

SPECIES ACCOUNT

The Belukha Whale (Delphinapterus leucas)

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A. Introduction

Only 2 closely related species of toothed whales reside in arctic and subarctic waters, belukhas (Delphinapterus leucas) and narwhals (Monodon monocerus). Of the 2, the belukha is more widespread and well known to northern coastal residents. These 2 whales, although very different in some ways, share many characteristics including aspects of morphology, natural history, and importance in the economics of northern villages.

Like the commonly used English name white whale, belukha, derived from the Russian word for white, is descriptive of the coloration of adult animals. The term beluga, which is commonly applied to this species, is a Russian name for the white sturgeon (Acipenser huso). In order to prevent confusion between the fish and the whale, many researchers prefer the common names belukha and white whale for Delphinapterus.

Belukhas appear well suited to life in arctic and subarctic waters where cold temperatures and seasonal sea ice are the rule. The white body color obviously blends well with their surroundings. This is true not only during ice-covered months but also during open water when herds of belukhas are often described as resembling white caps on the ocean. Newborn calves and immature animals are gray shaded with blue or brown and often blend well with the color of the surrounding water. The survival value, if any, of this apparent camouflage is not clear. Unlike most other odontocetes except the narwhal, the belukha has no

dorsal fin although a low ridge occurs on the backs of some animals. This is an apparent adaptation to moving in and around ice. The robust body shape is due to a comparatively thick blubber layer which reduces the loss of body heat into the water. The rounded head has a short snout topped by a large, bulging melon. The melon is filled with fine oil and may function as an acoustic organ for communicating, navigating, and locating food.

Belukhas are comparatively small whales. In Alaska, near-term fetuses range from 130 to 180 cm in length and weigh about 80 kg. Adult males are somewhat larger than females, ranging from 3.2-4.4 m in length and an estimated 520-1200 kg in weight. Females are about 3.1-3.6 m long and 480-700 kg in weight. Size attained at adulthood varies geographically. Individuals more than 6 m in length have been recorded in some areas of the arctic. Much of the weight is comprised of blubber which can be as much as 12 cm thick on large individuals.

B. Distribution and Migration

Belukhas are widely though not uniformly distributed throughout seasonally ice-covered waters of the northern hemisphere. Based on a knowledge of seasonal patterns of movement and concentration areas and the presence of major though not complete geographical barriers, it is likely that the population can be divided into a number of somewhat discrete stocks. Differences in size of adult animals among areas is considered by some as evidence of stock separation.

Belukhas in Alaska are considered to comprise two stocks. One ranges throughout the northern Gulf of Alaska from at least Kodiak Island to Yakutat Bay. The center of abundance of this stock is clearly in Cook Inlet where they are numerous throughout the year. Seasonal movements in this area are poorly known. However, spring concentrations of belukhas occur annually near mouths of rivers flowing into northwestern Cook Inlet.

A second much larger stock of belukhas ranges seasonally throughout the Bering, Chukchi, and Beaufort seas. During winter these whales occur in the ice fringe and front from the Alaska coast to Siberia, as well as in regions of the Bering and Chukchi Sea pack ice where open water regularly occurs. As the ice recedes in spring, a large segment of the population moves north, some of them passing Point Hope and Point Barrow during May. Those belukhas are thought to migrate eastward through offshore leads in the Beaufort Sea, then south along the west coast of Banks Island to the Mackenzie River estuary where they appear in late June. Other belukhas migrate less extensively and are seen in coastal waters of the Bering and Chukchi seas shortly after ice breakup. In summer months they occur in the Bering, Chukchi, Beaufort, and East Siberian seas primarily in the coastal zone and along the pack ice edge. Major concentrations in North American waters occur in the Mackenzie River estuary, Kasegaluk Lagoon (central Chukchi Sea), Kotzebue Sound, Norton Sound and Bristol Bay. They have been recorded in major river systems such as the Yukon River several hundred kilometers from the ocean. Belukhas leave the coastal zone in late summer to late autumn. Animals in the northern part of their range move southward ahead of and

with the advancing ice pack, most of them passing through Bering Strait and into the Bering Sea.

Factors which may limit the overall distribution of belukhas are poorly known. The coincidence of their range with that of sea ice suggests a strong affinity for arctic and subarctic waters. Although they are known to wander at least as far south as Tacoma, Washington on the Pacific coast and New Jersey in the Atlantic, there is no evidence to suggest that belukhas were ever abundant south of their present range. Predation by killer whales and sharks and competition for food with other marine consumers may be factors important in determining their southern limit.

Normal distribution of belukhas appears most affected by ice conditions and distribution of prey. During winter, ice characteristics are probably the most important single factor. Although they can break through thin ice, in areas where geographic, oceanographic, and meteorologic factors do not cause ice motion and the formation of leads, belukhas cannot survive. Well-documented accounts relate the entrapment and subsequent death of hundreds of belukhas in such circumstances. During summer and autumn, belukhas concentrate in areas where prey are abundant. It has been suggested that warm water temperatures in estuary systems confer an energetic advantage to newborn young which have not yet attained a thick blubber layer. The interplay of these two factors in determining belukha distribution during the open water season is of major interest. Animals of all sex and age classes are found in summer concentration areas; although some of the animals examined have been

actively feeding, many have empty stomachs. By the same token, although some calves are born in estuarine areas many are known to be born outside of estuarine concentration areas.

C. Habitat Requirements

Four factors are of considerable importance in determining suitability of habitat for belukha whales. They are:

1. Predictable and regular access to air.
2. Water of appropriate quality and characteristics.
3. Access to food of appropriate type and quantity.
4. Freedom from excessive predation and other disturbance factors.

The need for air to breathe excludes belukhas from vast areas of the Bering and Chukchi seas during winter and spring months. They cannot survive in much of their summer habitat in the coastal zone because of extensive shorefast ice. In addition, areas of stable, heavy ice cover such as occur north of Bering Strait and around major Bering Sea islands present unfavorable conditions. However, in areas where winds, currents, and land forms combine to create frequent ice motion and leads, belukhas are often common. Since they can easily break through several centimeters of ice, belukhas seldom suffer from short-term episodes of calm weather or freezing when new ice covers leads in such areas.

Belukhas appear able to tolerate waters with a wide range of temperature, salinity, and depth characteristics. During winter they commonly swim in water below 0°C while in summer some animals frequent areas such as lagoons where surface temperatures may reach 12°C. The possible importance of warm water areas for newborn animals has already been noted. Belukhas have been recorded in completely fresh waters of rivers as well as in brackish and fully marine areas. Although they are sometimes sighted in deep water north of the shelf break of the western Beaufort Sea, most belukha sightings are from coastal and continental shelf areas. The maximum diving depth of belukhas is not known. However, the duration of dives is short, frequently 3-5 minutes, and therefore belukhas are thought to feed at comparatively shallow depths.

Food habits of belukhas will be discussed in Section F. At this time it is sufficient to note that the areas and times in which belukhas appear in large numbers are in many instances closely correlated with the appearance of concentrations of fishes such as salmon, herring, smelt, and arctic cod. Each belukha must, on an annual basis, consume sufficient food to provide energy for growth, maintenance and, if appropriate, reproduction. If adequate nutrition is not attained, growth and productivity will be lessened and mortality may be increased. In addition to providing insulation, the thick blubber layer of belukhas serves as an energy reserve, making them somewhat independent of short-term fluctuations in food supply. As a result of the large proportion of blubber, belukhas have a comparatively small amount of body musculature. This probably results in a slow swimming speed which

may put them at a disadvantage in competing with the fast swimming porpoises of more southern waters.

Possible predators of belukhas include killer whales, sharks, polar bears, and humans. Other than those harvested by humans, it is probable that relatively few belukhas die from predation. Present harvests in Alaska do not appear to limit belukha numbers or range (see Section I). The incidence of mortality due to disease and parasitism is not known. Physical factors known to cause mortality include entrapment in ice and occasionally in fishing gear, especially large mesh gillnets and fish wiers.

Responses of belukhas to the array of possible disturbances caused by humans are poorly documented. Available evidence is scant and sometimes contradictory which suggests that the response to a particular factor will depend on its context and the particular animal or animals involved. For example, it appears that boat traffic and other activities in the Yukon River and Kotzebue Sound have altered the distribution of belukhas in those areas. In contrast, in Cook Inlet and Bristol Bay, where human activities are much more intense, belukhas have apparently accommodated to such activities. Most significant disturbances involve introduction of sounds, physical structures, or chemicals into belukha habitat. Available observations suggest that belukhas are quite adaptable and can accommodate reasonable amounts of acoustic and physical intrusions while are not also accompanied by direct harassment such as killing. Introduction of chemicals such as petroleum compounds into the marine environment would likely have

complex direct and indirect effects on belukhas, generally in proportion to the intensity of contamination.

D. Abundance and Trends

Although records of sightings of belukhas in Alaskan and Soviet waters are numerous, no comprehensive surveys have been undertaken in order to estimate total abundance.

The Cook Inlet stock probably comprises greater than 400 individuals. Recent visual counts of single large groups suggest that this number is conservative and the stock may number in excess of 500. Sightings of belukhas in Yakutat Bay suggest that some members of this stock may move relatively long distances away during winter.

Estimation of the size of the Bering-Chukchi stock of belukhas (including those that summer in the Beaufort and East Siberian Seas) is complicated by their large and seasonally variable range. Assuming limited interchange among animals in summer concentration areas, a minimum estimate can be derived from available counts and observations. Reliable estimates from aerial surveys suggest 5-6,000 belukhas, not including dark-colored juveniles, occur annually in July in the Mackenzie estuary. Estimated numbers increased markedly from 1972-1977, although the increase may have been an artifact of improved counts. In addition, 2-3,000 animals occur along the Chukchi Sea coast, approximately 1,500 occur in Bristol Bay and at least 1,000 are at other localities along the Alaskan Bering Sea coast. The number of belukhas

summering along the coast of Siberia is less well known but certainly numbers 4-5,000. These estimates indicate a minimum total of 13-16,000 belukhas summering in coastal waters of Alaska, western Canada, and eastern Siberia. Since belukhas are also numerous along and in pack ice during summer, this estimate can be considered extremely conservative. Available data indicate that this stock has been and continues to be stable in size.

E. Vital Parameters

Age structure of the population and rate of production of young are critical parameters for estimation of productivity of belukha whales. Due to methodological problems and controversies, there has been considerable difficulty encountered in deriving these values. Major problems have involved interpretation of growth rings in teeth and of structures present in ovaries. Recent thorough studies have largely resolved these questions allowing valid interpretation of data. It is now generally agreed that belukhas, like some other odontocetes, deposit two dentine layers (each comprised of a light and dark band) in the teeth each year. This is unlike pinnipeds such as ringed seals in which one dentinal layer is deposited annually. Tooth wear resulting in loss of rings causes underestimation of age in older animals. However, this is of comparatively little importance provided that reliable ages can be determined up to the age of sexual maturity. In many belukhas, more than one ovulation can occur during the breeding period which results in the presence of accessory corpora lutea in the ovary. These were

previously erroneously interpreted by Soviet researchers as evidence for annual breeding.

The reproductive cycle of belukhas is now quite well understood. Female whales first ovulate and are capable of breeding just prior to their fourth or fifth birthday. Reproductive activity commences in males at about age 8. Most breeding activity occurs in April and May. The gestation period is about 14.5 months, therefore females first give birth the following July or August at age 5 or 6. A single calf is usually born and nursed for a 2-year-period. It appears that few females ovulate in the estrous cycle which follows 10 months after calving but rather do not become pregnant again until the following year. Therefore, the breeding cycle is basically triennial. In a group of sexually mature female belukhas examined during summer one should find that about one-third of the animals have just calved or are carrying a term fetus, one-third have recently bred, and one-third are accompanied by year-old calves which they are nursing. This of course assumes that all animals capable of ovulating do so, and that they are successfully impregnated and bear a young. Although available data are sparse and subject to biases, it is likely that success in ovulation, pregnancy, and birth is somewhat less than 100 percent.

Biases associated with hunting and collecting of belukhas complicate estimation of sex ratio and age structure of the population. For example, only 6 of 68 female belukhas taken in western Alaska in 1977-1979 were less than 6 years of age. Available data suggest the sex ratio does not significantly deviate from unity. However, the

predominance of males in the harvest in many regions may have resulted in more adult females than adult males in the present population, the effect of which would be an increase in population productivity.

Assuming that one-third of adult females are capable of breeding each year and 90 percent of those actually breed and give birth, 30 percent of adult females would produce young each year. If the sex ratio is 1:1 and 60 percent of adult females are sexually mature, gross annual production of calves would be 9 percent. This rate is low compared to animals such as seals in which annual breeding is the rule. Some studies have suggested annual calf production rates of 12-13 percent based on occasional biennial breeding and a population comprised of 56 percent females.

Mortality rates of belukhas in Alaska cannot be calculated from the biased age samples that are available. Known causes of mortality other than hunting by humans include predation by killer whales and polar bears and occasional entrapment by sea ice and fishing gear. The possible role of disease and parasites in mortality of belukhas is not well known. Maximum ages recorded are 30-34 years old but these are probably underestimates due to tooth wear. The relatively low rate of production and large proportion of older animals in harvests suggests that natural mortality rates are low for both young and adult belukhas.

Sustainable yield of belukha populations is believed to be 5-10 percent per year.

F. Food Habits

Studies of food habits of belukha whales throughout their range have identified more than 100 different species in the diet. In all areas most of the available data are from animals taken during spring and summer. In coastal waters of Alaska, belukhas feed on a series of sequentially abundant and highly available prey, particularly anadromous and coastal spawning fishes. These include primarily salmon, smelt, capelin, eulachon, herring, and saffron cod. Other organisms such as shrimps, octopus, and sculpins are also commonly eaten. Arctic cod and pollock may be particularly important foods in offshore waters during winter and spring. Although food other than milk is found in stomachs of some yearlings, belukhas are not nutritionally independent until age 2. Small fishes and crustaceans may be more important in the diet of young whales.

Although some feeding has been observed in river systems and lagoons, in some concentration areas such as the Mackenzie Delta food is rarely found in stomachs of harvested animals. In such areas, feeding may occur in nearby marine waters. The influence of prey distribution on distribution of belukhas throughout the year merits further study.

Seasonal changes in feeding intensity have not been documented but are likely to occur in relation to patterns of prey abundance and availability. Differences in growth rates and adult size of belukhas in various parts of their range may be related to nutritional factors.

G. Ecological Significance

Belukha whales are widely distributed and generally abundant in ice-covered regions where the marine mammal fauna is often dominated by pinnipeds. Their range generally overlaps little with that of other toothed whales. The closely related narwhal occurs with belukhas in the eastern Canadian arctic. Harbor porpoise (Phocoena phocoena) range overlaps that of the belukha in Cook Inlet, the Bering Sea, and northwest Atlantic. These three species share characteristics such as generally small size, slow swimming speed, and ability to locate and utilize schools of shoaling fishes. The belukha is obviously more ice-adapted than the harbor porpoise. Competitive relationships among belukhas and narwhals are unclear. However, based on a comparison of their present ranges it appears that the belukha is the more broadly adaptable species.

The food resource base of belukhas in Alaska is shared with many species of marine mammals and seabirds. Arctic cod and pollock, which are probable major foods in offshore waters, are of similar significance in the diet of fur seals, sea lions, harbor, spotted, ribbon, and ringed seals and fin, minke, and humpback whales. In the coastal zone, herring, smelt, capelin, saffron cod, and salmon are eaten by belukhas, sea lions, harbor, spotted, and ringed seals, and harbor porpoise. Overall, the greatest trophic overlap probably occurs between belukhas and spotted seals which share major prey and much of their range throughout the year. In and near some concentration areas belukhas undoubtedly are the major fish-eating consumers. Stocks of several

major prey species are at present fully exploited by subsistence and/or commercial fisheries. Others have been identified as having potential for future harvests. Size, distribution, and productivity of stocks of these fishes are affected by patterns of human harvest and predation by major consumers including belukhas.

Well-documented instances of predation by killer whales and polar bears confirm the occasional importance of belukhas in the diet of those predators. Other possible natural enemies such as walrus and large sharks probably eat few belukhas. Carcasses of animals which die from predation and other causes provide nutrients and food for a host of marine and terrestrial scavengers and decomposers.

Because belukhas migrate along routes where they are accessible to humans, and live in the coastal zone during summer, coastal residents have developed a strong nutritional dependence on these whales in many areas of the arctic. Whales harvested from the Bering-Chukchi stock have in the past and continue to provide a substantial portion of the annual food procured by coastal residents of western and northern Alaska and northwestern Canada. The importance of the annual belukha hunt is obvious from the effort expended in procuring, preparing, and storing the meat, oil, and muktuk obtained. Hunters and families commonly travel many miles from their winter homes to areas where they traditionally hunt belukhas.

H. Conflict Situations

The wide general distribution of belukhas and the variety of habitats in which they are found may indicate an ability to adapt to an array of ecological conditions. However, a limited number of areas are used annually by large numbers of animals. Although the reasons for such use are somewhat unclear, it is likely that conditions found in these areas are critical to the health of populations.

The stock of belukhas in Cook Inlet ranges within view of the growing city of Anchorage. Although bordered on the northwest by vast areas of wilderness, the Inlet, particularly in the northern and eastern portions, is the site of considerable activity. Commercial fishing, recreational boating, and transport of people and materials have occurred for many years. Activities associated with oil and gas development began in the early 1970's and have recently expanded in the central Inlet. To date these activities have had no discernible effect on belukhas. Areas particularly important for calving have not been identified, perhaps due to the comparatively warm conditions in the Inlet. Observed concentrations of belukhas are probably caused by local availability of prey such as salmon and herring. Although belukha at times damage fishing gear and may become entangled and drowned, this type of interaction does not appear acute at present.

Concerns with regard to the Bering-Chukchi stock vary greatly among areas. The winter range of much of the population coincides with productive regions of the Bering Sea shelf. Stocks of fishes on which

belukhas prey are intensively harvested, primarily by foreign nations. Present fishery management plans are designed to stabilize or enhance most of these stocks and should therefore provide for maintenance of that segment of the belukha food resource base. High seas fisheries cause little or no direct mortality to belukhas since they seldom operate in ice-covered areas frequented by the whales. Proposed Federal oil and gas leases in the North Aleutian Shelf and Navarin and St. George Basins are a major concern for both belukhas and fisheries in those biologically rich areas.

Conflicts between fishermen and belukhas are most acute in some areas of the Bering Sea where both exploit dense summer concentrations of fishes in coastal areas. Historically the greatest conflict has occurred in inner Bristol Bay associated with salmon runs. After documenting the magnitude of the conflict, the Alaska Department of Fish and Game developed and implemented a program by which belukhas could be displaced from selected areas without causing them any apparent harm. Recorded killer whale sounds broadcast underwater successfully kept belukhas away from the mouths of major rivers during the peak of salmon smolt out migration. A few belukhas are taken incidentally each year by salmon fishermen. It is thought that belukhas avoid all but large mesh nets such as those used to catch king salmon, and therefore seldom become entangled in and damage gear. Although intense, the boat and aircraft traffic associated with catching, processing, and transporting salmon and herring in Bristol Bay has apparently not altered use of the Bay by belukhas.

North of the Yukon-Kuskokwim delta the areas where belukhas feed during summer are presently fished mostly for subsistence purposes. Some of these stocks may be fished on wintering grounds or as they pass through more southerly waters. Commercial fishing for herring has occurred intermittently in Norton Sound since about 1909 while salmon have been taken commercially there since 1961 and in Kotzebue Sound since 1965. Present fishery management plans provide for maintenance of those stocks. Future fisheries development in northern waters such as Norton and Kotzebue sounds must be designed such that the sum of fishery related activities does not detrimentally affect belukhas or their habitat.

Belukhas annually occur in large numbers in summer in Kotzebue Sound, Kasegaluk Lagoon, and the Mackenzie River delta. While in these summer concentration areas belukhas appear to be very sensitive to disturbance. Barge traffic in the Mackenzie delta has been observed to cause temporary changes in belukha movements, behavior, and distribution. Local people have observed fewer belukhas in northeastern Kotzebue Sound since the development of the commercial salmon fishery. It appears that relative freedom from disturbance as well as a complex of biological and physical factors make these concentration areas suitable. Probable future developments affecting areas of important coastal habitat are many as are their possible effects on belukhas. Management plans must be developed to protect the biological and physical integrity of these areas as well as to minimize activities directly detrimental to belukhas. Since we presently know little of the functional significance of concentration areas and the responses which

belukhas will show to the array of possible disturbance factors, a cautious approach to coastal development is warranted.

Much of the Bering-Chukchi belukha population moves twice annually through Bering Strait. Development near this narrow passage and possible accompanying contamination could have a severe impact on belukhas. Exploration and development of petroleum reserves as well as transportation of materials and products are of major concern.

Harvests of belukha whales by humans will be discussed in the next section. Harvests in recent years have been well within sustainable limits and have had no discernible effect on population size or distribution. Coastal residents utilize a variety of natural food sources in varying quantities depending on customary patterns of use, current need, and annual availability of the various species. Stocks of terrestrial species are maintained under regulations and provisions of the State of Alaska. Of the marine resource species, fishes are regulated by both State and Federal agencies while marine mammals, with the exception of fur seals and depleted bowhead whales, are "protected" by the Marine Mammal Protection Act (MMPA). Possible conflicts arise when, for example, it is suggested that the harvest of a species such as belukhas be increased as a substitute for a depleted species such as bowheads. Sustainable yields of all resource species must be considered in light of human needs and demands if multi-species management and ecosystem stability are desired.

I. Harvest Levels

The Cook Inlet stock of belukha whales is currently subject to insignificant harvest by humans. Only a few animals are taken annually. In the 1930's an attempt was made to commercially harvest Cook Inlet belukhas. About 100 were netted in the Beluga River and processed for meat and oil. The venture was abandoned after the initial catch. During the 1960's a few belukha were taken in Cook Inlet by recreational hunters.

The Bering-Chukchi stock of belukhas provides an important food resource to residents of coastal Alaska, Canada, and Siberia. In American waters, belukhas are available to subsistence hunters at several sites in spring as they move north through lead systems of the Bering and Chukchi seas, and during months of open water when they occur in the nearshore coastal zone from Bristol Bay to the Beaufort Sea. They provide relatively large amounts of meat, muktuk, oil, and byproducts for local use and barter. At favorable hunting locations the return per unit effort is quite high.

Archaeological evidence indicates that belukhas were taken by prehistoric subsistence hunters along the western and northern mainland of Alaska as well as at Nunivak, St. Lawrence, King, and the Diomed Islands. Due to changes in settlement patterns and resource dependencies they are no longer hunted in a regular and organized manner in Bristol Bay, Kuskokwim Bay, or the Yukon River estuary. However, organized annual summer hunts still occur in southern Kotzebue Sound, in

Kasegaluk Lagoon near Point Lay, and in the Mackenzie delta. In most of these locations coordinated groups of hunters in outboard powered boats drive the belukhas into shallow water where large numbers can be killed with few lost due to sinking. During April to June belukhas are also taken by bowhead whaling crews camped along the nearshore lead of the Chukchi Sea near the villages of Wales, Kivalina, Point Hope, Wainwright, and Barrow. The number of whales taken in this fashion depends greatly on ice and weather conditions and the success of the bowhead hunt. Opportunistic hunting during the open water season may occur on an irregular basis at many locations, particularly in Hooper, Tooksook, and Norton bays and near Kaktovik, Wainwright, and Tuntutuliak.

The magnitude of recent harvests in Alaska and Canada has been well documented. The annual retrieved harvest in the Mackenzie estuary from 1972-1977 ranged from 122 to 177 with an average of 141 whales taken. Since it was estimated that 1 belukha was killed but lost for every 2-3 retrieved, the total kill in this area in recent years has averaged about 200 animals annually. Based on available records this is considerably fewer whales than were taken in this area in earlier years. Whales harvested are predominately males.

Between 1968 and 1973 the total harvest of belukhas in Alaska at all locations from Bristol Bay to Barter Island averaged 183 animals annually. Harvest levels in 1977, 1978, and 1979 were 247, 177, and 138, respectively. In 1981, the statewide take was 154-191. The geographical distribution of the harvest varies somewhat from year to

year. For example, hunters at Elephant Point (inner Kotzebue Sound) take about 80 whales each year but harvested only 5 in 1979, which resulted in the low total harvest for Alaska. Harvests of more than a few animals are usually taken annually at Hooper Bay, Stebbins, Koyuk, Elephant Point, Point Hope, Point Lay, and Wainwright. Of 195 animals harvested in 1977 to 1979 for which sex was known, 106 (54%) were males. In 1980 to 1982, 109 of 281 (39 percent) were females.

The loss rate associated with harvests in Alaska varies with the circumstances under which the hunt is conducted. It is estimated that one-fourth to one-third are taken in deep water with losses of 60 percent and the remainder are taken in shallow water with losses of 20 percent. Based on a harvest of 185 animals per year, the average annual total kill would be 241-247 belukhas. This level of exploitation is less than that sustained in former times, for example in the late 1950's when the annual harvest in Alaska was 400 to 500 whales.

The number of belukhas from the Bering-Chukchi stock harvested annually in Soviet waters is less well known. One source indicates that along the Chukchi Peninsula, "the yearly catch sometimes reaches 100-200 animals." Total annual removals from the Bering-Chukchi stock in recent years have therefore been about 600-700 animals.

J. State Management Objectives

The primary objective which the State will pursue with regard to belukha whales is the maintenance of healthy and productive populations. In order to achieve this objective a broad program of research and management will be needed to determine the optimum size of belukha populations in relation to other ecosystem elements and to regulate harvests such that the population remains at optimum size. Belukhas will be incorporated into an ecosystem based, multi-species resource management plan. In addition protection of belukha habitat will be provided in the formulation of State policies and regulations.

The second major objective of State management will be to provide for beneficial use of the belukha resource by all people. As provided for in State statutes, preference in harvest will be given to residents with a customary and traditional dependence on belukhas. Regulations will be designed to ensure reasonable distribution of the allowable harvest, to minimize loss associated with taking, and to promote complete and efficient utilization of harvested animals. Nonconsumptive uses such as viewing and photography of belukhas in the wild, and capture for public display will be encouraged to the degree possible.

K. Problems

Since 1972 belukhas have been protected under terms of the MMPA. Unlimited harvests by Natives have been allowed while non-Natives have been prohibited from taking belukhas. Such a policy has had no effect

on the magnitude of recent harvests. However, such racial discrimination is constitutionally prohibited and it prevents subsistence use of belukha by people who may have a justifiable and traditional reliance on them. In addition, such a combination of unregulated harvest and total protection precludes any attempt to manage marine resources in a multi-species context with ecosystem stability as the goal.

Since it was assumed that responsible Federal agencies would monitor harvests and conduct biological research on belukhas, such involvements by the State were greatly reduced starting in 1973. However, programs were not developed by Federal agencies with the result that needed information on belukha biology and Native harvests was not gathered. A small-scale State program was conducted in 1977-1979 with limited funds gathered from several sources. However, this project did not have adequate support and was limited in scope. In 1981 the project was expanded somewhat to include studies of distribution and movements in Alaskan waters. That project is ongoing at this time. The interruption of belukha research and management programs caused by the MMPA is the primary reason that major data gaps which presently exist have not been filled. It is difficult to preserve belukha habitat when critical habitats are poorly defined or to prevent disturbance when the nature of and responses to disturbances are not known. This lack of information could have a major impact on present and future programs which may affect belukhas and their habitat.

L. Biological Impacts of Current and Proposed Management Plans

Belukhas are currently "protected" under terms of the MMPA. They may be taken only by Eskimos, Indians, and Aleuts. Such Native taking is without regulation provided it is done for subsistence or handicraft purposes. Harvest statistics and biological specimens have been collected in recent years by the Alaska Department of Fish and Game (ADF&G). The responsible Federal agency has not made any discernible attempt to monitor harvests, collect biological data or provide for protection of belukha habitat.

If management authority for belukhas is returned to the State, the Department of Fish and Game will continue and expand its ongoing program of monitoring harvest levels in Alaska and collecting biological data. The belukha is recognized as a species of particular interest due to their importance in the local economy of many Alaskans and Canadians and the increasing rate of development within their habitat. Materials will be collected from belukhas taken throughout the state in order to better understand their basic biology and to monitor parameters indicative of population health and productivity. Regulations will be designed and implemented to maintain the belukha harvest within the sustainable range. Additional regulations may be needed to reduce loss rate or manipulate sex and age composition of the harvest in order to affect stock sizes. Research will be undertaken to improve available data on belukha distribution, particularly in the coastal zone, and to determine the factors which affect observed distribution. Information on belukhas and areas of particular importance to them will be incorporated into

State and local planning such as preparation of Coastal Zone Management Plans. In addition ADF&G biologists will provide input in the development of relevant Federal policies and plans such as Fishery Management Plans.

M. Projections

Upon resumption of management authority for belukhas, the State will implement a broad-scale research and management plan. Harvest monitoring will be expanded to include greater geographical coverage, particularly in the southern Bering Sea. Greater effort will be devoted to determining sex, age, and biological parameters of harvested animals. It is anticipated that the major harvest of belukhas will be by subsistence hunters in the Bering-Chukchi region. The average total annual kill will be limited such that the population remains within the optimum sustainable range. A general consideration of present and future distribution and needs of subsistence users indicates that bag limits or quotas will not be needed in order to limit subsistence take. Total harvest levels are expected to be similar to recent years. Non-Native subsistence hunters will benefit since they will be allowed to harvest belukha.

In addition to analysis of biological parameters, State research programs will initially focus on aspects of distribution in and use of the coastal zone by belukhas. A major improvement in available data is expected within the first 2 years of such a program. Such data are essential for evaluating importance of various areas. Development is

occurring within the habitat of belukhas and informed decisions must be made with respect to potential conflicts and compatible uses. Critical habitat areas within State waters will be protected by statute or regulations. Protection of habitat is the most immediate concern with respect to belukha whales and is probably of greatest overall significance for the future health of belukha populations. Protection of belukha habitat will be actively pursued.

The belukha will be managed as one of a group of interacting marine resource species. Stock sizes of the various species may be manipulated through regulation of harvests in order to offset environmental factors, balance biological interactions, or alleviate conflicts. It is expected that multi-species management will be of great benefit to the future health and stability of belukha stocks and the marine ecosystems of which they are a part.

No adverse impacts are expected from resumption of State management of belukhas.

N. Economic Analysis

Although commercial harvesting of belukhas has occurred commonly throughout the arctic, the present primary use of belukhas in Alaska is for subsistence. The value of the belukha hunt to subsistence hunters is difficult to quantify. In addition to the value of the products, principally food, the hunt is of great traditional and cultural value and is often a major annual event for entire families and villages.

Belukhas are comparatively large animals and, where hunted, they are often taken in considerable numbers. Whales are primarily processed into meat, muktuk, and oil. Some organs are eaten, containers are sometimes made from the stomachs or esophagus, and teeth are used in handicrafts. In 1960 it was estimated that 182,000 pounds of meat and oil were used by Eskimos living in villages along the Bering Sea coast, representing a yield of about 500 pounds from each of the 300-400 animals harvested. An average whale taken in the Mackenzie estuary has been estimated to yield 105 pounds of dried meat, 20 gallons of oil, and 30 gallons of muktuk.

The cash value of belukha products can be figured in two ways, either as what the actual products could be sold for in native villages or elsewhere, or as the cost of purchasing substitutes. Neither method is entirely adequate. Little of the products from belukhas harvested in Alaska is sold to others although substantial amounts may at times be bartered. The domestic value of belukha products in the Mackenzie region in 1977 approximated \$0.50 per pound for dried meat, \$1.50 per gallon for oil, and \$5.00 per gallon for muktuk. An average whale was worth approximately \$233. Costs for equivalent foods in Alaskan villages are 3 to 4 times greater. Substitutes for meat and oil are generally available but there is no adequate substitute for muktuk. Costs of imported foods in remote areas have always been high and have increased markedly in recent years due to inflation and rising transportation costs. The comparatively low income of many rural residents and the relatively poor quality of substitute foods make them a poor alternative in most instances. The belukha harvest in Alaska is

undoubtedly worth tens of thousands of dollars annually to coastal residents.

Commercial uses of belukhas are numerous. Hides can be processed as leather, and oil is suitable for industrial use or human consumption. Meat is suitable food for humans or animals while bones and viscera could be processed as animal food. Buttons have been made from belukha teeth.

Although difficult to quantify, nonconsumptive uses of belukhas undoubtedly are of great value. With the exception of Cook Inlet, much of the habitat of belukhas in Alaska is comparatively remote, therefore viewing and photography in the wild may never become popular as they have in some localities in Canada. Belukhas adapt well to captivity and are successful and popular attractions at several oceanaria.

0. Management Effectiveness

After statehood in 1958 and prior to the MMPA in 1972, belukhas were managed by the State of Alaska. Since harvest levels were comparatively low and generally reduced from previous years, no limit was imposed on the take, although harvests were monitored by biologists working in coastal areas. Nonlethal techniques were developed to displace belukhas from areas in Bristol Bay where they severely conflicted with major salmon fisheries. This effectively moderated the conflict without harm to the belukhas.

After 1972 only Eskimos, Indians, and Aleuts were allowed to harvest belukha. This had no overall effect on total harvest since the bulk of the take has always been by Eskimos. Sale of products from belukhas to non-Natives was prohibited. From 1974-1976 the magnitude of the harvest was not monitored. Due to an urgent need for harvest data and the lack of any Federal program to obtain the information, State biologists resumed monitoring of harvests in 1977. Since then they have collected all available information on magnitude and sex and age composition of the harvest and biological specimens from harvested animals.

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