection, restoration and propagation" of "certain species or subspecies of fish and wildlife [that] are now and may in the future be threatened with extinction." The Alaska Department of Fish and Game (ADF&G) has requested comment on whether "Cook Inlet beluga whales constitute a species or subspecies within the meaning of AS 16.20.190." The referenced section of the Alaska ESA, however, provides no taxonomic or applied management guidance regarding species or subspecies definition. Generally accepted taxonomic and conservation management criteria for recognizing species, subspecies, and populations therefore must be applied to Cook Inlet beluga whales in order to respond to the ADF&G request. Some guidance may be obtained from the federal Endangered Species Act (federal ESA) and current taxonomic literature as applied to conservation biology.

The federal ESA states, "The term ‘species’ includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. 1531 et seq). Waples (1991), drawing upon the concept of the "evolutionarily significant unit" (ESU) introduced by Ryder (1986), proposed that the ESU be used to define "distinct population segment" during application of the federal ESA to Pacific salmon. Waples (1991) further proposed that the ESU "(1) Is substantially reproductively isolated from other conspecific population units, and (2) Represents an important component in the evolutionary legacy of the species." Dizon et al. (1992) subsequently proposed a hierarchical classification scheme for determining "the degree to which a population can be considered an evolutionarily significant unit," using minke whales as exemplars. The scheme used geographic localization and proxies for differential selection to rank populations by their probabilities of being ESUs. Moritz (1994) proposed distinguishing "management units" (MUs) from ESUs. In this construction, "ESUs should be reciprocally monophyletic for mtDNA alleles and show significant divergence of allele frequencies at nuclear loci" whereas MUs are "populations with significant divergence of allele frequencies at nuclear or mitochondrial loci, regardless of the phylogenetic distinctiveness of the alleles."

Some authors have criticized use of the ESU to define distinct population segments under the federal ESA as being unnecessarily narrow and deviating from the intent of the federal ESA. Dimmick et al. (1999) state that "any unit of conservation defined solely in terms of adaptation is likely to underestimate biological diversity" and believe that conservation priorities and units of conservation should be based on a wide range of values and practical management considerations. Pennock and Dimmick (1997) strongly argue that a "historical approach to distinct population segments can

integrate demographic, behavioral, economic, and cultural justifications for preserving populations that cannot be easily accommodated by the ESU approach." Although controversy over the ESU approach to defining distinct population segments is particular to the federal ESA, we recommend the ADF&G use the relevant literature as guidance for interpretation of "species" and "subspecies" under the Alaska ESA.

The Alaska ESA and federal ESA both reference "species" and "subspecies" as taxonomic units eligible for listing under the respective statutes, but longstanding disagreement on the definition of subspecies exists among systematists (e.g., Barrowclough 1982, Mayr 1982). O'Brien and Mayr (1991), citing earlier literature, define subspecies as "a geographically defined aggregate of local populations which differ taxonomically from other subdivisions of the species" and suggest that "[m]embers of a subspecies share a unique geographic range or habitat, a group of phylogenetically concordant phenotypic characters, and a unique natural history relative to other subdivisions of the species." Recently, however, the traditional biological species concept, wherein species are defined as "groups of actually or potentially interbreeding populations that are reproductively isolated from other such groups" (Mayr 1940 in O'Brien and Mayr 1991), has fallen into disfavor among some systematists (J. Cook, Univ. of Alaska, personal communication). Alternative species concepts leave little place for subspecies.

Under the alternative phylogenetic species concept, "a phylogenetic species is defined as a cluster of organisms possessing a unique character or a unique combination of characters. As such, it is the smallest detectable group of organisms distinguishable ('diagnosable') by unique attributes" (Vogler and DeSalle 1994). Vogler and DeSalle (1994) cite literature that equates ESUs and phylogenetic species. Vogler and DeSalle (1994) refrain from directly adopting the preceding viewpoint, but they suggest that cladistic analysis of "characters based on heritable genetic, morphological, ecological, or behavioral information," typically used to identify phylogenetic species, is applicable to identification of ESUs, as well. Subspecies, as conceived under the biological species concept, would be replaced by phylogenetic species under the phylogenetic species concept (J. Cook, Univ. of Alaska, personal communication) or possibly by ESUs under other formulations (e.g., Dizon et al. 1992, Moritz 1994).

The Alaska Chapter of The Wildlife Society recommends that the ADF&G view "species" and "subspecies" under the Alaska ESA in light of the current species definition under the federal ESA, which admits any "distinct population segment" of an interbreeding species (biological species concept) for potential listing. The Department may wish to apply concepts such as the ESU to identify distinct population segments, but would be wise to incorporate broader biological, societal, and practical management concerns as espoused by Pennock and Dimmick (1997) and Dimmick et al. (1999). Should the phylogenetic species concept continue to gain acceptance, the "species level" will approach that of the population or cluster of populations, further argument for inclusion of distinct population segments under the Alaska ESA. We also urge the ADF&G to consider its mandate to "manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state" [AS 15.05.020(2)] and to maximize the potential precision of its management actions when interpreting the meaning of species and subspecies under the Alaska ESA.

Taxonomic Status of Cook Inlet Beluga Whales: Five stocks of beluga whales have been identified in Alaska and northwest Canada. Based on mitochondrial DNA analysis, NMFS' researchers have found the Cook Inlet population to be the most genetically distinct of all Alaska's geographical subpopulations (O'Corry-Crowe et al. 1997). The Cook Inlet population of beluga whales historically

ranged throughout Cook Inlet with the largest numbers seen north of Kalgin Island during summer and fall. Sightings in the lower Inlet were regular, particularly in fall and winter, but such sightings were more dispersed and of smaller groups than those in the upper Inlet. Although belugas formerly were occasionally seen in the Gulf of Alaska, in recent years sightings are largely confined to Upper Cook Inlet.

No interchange of individuals appears to occur between the Cook Inlet population and the nearest beluga population in Bristol Bay, but if movement between populations has occurred, it has been very low to the point of being inconsequential. In fact, O'Corry-Crowe and Dizon (in Moore et al. 1999) have speculated has speculated that this level of genetic differentiation suggests that Cook Inlet beluga whales may have been effectively isolated for several thousand years. Based on available science, these five identified stocks, including the Cook Inlet population of beluga whales "…are demographically, if not evolutionarily, distinct sub-populations and should be treated as separate management stocks for monitoring populations trends and designing management policies that maintain population and species viability" (O'Corry-Crowe et al. 1997). Thus, the Cook Inlet population of beluga whales can be considered geographically isolated and should be managed as a distinct population segment or ESU.

The Alaska Chapter of The Wildlife Society recommends that the ADF&G consider the Cook Inlet population of beluga whales as a subspecies for purposes of administering the Alaska ESA. We base this recommendation on recognition of both the genetic and geographical isolation of the Cook Inlet population of beluga whales, which we believe substantially meets subspecies criteria forwarded by O'Brien and Mayr (1991) and probably achieves ESU status under the formulation of Dizon et al. (1992).

Decreased Numbers: In order for a species or subspecies to be considered endangered, the ADF&G must determine "that its numbers have decreased to such an extent as to indicate that its continued existence is threatened" [AS 16.20.190(a)]. Silt-laden water in the Inlet makes belugas difficult to count; nevertheless, some population estimates are available. Early estimates by Alaska Native hunters ranged from 1,000-2,000 [Federal Register 64(229):66902]. Historical estimates of 300 to 400 (Klinkhart 1966) individuals in the Cook Inlet population of beluga whales were not based on systematic surveys and are unreliable. Calkins (1984) concluded that the population was larger than indicated by Klinkhart (1966) but lacked the data for a reliable estimate.

Since 1994, the National Marine Fisheries Service (NMFS) has conducted more systematic beluga surveys than earlier efforts. The improved surveys included estimates of numbers of whales under the surface, based on video observations. Estimates by NMFS of the total Cook Inlet population of beluga whales from 1994 to 1999 (Table 1), using consistent methodology, have ranged from a high of 653 belugas in 1994 to a low of 347 in 1998 (Rugh et al. 1999). The 1999 estimate (Table 1) was 357 whales (unpublished data, NMFS, D. DeMaster and R. Hobbs, personal communication); however, at least six whales died after the survey as a result of a stranding in Turnagain Arm in August (Brad Smith, NMFS, personal communication). Thus the current estimate is about 350 whales, a 46% decline in the past 5 years. In recognition of this decline, NMFS proposed listing this population as depleted under the Marine Mammal Protection Act (Federal Register 64(201): 56298-56304, October 19,1999). Subsequent linear regression analysis of whale abundance by year shows that the decline achieves statistical significance ($P = 0.018$) with inclusion of the 1999 data (L. Lowry, ADF&G, personal communication).

Table 1. Population estimates for Cook Inlet beluga whales, 1994-1999. Data from Hobbs et al. (1999) and (1999 estimate) unpublished NMFS data (D. DeMaster and R. Hobbs, personal communication).

Year	1994	1995	1996	1997	1998	1999
Abundance	653	491	594	440	347	357
Coefficient of Variation	0.43	0.44	0.28	0.14	0.29	0.20

The current distribution of the Cook Inlet beluga whale population, largely restricted to Upper Cook Inlet, contrasts with its more widespread distribution in the 1960s through the mid-1980s. Fewer beluga sightings in Lower Cook Inlet could be consistent with a reduction in population size because smaller populations often make less use of "peripheral" habitats. The Alaska Chapter concludes that Cook Inlet beluga whales have experienced a precipitous decline in numbers as evidenced by NMFS survey data, regression analysis, and a significant contraction of the population's range.

Population decline alone may not be sufficient to justify listing of a distinct population segment or other taxon under the Alaska ESA if the organism in question has a large intrinsic rate of increase and consequent potential for extremely rapid recovery. Whales, however, exhibit extremely slow recovery from depressed levels of abundance and thus declines in their populations deserve the most serious treatment by management agencies such as the ADF&G. The ARSG recommended, and the NMFS adopted, use of the cetacean maximum theoretical net productivity rate (Rmax) of 4% for beluga whales in Cook Inlet (Hill and DeMaster 1998). We conclude it is appropriate to take a conservative approach to estimating Rmax for this stock because few data are available which describe current productivity, age-sex composition of the remaining stock, or structure of the harvest.

Habitat Loss or Modification: In making a determination that a potentially listed population's continued existence is threatened, the ADF&G must consider "the destruction, drastic modification, or severe curtailment of its habitat" [AS 16.20.190(a)(1)]. Physical habitat for Cook Inlet belugas is largely intact. Offshore platforms for oil and gas production are present in the Upper Inlet but are not known to adversely affect beluga whales. Likewise, biological components of beluga habitat such as forage fish (e.g., Pacific salmon) and natural predators (e.g., killer whales) are not known to limit the Cook Inlet beluga population at the present time. It is important to recognize, however, that Cook Inlet is experiencing the highest rate of human population growth in Alaska with a wide variety of resource development activities including oil and gas exploration, development, and transport; commercial and sport fishing; marine transportation, tourism, and port development; and discharge of urban and residential effluent. It is probable that more, not less, development will occur in the Inlet in the future. It will be important to monitor the cumulative effects of these and other activities to ensure that they don't adversely impact beluga whales or their habitat.

Harvests: In making a determination that the continued existence of a potentially listed species or subspecies is threatened, the ADF&G must consider "overutilization [of the species or subspecies] for commercial or sporting purposes" [AS 16.20.190(a)(2)]. Historically harvests of beluga whales were low. Local Native villages took small numbers of belugas, and sport hunting was briefly popular in the Kenai area in the 1960s. A brief attempt at commercial harvest in the 1930s apparently took 100 whales. The Marine Mammal Protection Act of 1972 restricted harvest of beluga whales to Alaska Natives. Those harvesting Cook Inlet belugas fell into two groups: "local" Natives from villages bordering Cook Inlet and "non-local" Natives who had moved to Anchorage from other villages around the state (e.g., Elim) or who hunted while visiting Anchorage. The number of beluga whales taken by most local Native hunters probably remained fairly small until the mid-1990s when it began

to dramatically increase. This increase was primarily due to a few (<3) hunters who began to each take up to 30 whales/year for sale in Anchorage to George's Market or the Native Hospital. The value of muktuk from each whale is estimated to be about $800 to the hunter.

Harvest records for Cook Inlet belugas are uncertain because the NMFS did not require reporting and tagging until October 1, 1999 [Federal Register 64(190):53219]. Estimates based on systematic harvest survey reports are available only for local hunters and only for 1995-1996. The number actually reported taken during those years were 42 and 49, and the proportion struck and lost to landed during the same time period was 1:1 or 2:1, based on actual hunt observations (Cook Inlet Marine Mammal Council 1996, 1997). Thus 100 beluga whales killed per year would be a conservative estimate during that time period. A high rate of struck and lost is likely due to the hunting approach currently used and the silty water in the Inlet. In Cook Inlet a high rate of mortality among those struck is not unusual as most whales are shot with a rifle before they are harpooned. In Kvichak Bay, which also has silty water, the traditional method is to harpoon the whale first, thus reducing the number lost and probably reducing the number of mortalities among lost animals.

NMFS estimated the annual kill during 1994-96 at about 71 animals per year, greatly exceeding the sustainable harvest (Potential Biological Removal [PBR]) of 14 whales/year estimated by NMFS for the same period (Hill and DeMaster 1998:72-76). For 1998, NMFS has documented the minimum number of whales harvested to be 25, plus an estimate of another 25 (assuming a conservative 1:1 struck and lost to recovered ratio) for a total minimum estimated kill of 50 whales (B. Mahoney, NMFS, personal communication). This greatly exceeded the 1998 PBR, estimated to be 14 animals. In 1999, NMFS recalculated the PBR at 2.7 animals based on a recovery factor (Fr) decreased to 0.5 to account for the stocks' declining size. The Alaska Regional Scientific Review Group (ARSRG) has further recommended the Fr be further reduced to 0.1 because the stock should be considered "high risk" due to "their low abundance, declining trend, limited range, and susceptibility to catastrophic events" (ARSRG 1999a,b); this would result in a PBR of between 0.6 and 0.7 animal.

The Alaska Chapter concludes that excessive harvest is the primary factor accounting for significantly decreased numbers of Cook Inlet beluga whales and that continued unregulated harvest would threaten the existence of this population. We find that the observed decline of the Cook Inlet beluga population (Table 1) is consistent with estimated harvest rates well in excess of sustained yield, strongly supporting harvest as the main cause of the decline. In addition, the fact that Cook Inlet belugas concentrate in predictable areas, readily accessible from Anchorage, at predictable times, means that hunter success could remain high even with a drastically reduced population. Should harvest not be curtailed to the level recommended by the ARSRG, these areas could become "sinks" that would lead to a much faster and greater reduction (possibly to below viable levels) than would otherwise be expected to occur. The Alaska Chapter strongly advocates immediate and dramatic action to curtail harvest of Cook Inlet beluga whales. Although such action is not within the direct purview of the ADF&G, or enabled by a listing under the Alaska ESA for this federally managed population, we recommend that the State of Alaska aggressively pursue recovery of the Cook Inlet beluga population in all available arenas. Habitat protection for Cook Inlet beluga whales under the Alaska ESA would provide an important adjunct to federal harvest limitation during the long period likely required for the population to return to historic levels.

Disease or Predation: In making a determination that the continued existence of a potentially listed species or subspecies is threatened, the ADF&G must consider "the effect on [the species or subspecies] of disease or predation" [AS 16.20.190(a)(3)]. Killer whales (Orcinus orca) are known

predators on belugas in some areas. Studies in Prince William Sound suggest that not all killer whales regularly prey on marine mammals, but some groups are known to do so (Heyning and Dahlheim 1988). Killer whales thus may have a significant effect on the mortality and movements of beluga whales. However, biological surveys and observations by hunters in Cook Inlet have not provided data suggesting there has been any change in the occurrence of, or increased predation on belugas by killer whales within Cook Inlet (NMFS personnel, personal communication). In addition, observations of killer whale predation, if it were occurring with regularity, likely would be common knowledge with the number of boats in Cook Inlet; however such reports are rare or absent (G. Del Frate, ADF&G, personal communication).

Likewise, disease is known to affect some cetaceans (e.g., Delphinidae) and potentially could affect Cook Inlet beluga whales. Beluga whales in some populations have exhibited pathological evidence of inflammation due to infectious disease and are subject to parasitism from lungworms and kidney worms (Dr. Todd O'Hara, North Slope Borough, personal communication). The Alaska Chapter was unable to gather detailed information in time for this review, but Dr. T. O'Hara recommends contacting Dr. Kathy Bureck (Alaska Veterinary Pathology Services, 696-3704) for specific disease/pathology information on the Cook Inlet population of beluga whales and contacting Victoria Woshner in Barrow (852-4673) for her current disease/pathology doctoral work on Chukchi Sea belugas. In the absence of observations of significant whale mortality in Cook Inlet attributable to disease or predation, the Alaska Chapter concludes that excessive harvest alone can account for the diminished numbers of beluga whales in Cook Inlet.

Other Natural and Anthropogenic Factors: In making a determination that the continued existence of a potentially listed species or subspecies is threatened, the ADF&G must consider "other natural or man-made factors affecting [the species or subspecies'] continued existence" [AS 16.20.190(a)(4)]. Perhaps foremost among the natural and anthropogenic factors affecting diminished Cook Inlet population of beluga whales is simply the vulnerability of a small, isolated population to extirpation from any number of causes. A great deal of ecological theory, and its practical application to endangered species recovery, has addressed viability of small populations (Wilcove 1987). Risk of extirpation increases as population size decreases.

Anthropogenic factors that place the diminished Cook Inlet population of beluga whales at risk include potential oil spills from offshore platforms, subsea pipelines, and tanker/barge traffic; potential displacement from important seasonal habitats such as Knik and Turnagain arms and Chickaloon and Susitna flats by resource-development activities, including oil and gas exploration and production; and port developments, marine transportation, loss of marine cargos (e.g., urea or other chemicals), commercial and sport fishing activity, and tourism. Natural factors that place the diminished Cook Inlet population of beluga whales at risk include stranding, as actually occurred in 1999; disease, should an epizootic occur; predation, should marine mammal-feeding killer whales increase in Cook Inlet; reduced reproductive success and survival rates as a result of inbreeding and loss of genetic diversity; and random adverse environmental fluctuations.

The Alaska Chapter concludes that the continued existence of Cook Inlet beluga whales is threatened by small population size and consequent vulnerability to adverse natural and man-made factors. . The Alaska Chapter believes a population stock so reduced that it is likely to decline toward extinction in the event of harvest of a single individual clearly should be considered "endangered." Furthermore, while we commend and support continued efforts to develop a co-management agreement to manage the harvest of Cook Inlet belugas, the Alaska Chapter believes such an agreement alone could not

provide the statutory authority necessary to protect habitat essential for maintenance or recovery of Cook Inlet beluga whales.

Recommendation for Listing: The Alaska Chapter of The Wildlife Society recommends that the ADF&G add the Cook Inlet population of beluga whales as an endangered species under the Alaska Endangered Species Act. We base our recommendation on the following facts. The Cook Inlet population of beluga whales is small, geographically isolated from all other beluga populations in Alaska, and genetically distinct. This population has declined from perhaps 1,000 animals a decade ago to an estimated 350 today, with remaining individuals seasonally concentrating in a few aggregations susceptible to overharvest and a variety of catastrophic events. Cook Inlet belugas are located in the most densely populated region of the state and potentially face many cumulative environmental impacts, increasing the likelihood of adverse events. Small, geographically isolated populations, such as the Cook Inlet beluga whale, are particularly vulnerable to extirpation from many causes both natural and anthropogenic. The ARSRG stated on May 22, 1999, "The ARSRG is very concerned that the Cook Inlet beluga population may be facing a real threat of extinction." The Alaska Chapter also views the risk of losing beluga whales from Cook Inlet as very real.

Management Benefits of Listing: The ADF&G has designated the Cook Inlet population of belugas as a "Species of Special Concern," which guides the Department's actions with regard to conservation of the subject population. Although listed as a Species of Special Concern, which the Alaska Chapter finds commendable for providing focus for ADF&G actions, it does not directly affect actions by other departments of the State of Alaska. One benefit of listing a species or subspecies under the Alaska Endangered Species Act is that such listing directs the Commissioner of the Alaska Department of Natural Resources (ADNR) to "take measures to preserve the natural habitat of species or subspecies of fish and wildlife that are recognized as threatened with extinction" (AS 16.20.185). As the primary land management agency for the State of Alaska and primary State regulator of many resource-development activities (e.g., oil and gas leasing, mining), actions by the ADNR potentially significantly affect fish and wildlife habitats and populations. Thus, listing of Cook Inlet belugas would mandate that the ADNR fully recognize the potential effects of their management actions on the endangered population, particularly in sensitive areas such as Chickaloon and Susitna flats.

The Alaska Chapter believes that prompting more active involvement of the State of Alaska in recovery of the population is another benefit of listing Cook Inlet beluga whales under the Alaska Endangered Species Act. The ADF&G properly should be at the table, working with NMFS and other federal agencies, to forestall further decline of the subject population and to rebuild its numbers to historic levels. Although marine mammals are under federal management, the State can ill afford to lose a unique stock of belugas through inaction and has a public trust responsibility to ensure the continued viability of all fish and wildlife resources for benefit of the people of Alaska, and, indeed, the world.

Finally, the Alaska Chapter wishes to point out that the Alaska Endangered Species Act requires biennial review of the endangered species list, which provides the ADF&G flexibility to respond to changes in the Cook Inlet population of beluga whales. Should future management and recovery actions result in substantial increase of the Cook Inlet population and significantly reduce risk of extirpation, the ADF&G should, at the appropriate time, remove the population from the endangered species list.

Selected References

Alaska Regional Scientific Review Group. 1999a. Letter to Rolland A. Schmitten, NMFS (January –8, 1999).

Alaska Regional Scientific Review Group. 1999b. Letter to Penelope Dalton, NMFS (November 23, 1999)

Barrowclough, G. F. 1982. Geographic variation, predictiveness, and subspecies. Auk 99:601-603.

Cook Inlet Marine Mammal Council. 1995, 1996, 1997. Native harvest and use of beluga in the upper Cook Inlet. Report presented to the NMFS.

Calkins, D. 1984. Belukha whale. Vol. IX in Susitna Hydroelectric Project; final report; big game studies. Alaska Department of Fish and Game Doc. No. 2428. 17pp.

Dimmick, W. W., M. J. Ghedotti, M. J. Grose, A. M. Maglia, D. J. Meinhardt, and D. S. Pennock. 1999. The importance of systematic biology in defining units of conservation. Conservation Biology 13(3):653-660.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conservation Biology 6(1):24-36.

Hazzard, K. 1988. Beluga whale, *Delphinapterus leucas*. Pages 195-235 in J. Lentfer, ed. Selected marine mammals of Alaska. MMC, Washington, D. C.

Heyning, J. E., and M. E. Dahlheim. 1988. *Orcinus orca*. Mammalian Species 304:1-9.

Hill, P. S., and D.P. DeMaster. 1998. Alaska marine mammal stock assessments, 1998. NOAA Technical Memorandum NMFS-AFSC-97.

Hobbs, R. C., D. J. Rugh, and D. P. DeMaster. 1999. Abundance of beluga whales in Cook Inlet, Alaska, 1994-98. International Whaling Commission, Scientific Committee Document SC/51/SM8. 23pp.

Klinkhart, E. 1966. The beluga whale in Alaska. Alaska Department of Fish and Game, Federal Aid in Wildlife Restoration Project Report, Vol. VII. 11pp.

Mayr, E. 1982. Of what use are subspecies? Auk 99:593-595.

Moore, S., D. Rugh, K. Shelden, B. Mahoney, and R. Hobbs. 1999. Synthesis of available information on the Cook Inlet Stock of beluga whales. NMFS-AFSC Processed Report 99-06. 22pp.

Moritz, C. 1994. Defining "evolutionarily significant units" for conservation. Tree 9:373-375.

O'Brien, S. J., and E. Mayr. 1991. Bureaucratic mischief: recognizing endangered species and subspecies. Science 251:1187-1188.

O'Corry-Crowe, G.M., R.S. Suydam, A. Rosenberg, K. J. Frost, and A. E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. Molecular Ecology 6:955-970.

Pennock, D. S., and W. W. Dimmick. 1997. Critique of the evolutionarily significant unit as a definition for "distinct population segments" under the U.S. Endangered Species act. Conservation Biology 11(3):611-619.

Ryder, O. 1986. Species conservation and systematics: the dilemma of subspecies. Tree 1(1):9-10.

Rugh, D. J., K. E. W. Shelden, and B. A. Mahoney. 1999. Distribution of beluga whales in Cook Inlet, Alaska, during June and July, 1993-98. International Whaling Commission, Scientific Committee Document SC/51/SM12. 28p.

Small, R.J., and D.P. DeMaster. 1995. Alaska marine mammal stock assessments, 1995. NOAA Technical Memorandum NMFS-AFSC-57. 93pp.

Vogler, A. P., and R. DeSalle. 1994. Diagnosing units of conservation management. Conservation Biology 8(2):354-363.

Waples, R. S. 1991. Pacific salmon, *Onchorhynchus spp*., and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53(3):11-22.

Wilcove, D. 1997. From fragmentation to extinction. Natural Areas Journal 7(1):23-29.