Report of the Workshop on

Bering-Chukchi-Beaufort Belugas

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Preface

This workshop came to life because of the desire of the Canadian Inuvialuit Fisheries Joint Management Committee (FJMC) and the Canadian Department of Fisheries and Oceans (DFO) to extend the knowledge acquired by satellite tracking of Beaufort Sea belugas in summer and autumn. The distribution and ecology of belugas in winter in the region are largely unknown, which is a major gap in our understanding. Realising that the live-capture and tracking of belugas in late autumn and winter would require working in Russian territory, they suggested that a workshop be convened to meet with Russian scientists and Chukotka hunter representatives and discuss potential collaborations and logistic details of such an enterprise. Because we thought that such a meeting could engender collaborations on other research initiatives, such as genetic differentiation and sighting studies of Bering, Chukchi and Beaufort Seas belugas, we extended an invitation to U.S. beluga researchers and hunter organisations, to which they responded with enthusiasm. The FJMC provided initial funding for the workshop. We sought additional funding from the U.S. National Science Foundation and the World Wildlife Fund USA (WWF) who were interested in supporting a meeting which would result in international research co-ordination and exchange on a biological resource of the Bering-Chukchi-Beaufort Seas. We also got in-kind support from the National Oceanic and Atmospheric Administration's (NOAA) National Marine Mammal Laboratory (NMML) in Seattle, where the meeting was held, and from the Alaska Beluga Whale Committee and the North Slope Borough, which covered the costs of many U.S. participants.

The meeting was by all accounts a success in that it allowed people involved in beluga research and hunting to exchange information on their research results and observations on Bering-Chukchi-Beaufort belugas, to identify gaps in the knowledge of beluga seasonal distribution and ecology, and to consider logistical constraints while setting priorities for future research initiatives. Our hope is that this workshop will act as a catalyst to multinational co-operation and that, despite logistical difficulties, this co-operation will result in a better understanding of beluga winter distribution and ecology in the Bering and Chukchi Seas. In the long term, we hope that it will engender relationships between scientists and hunters of all three countries that will result in effective beluga conservation in the region. This is certainly the hope of WWF, which by several initiatives is already invested in Bering-Chukchi ecosystem conservation. It is also the hope of the many organisations that supported this workshop.

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Introduction

Background

Beluga whales (*Delphinapterus leucas*) are found in the tens of thousands in the Bering, Chukchi, and Beaufort seas. At least four distinct stocks have been identified by genetic analysis, and satellite tagging has shown that the migratory paths of some stocks link Canadian, American, and Russian waters. Belugas are an important subsistence species for many communities in Alaska and Canada, and are taken sporadically in Chukotka.

Recent studies have greatly expanded our understanding of the ecology of the beluga in this region, and have highlighted the need for collaboration on research and management of the beluga. In Alaska and Canada, cooperation among researchers, managers, and indigenous hunters is formalized through co-management bodies, the Alaska Beluga Whale Committee and the Fisheries Joint Management Committee. Cooperation between the two countries and the two groups is good, and several collaborative projects have been undertaken, including genetic analysis and the sharing of satellite telemetry technology and techniques.

Cooperation with Russia, on the other hand, has been limited. It is clear that beluga stocks are shared between North America and Russia, but many questions remain, including:

- Are there separate stocks of belugas that remain in Russian waters during the summer, such as in the Gulf of Anadyr or along the north coast of Chukotka?
- Which North American stocks migrate to Russian waters and when?
- Where do the region's belugas spend their winters, and to what extent do they interact and even interbreed in the wintering region?
- What are the habitat requirements of these belugas during the winter?

Answering such questions is a critical first step to identifying and addressing the management and conservation needs for belugas across the region.

Workshop Purpose

A workshop on Bering-Chukchi-Beaufort belugas was held from 15-17 November 2000 at the National Marine Mammal Laboratory in Seattle. Its purpose was to promote cooperation among researchers, managers, and hunters throughout the region, especially with Russian scientists and indigenous people, in order to begin addressing the questions outlined above and related matters concerning belugas in the region. Participants from Canada, Denmark/Greenland, Russia, and the United States included scientists, managers, and indigenous hunters and leaders (see Appendix 1). The workshop was structured to promote discussions among the participants. Presentations addressed beluga distribution and habitat use, efforts and results from satellite telemetry, genetic analysis of stock identity and interaction, and current research efforts in Russia. (Abstracts of the presentations are included in Appendix 2.)

Workshop Summary

This report summarizes the presentations and discussions of the workshop, noting plans for future study and collaboration. It is structured by the main workshop themes of satellite telemetry, genetics, and distribution sightings. Each section describes the background, needs, obstacles, and priorities for research. Although the workshop did not attempt to prepare recommendations, the report includes significant conclusions regarding belugas in the Bering-Chukchi-Beaufort region.

Acknowledgments

The workshop was funded by the Fisheries Joint Management Committee (Canada), National Science Foundation (U.S.), and the World Wildlife Fund (U.S.). The Fisheries Joint Management Committee, the Inuvialuit Game Council, the Department of Fisheries and Oceans Canada (DFO), the Alaska Beluga Whale Committee, the Alaska Department of Fish and Game, the North Slope Borough, the National Marine Fisheries Service, and the World Wildlife Fund sent representatives to the workshop. The National Marine Mammal Laboratory hosted the workshop and helped with logistics. Pierre Richard provided the catalyst for the workshop, which was initially inspired by the Fisheries Joint Management Committee (FJMC). Jack Orr, Sue Moore, and Dave Rugh took care of the logistical arrangements. Henry Huntington was the workshop chairman. Natalie Novik of Anchorage, Alaska, interpreted the presentations and discussions and helped arrange the travel of the Russian participants. Without the combined efforts of these organizations and persons, the workshop would not have been possible.

Satellite Telemetry

Background

In the Beaufort Sea region, satellite transmitters were first put on beluga whales in 1993. To date, 30 transmitters have been put on belugas in the Mackenzie Delta area (Richard et al. in press). Following the attachment of transmitters in the summer months, belugas from the Mackenzie Delta have traveled north of Banks Island, and have migrated northwest into the pack ice of the Arctic Basin. In fall, the belugas traveled west as far as Wrangel Island, and then southeast along the north coast of Chukotka towards the Bering Strait. One tagged beluga moved south through the Bering Strait on 29 November, and then its transmitter stopped sending signals.

Ten transmitters were put on belugas in Kasegaluk Lagoon near Point Lay in the eastern Chukchi Sea in the summers of 1998 and 1999 (Suydam et al. in press; see abstract Appendix II). Belugas from the eastern Chukchi Sea, which were thought to remain near the edge of the pack ice during the summer, traveled hundreds of kilometers to the north and east through dense ice, reaching as far north as approximately 80°N. By the late summer and early fall, these animals had returned southwards in the Beaufort Sea, after which no further data were received.

Efforts in October 2000 to put transmitters on belugas in Norton Sound in the eastern Bering Sea were not successful (Suydam, see abstract Appendix II). The Alaska Beluga Whale Committee plans to try tagging again in 2001.

The results from satellite tagging have been surprising. The long-distance summer movements of belugas in the region had not been suspected, nor had the use of deep-water habitats in dense pack ice. Further telemetry work may give more insight into the regularity of these patterns, differences between male and female habitat use and travel, and other details of beluga behavior and distribution. Without the development of a tagging system that can provide data over a longer period, however, tagging efforts in the North American Arctic are not likely to provide information about winter distribution and behavior of Bering-Chukchi-Beaufort belugas.

Needs

The lack of information on winter distribution and behavior is one of the most significant gaps in understanding of beluga whales in the region. Although aerial and ship-based observations have found large numbers of belugas in the Bering Sea in winter, there is no way to identify which stocks are represented, nor whether the summering stocks interact during winter. Habitat preferences in winter are also unknown. Tracking movements and recording dive data of belugas from known stocks via satellite is the best available means of monitoring winter distribution and behavior as a starting point for understanding the winter ecology of belugas in the Bering Sea.

To date, transmitters have provided data for a maximum of five months. It is thought that most, if not all, transmitters fail because they come off the animal. Thus, to gather data from mid-winter, tagging must take place in fall. For the Beaufort Sea stock of belugas,

this means tagging either in the Beaufort Sea in September or on the north coast of Chukotka in October or November. Along the coast of Chukotka, the Eastern Chukchi Sea stock may mix with the Beaufort Sea stock in October and November, requiring further work to identify the stock to which the tagged animal belongs. Eastern Bering Sea belugas are not thought to migrate north of the Bering Strait, although it is feasible for them to do so. If efforts to tag belugas in Norton Sound in October are successful, we expect to learn whether this stock is shared with Russia. Ideally, tagging animals from the various stocks in the same year will help determine the extent of interactions between stocks in winter.

In addition, significant questions remain regarding summer behavior. These include whether males and females have different distributions or follow different migratory patterns. Results to date indicate that males may travel farther into the pack ice, but more tags need to be put on females to confirm this. Belugas tagged in the Mackenzie Delta at different times of the summer have shown similar but distinct movement patterns. Whether these are annual differences or reveal groups that behave differently is not clear.

Obstacles

The priority for satellite telemetry is tagging whales in the fall. There are many obstacles to doing so in Chukotka. First, there are permitting requirements for foreign researchers and the import of satellite and radio equipment. Tagging teams that include American or Canadian researchers will have to prepare well in advance and make a substantial effort to get approval from Russian authorities to work in the field. The involvement of Russian scientists collaborating in the project in obtaining official permits will be necessary.

Second, getting the necessary field gear to the tagging location will take considerable planning. Some equipment, such as certain types of boats, is available in Chukotka. Other gear, such as inflatable boats, nets, rope, and dry suits, can be purchased in Moscow or Vladivostok and then transported to the field. Bringing gear from North America requires permits and probably the payment of substantial customs duties. Further investigation is needed to determine which would be the best approach or if some combination makes sense.

Third, belugas are not often hunted in Chukotka, and favorable sites for capturing the whales have to be identified. Russian researchers noted several possibilities along the north Chukotkan coast. Places on the coast near Uelen and Inchoun were mentioned as good places. Other places considered were near the village of Enurmino, Cape Akkani, Mechigmen Bay, Lavrentiya Bay, and Seniavin Strait. Some felt that Anadyr Bay would be the best place but it was largely regarded that this would not address questions relating to wintering distribution of North American populations. There was no conclusion on which place would be the best, but participants agreed that several of these places should be examined to try to identify the best prospects and appropriate capture methods. A variety of capture techniques, including hoop netting, deploying surrounding nets, and setting passive shore nets, have been used in North America and Greenland, offering a range of choices to suit a particular site or sites (Orr et al. in press).

Fourth, it seems likely that belugas from the Eastern Chukchi Sea and Beaufort Sea stocks are both found along the north Chukotkan coast in fall. Genetic analysis can help identify the probable stock to which a tagged animal belongs, but the results will not be available during tagging. Furthermore, identifying the stock to which an individual animal belongs involves a degree of uncertainty. Biopsy sampling of a number of animals during tagging may help identify aggregations of belugas from one stock or the other. Tagging several whales will increase the likelihood that stock identity can be determined with greater confidence.

Priorities

Beyond the current and planned tagging efforts in North America, the highest priority for satellite telemetry is putting tags on belugas in fall to determine where they go in winter. Tagging in the Beaufort Sea in September is one option; the other is tagging in Chukotkan waters in October and November. For the latter, several steps are needed in addition to obtaining funding:

- Getting approval for research plans, including the necessary paperwork for getting personnel and equipment into Russia and out to the field. Some help may be available from the Working Group on Marine Mammals (Area V, Project 02.05-61) under the *Agreement between the Government of the United States of America and the Government of the Russian Federation on Cooperation in the Field of Protection of the Environment and Natural Resources*. This group should be approached as soon as possible.
- Finding tagging sites on the north Chukotkan coast. This will require field reconnaissance, which ideally would be carried out during the fall migration. The U.S. icebreaker *Healy* is a potential research and logistics platform that could help survey the coast for suitable capture locations, transport a tagging crew to a remote location in Chukotka, or serve as a base for tagging.
- Determining the appropriate capture technique, and providing training to Russian researchers in that technique, in attaching the transmitters to the whales, and the analysis of data. The training can take place in Russia, in North America, or both, depending on logistics, funding, and timing.
- Taking biopsy samples for genetic analysis to determine stock identity of belugas in fall in northern Chukotka. This can be done during tagging work, or perhaps during reconnaissance.

In addition to preparing for work in Russia, efforts to develop a transmitter and attachment that operate for longer periods should continue. A transmitter that functioned for a full year, for example, would allow the collection of winter data from animals tagged in summering areas in North America, where capture techniques have already been refined.

To further the development of collaborative projects on satellite tagging of belugas, lead persons from each country were designated. The responsibility of the leads is to coordinate both international cooperation and the national efforts required to support it. They are Vladimir Melnikov (Pacific Oceanological Institute [TINRO] Vladivostok),

Dennis Litovka (TINRO Anadyr), and Mikhail Zelensky (Naukan Production Cooperative) for Russia; Robert Suydam (North Slope Borough) for the U.S.; and Pierre Richard (DFO) for Canada.

Genetics

Background

There are at least five distinct areas in the Bering-Chukchi-Beaufort where beluga whales concentrate in summer: Bristol Bay, the eastern Bering Sea (Norton Sound – Yukon Delta), and the eastern Chukchi Sea in Alaska; the Mackenzie Delta in Canada (Fraker 1980, Norton and Harwood 1985, Frost and Lowry 1990, Harwood et al. 1996, Mymrin et al. 1999, Huntington et al. 1999); and Anadyr Bay in Russia. Some 740 samples from the first four areas have confirmed that these summering groups are genetically distinct and return faithfully to the same areas each year (O'Corry-Crowe et al. 1997, Brown-Gladden et al. 1999). Belugas in the eastern Chukchi may be further divided into Kotzebue Sound and Kasegaluk Lagoon stocks, but more samples are needed to determine if this is in fact the case. The stock affiliation of belugas taken in the Kuskokwim River area of Alaska (between the Bristol Bay and Eastern Bering Sea stocks) is unknown. No samples have been taken from belugas in Anadyr Bay, so its relationship with the other stocks is unknown.

The analyses done to determine stock identity use patterns of variation within mitochondrial DNA, which is passed to offspring exclusively from the mother. The summer stocks represent distinct maternal lineages, indicating that whales return to the same summering ground generation after generation. Analysis of nuclear DNA suggests that some degree of interbreeding may take place, presumably in winter or spring when stocks may interact in the Bering Sea. It is hoped that further work will shed more light on these and other aspects of beluga breeding behavior in the region.

Needs

No beluga samples from Russia have been analyzed, and thus there is no information on potential stock identity of animals seen at Wrangel Island, along the north coast of Chukotka, in the Seniavin Strait area, in the Sireniki Polynya, or in Anadyr Bay. Analysis of DNA from these animals would help establish if and how beluga concentrations in Russia relate to the identified summering stocks in North America and vice-versa.

Additional samples from all areas will help determine the extent of interbreeding between stocks, family structure within groups, and whether more than one stock exists in the eastern Chukchi Sea. The possibility of genetic differences among spatial and temporal beluga aggregations in the Mackenzie Delta also requires further analysis.

Obstacles

The priority for genetic analysis is obtaining samples from Russia. Several factors complicate this process. First, few belugas are hunted in Chukotka each year. Obtaining samples from hunters, as is done in North America, will not provide sufficient numbers or geographic distribution. Biopsy techniques, including jab sticks, crossbows, and rifles, will be required. This equipment, and the vials in which samples are stored, must be sent to Russia. Furthermore, personnel need to be trained in the collection of samples from live animals.

Second, the export of samples from Russia and their import to the U.S. or Canada requires permits from both exporting and importing countries. (The U.S. already has the required import permits.) Obtaining the necessary permits is possible, but will take time and effort on all sides. If samples can be processed by polymerase chain reaction (PCR—the technique used to amplify genetic material for analysis), then the PCR output is no longer considered beluga tissue, and can be transported without permits. Whether it is possible or desirable to do this and further analytical steps in Russia needs to be investigated.

Third, taking and analyzing genetic samples takes a great deal of effort. A critical link in the process is getting information back to those who have provided the samples and are interested in the results. In North America, scientists involved in genetic analysis have made presentations to co-management groups, which has greatly increased the sense of cooperation and collaboration between researchers and hunters. Getting information to Russia will require translation and an extra effort to get materials to remote villages where communication is poor.

Priorities

Obtaining samples from Russia is the highest priority. Anadyr Bay offers the easiest location, and determining the stock identity of those animals is of great interest. The north coast of Chukotka is a priority, to determine any mixing of the Beaufort Sea and Eastern Chukchi Sea stocks, especially if satellite-tagging efforts are to be conducted there. Samples in northern Chukotka could, of course, be obtained without a tagging project, and in fact might help identify the best times and locations for capturing animals from a particular summering stock. Samples from Seniavin Strait, where belugas often concentrate in fall, and the Sireniki Polynya, where belugas are found in winter, would also be useful in determining stock distributions and migrations to and from North America.

To obtain and analyze samples from Russia, several steps are needed:

- Providing Russian researchers with sampling equipment, including biopsy crossbows or rifles and vials for storing samples.
- Determining what types of processing and analysis can be done in Russia.
- Obtaining the necessary permits in Russia, Canada, and the U.S. for transporting beluga tissues.
- Figuring out when and where samples can be taken opportunistically, and where dedicated and systematic efforts should be focused.
- Determining how sample transfer and analysis will be coordinated between U.S. and Canadian laboratories.

To further the development of collaborative projects on genetics, lead persons from each country were designated. They are Vladimir Melnikov (TINRO Vladivostok), Dennis Litovka (TINRO Anadyr), and Mikhail Zelensky (Naukan Production Cooperative) for Russia; Greg O'Corry-Crowe (National Marine Fisheries Service [NMFS]) for the U.S.; and Brigitte de March (DFO) for Canada.

Sightings

Background

Observations of beluga whales fall into two categories: systematic efforts to determine distribution, abundance, habitat use, and harvest locations and levels; and opportunistic sightings that offer some data on seasonal distribution and habitat use. Systematic aerial surveys off the coast of northern Alaska have been conducted mostly in summer and autumn. Distribution and habitat use and movement patterns have been best studied for the Beaufort Sea stock, while more limited surveys have resulted in distribution and population estimates for the three stocks that summer in the Chukchi and Bering seas. (Moore et al. 1993, Moore 2000). Harvest data provide additional records of beluga distribution over time. Minimal stock sizes have been estimated with reasonable confidence, and habitat use and movement patterns in certain areas such as the Beaufort Sea are relatively well documented (Moore et al. 2000). These data, however, are limited by season.

In Russia, observations have been largely land-based, supplemented by some, largely opportunistic, ship-based and aerial sightings. Patterns of movement in Anadyr Bay have been studied recently. A coastal network of observers from several villages has compiled a record of marine mammal sightings at several locations along the coast of Chukotka. Ship-based and aerial surveys for walrus and other marine mammals have provided extensive observations of belugas, especially in fall in the western Chukchi Sea and the area of Wrangel Island, and in winter and spring in the Gulf of Anadyr. Large groups of belugas have been seen in these areas, but little else is known about them.

Needs

The observational data from various platforms has been compiled in raw form, but has not been analyzed with regard to survey effort to determine how frequently belugas are seen in each location and how the characteristics of the survey effort bias the results. The compiled observations offer a picture of fall migration westward across the Beaufort and Chukchi Seas in late summer and early fall, to and perhaps beyond Wrangel Island and then southeast toward the Bering Strait. Winter data show occasional large aggregations in the Gulf of Anadyr, particularly near Cape Navarin. In spring, the animals move northward and diverge, some towards the Anadyr River and some towards the Bering Strait. Although satellite telemetry and genetic analysis offer the most promising techniques for further research, analyzing existing observational data may provide valuable insights and indicate opportunities for further systematic surveys.

Obstacles

The existing data are scattered in many places in both Russia and the U.S. Compiling the data—including survey effort—will take time and effort, and may not be possible given the constraints on management agencies and researchers. Nonetheless, it is worthwhile making the effort to enter what is available into a database from which further analysis can be made, particularly using a geographic information system (GIS).

Priorities

At the workshop, researchers from the National Marine Mammal Laboratory provided Russian researchers with a database format in Microsoft Access currently being used to compile observational data on belugas in Cook Inlet, Alaska. With minor modifications, this format can be used for Bering-Chukchi-Beaufort belugas. Once this is accomplished, the data can be readily exported to a GIS for further analysis of spatial patterns and trends. Whether the data will allow assessment of survey effort remains to be seen.

To further the development of collaborative projects on sightings of belugas, lead persons from each country were designated. They are Anatoly Kochnev (TINRO Anadyr) and Nikolai Mymrin (Eskimo Society of Chukotka) for Russia; Dave Rugh and Kristin Laidre (NMFS) for the U.S.; and Pierre Richard (DFO) for Canada.

Conclusions

Research

The efforts of the Alaska Beluga Whale Committee have brought research throughout much of Alaska under one umbrella. The Fisheries Joint Management Committee plays a similar role in northwestern Canada. Cooperation between the two groups and between researchers and hunters in both countries has led to a greatly enhanced understanding of beluga whales in the Bering, Chukchi, and Beaufort Seas. The use of satellite telemetry and genetic analysis has broadened the scope of inquiry as animals from particular stocks are tracked over great distances, and the stocks themselves are compared with one another to determine how they are related.

Two major gaps remain: What do the belugas do in winter? How are beluga concentrations in Russia related to stocks identified in North America? Genetic analysis of samples from belugas in Russian waters and data from satellite transmitters that last into and through the winter are the best prospects for answering these questions.

Management

In the 1980s, little was known about stock identify and harvests of beluga whales in Alaska. More was documented about beluga harvests in Canada, but such studies had only begun in recent years. The management status of belugas in both countries was uncertain, although there were few indications of any problems. Research and harvest documentation since then have confirmed that current harvests pose little threat to beluga stocks in the Bering, Chukchi, and Beaufort Seas. Harvests in Russia are minimal, even if the stock or stocks harvested are unknown, and do not change the assessment of management status in North America.

Whether this situation will change in the future is, of course, unknown. Food shortages and the resumption of traditional marine mammal harvests in Chukotka may lead to an increased take of beluga whales. The Anadyr Bay population is particularly vulnerable in the short term, because access is simple from the city of Anadyr and because these animals do not avoid boat traffic on the river. Monitoring harvests and harvest pressures in all three countries is important for the early detection of any significant changes.

Conservation

Beyond harvests, there are many potential threats to belugas in the region. Some are specific to an area, such as conflicts with fisheries in Bristol Bay, development of offshore mineral or petroleum resources, or the potential for harvests in Anadyr Bay. Others are regional, such as climate change and increased shipping. At present, there are few indications of serious threats. Nonetheless, the Bering Sea in particular is showing signs of significant ecosystem change, the implications of which for belugas are unknown. It is critical to monitor the situation carefully to identify changes early and plan responses where possible to prevent impacts to belugas. The absence of a crisis should not lead to complacency. Preserving the region's healthy stocks of belugas remains a priority for hunting communities as well as conservationists.

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Appendix 1: List of Participants

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Appendix 2: Abstracts of presentations

Satellite Telemetry

J. Orr, R. Joe, and D. Evic

Capturing and handling of white whales (Delphinapterus leucas) for instrumentation and release, in the Canadian Arctic

(Abstract of paper in press, *Arctic*)

For many decades humans have captured white whales (*Delphinapterus leucas*) for food, research and public display, using a variety of techniques. The recent application of satellite-linked telemetry and pectoral flipper band tags, to determine the movements and diving behavior of these animals, has required the live capture of a considerable number of belugas. Three principal techniques have been developed and their use is dependent on the clarity and depth of the water, tidal action, and bottom topography in the capture area. When the water is clear enough to see the whales swimming under the water and they can be herded into shallow sandy areas, a hoop net is placed over their head from an inflatable boat. When the water is murky and the belugas can't be easily seen under the water, but can be herded into relatively shallow sandy areas, a seine net is deployed from a fast moving boat, to encircle them. If the whales are in deep water and can't be herded into shallow water, a stationary net is set from shore to entangle them. Once captured, the whales have to be restrained in such a way so they can breathe easily, have the tags attached and be released as quickly as possible. The methods have proved to be safe, judging from the whales' rapid return to apparently normal behavioral patterns.

P.R. Richard, A.R. Martin, and J.R. Orr

Summer and autumn movements of belugas of the eastern Beaufort Sea stock

(Abstract of paper in press, *Arctic*)

Beluga whales of the eastern Beaufort Sea Stock were tagged with satellite-linked time-depth recorders and tracked during the summers and autumns of 1993, 1995 and 1997. Whales occupied the Mackenzie Estuary intermittently and for only a few days at a time. They spent much of their time offshore near or beyond the shelf break and into the polar pack ice of the estuary or in Amundsen Gulf and McClure Strait and Viscount Melville Sound. The movements of tagged belugas into the polar pack and into passages of the Arctic Archipelago suggest that aerial surveys conducted in the southeastern Beaufort Sea and Amundsen Gulf may have substantially underestimated the size of the eastern Beaufort Sea stock. Ranges of male and female belugas were somewhat segregated in two of the three years of study. In late July of 1993 and 1995, most males were located in Viscount Melville Sound while females were primarily in Amundsen Gulf. Movement patterns of males tagged in late July in 1997 were different from those tagged early in July 1993 and 1995. In September, belugas migrated westward along the continental shelf and farther offshore in the Alaskan Beaufort Sea. The tracks from1997 show the Western

Chukchi Sea as an autumn migratory destination and that at least some belugas continued their migration south towards the Bering Strait in November. Some conclusions from this study about beluga ecology challenge conventional wisdom in that estuarine occupation appears to be short-lived, belugas travel long distances in the summer to areas hundreds of kilometers from the Mackenzie Delta, and they do not avoid dense pack ice in summer and autumn.

R.S. Suydam, L.F. Lowry, K.J. Frost, G.M. O'Corry-Crowe, and C.F. Saccheus Sr.

Satellite tracking of beluga whales of northwestern Alaska

In western Alaska, there are three summering stocks of beluga whales (*Delphinapterus leucas*): eastern Chukchi Sea, eastern Bering Sea, and Bristol Bay. These stocks are genetically distinct and based on aggregations of whales in nearshore waters that are consistently used from year to year. Here we address only the eastern Chukchi Sea and the eastern Bering Sea stocks. The eastern Chukchi Sea stock is seen primarily in Kotzebue Sound and near Kasegaluk Lagoon, in June and July. The eastern Bering Sea stock is seen primarily in Norton Sound and Norton Bay during the summer.

Little was known about where eastern Chukchi Sea belugas traveled after they left the northwest coast of Alaska before this study. We live-captured five belugas in Kasegaluk Lagoon in 1998 and five more in 1999 and attached satellite-linked depth recorders to them. The belugas were caught between 26 June and 1 July 1998 and on 30 June in 1999. They included 9 males ranging in length from 398 to 441 cm and 1 female, 266 cm long. The tags operated for up to 104 days. In 1998, two of the tagged belugas only sent signals for two weeks. The other three whales traveled more than 2000 km and reached 80^{o} N and 133^{o} W, almost 1100 km north of the Alaska coast. This required them to move 700 km through >90% ice cover. The whales then moved southward into the Beaufort Sea north and east of Point Barrow. Two whales later moved to an area north of the Mackenzie River delta where they spent 2-3 weeks before once again heading southwest towards Barrow. In 1999, movements were very similar. The tagged whales did not move quite as far north as in 1998, but they moved north along a path almost identical to the one used by the whales tagged in 1998. In 1999, one small female was tagged; she spent most of the summer in the western Beaufort Sea in the vicinity of the Barrow Canyon. The figure below shows the movements of these tagged belugas.

Belugas of the eastern Bering Sea spend most of the summer months in Norton Sound and Norton Bay. Little is knows about their movements at other times of the year. In 1999 and 2000, we attempted to capture belugas near Elim, Alaska, in Norton Bay in collaboration with Barbara Mahoney of the National Marine Fisheries Service. The goal of this work was to determine the wintering location of this stock of whales. No belugas were captured but methods and capture locations are now better defined.

M.A. Zelensky

Options for capturing and tagging belugas in the Chukotsky District, Chukotka

We have discussed with V. Melnikov the various options for catching belugas to tag them in the Chukotsky District. From all the possible places, we agree that the best area to catch belugas is in the vicinity of Inchoun and the old villages of Nuniamo and Pinakul. There, success is practically assured.

In order to catch the belugas, we can recruit the hunters from the villages of Inchoun, Lavrentiya, and Lorino. I do not think it will be a problem for these marine mammal hunters to join the program. For equipment, we can provide whaling boats (9 meters), motor boats (6 meters), and Evinrude overboard engines (30, 40, or 115 HP). We also have mobile, fixed and portable radios and CB's.

At all the points mentioned above, there is lodging available.

Genetics

B.G.E. de March

Results of genetic studies on Beaufort and Chukchi Sea belugas done at the Freshwater Institute, DFO, Winnipeg

We analyzed 262 beluga samples—180 from 26 Beaufort Sea locations and/or years, 68 from Point Lay (Alaska) in 4 years, and 14 from Norton Sound (Alaska)—for two types of DNA. The first, mitochondrial DNA (mtDNA), is inherited mainly maternally through egg cell material. We also examine 15 microsatellite loci, regions of nuclear DNA that recombine as they are inherited from both parents. Examination of both types of DNA may provide information about the breeding history, mating systems, migrations, and distribution of the population. Because mtDNA is inherited only maternally, it can also provide information about female patterns of socialization and dispersion when they are different from the male patterns.

When the Beaufort Sea, Chukchi Sea, and Norton Sound belugas were compared as three populations with 180, 68, and 14 individuals, both mtDNA and microsatellite allele frequencies were highly significantly different from each other in the three populations. The patterns observed agreed very strongly with those published by O'Corry-Crowe et al. (1997). However, when animals from the three populations were considered to be from 31 different identifiable "collections", the term referring to animals obtained in one year at one location, differences were not as strong. mtDNA differed between Beaufort Sea and Chukchi Sea collections in 94 of 104 (104=26*4) possible comparisons; among the 26 Beaufort Sea collections in 53 of 325 (325=26*25/2) comparisons; and among 4 Chukchi Sea collections in 0 of 6 (6=4*3/2) comparisons. Years and location where belugas tended to be different from their expected stock could be identified. Norton Sound belugas differed from Beaufort Sea in 22/26 comparisons, and differed from Point Lay in 4/4 comparisons. There were very few differences among collections from both stocks on the basis of microsatellites. The few differences that did exist could be due to chance.

These results confirm the existence of the Beaufort Sea and Chukchi Sea stocks, and demonstrate genetic differences primarily in mtDNA. However, genetic characters do overlap and it is also known that individuals wander extensively. On the basis of observations with microsatellites, it is possible that the stocks interbreed, or interbreed at a low frequency. However, the two stocks are defined by different mtDNA characteristics. This means that social groups of females and their families return to the same summering areas every year.

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G.M. O'Corry-Crowe

Molecular genetic studies of beluga whales (Delphinapterus leucas) in Alaska, Northwest Canada, and Russia

We are using a range of molecular genetic markers to study population structure, dispersal patterns, and social organization in beluga whales throughout Alaska and northwest Canada. Recently, we have expanded this research to include beluga populations in Russia's Far East. More than 500 samples have been analyzed for both mitochondrial DNA (mtDNA) and a set of 8 highly variable nuclear markers, termed microsatellites. The different properties of these markers enable us to compare male and female dispersal and breeding patterns. MtDNA is inherited solely through the maternal line and the geographic pattern of variation in this marker suggests a rapid radiation of beluga whales into the Bering, Chukchi, and Beaufort Seas following the last glaciation and indicates that beluga whales return to the same summering ground year after year, generation after generation. These findings indicate that there is little movement of whales between the 5 separate summer concentrations of belugas found along the coast of Alaska and northwest Canada and that they should be managed as 5 separate stocks: Cook Inlet (which is outside the Bering-Chukchi-Beaufort region), Bristol Bay, the eastern Bering Sea (Norton Sound and Yukon Delta), the eastern Chukchi Sea, and the eastern Beaufort Sea. The faithfulness of whales to particular summering grounds is maintained through the female line: mothers bring their calves back to their own birth site and thus insure that subsequent generations will continue to return to the ancestral ground. However, little is known about the winter distribution of beluga whales in this region and it has been suggested that a number of separate summering stocks may overwinter together, where belugas from the different stocks may interbreed. Results from the microsatellite analysis, however, indicate that there is little or no interbreeding among the summer stocks. This could also mean that the 5 separate summer groupings are unlikely to share a common wintering area. A limited amount of genetic data has been collected to date from beluga whales in the Sea of Okhotsk. Our analysis has revealed that these whales are very different from those of the Bering-Chukchi-Beaufort region. The complete resolution of stock structure and dispersal patterns of beluga whales in the Bering-Chukchi-Beaufort region requires the collection and molecular genetic analysis of beluga whale samples from Chukotka and all other areas west of the Bering Strait.

Sightings

A.A. Kochnev

Beluga distribution and migration in the Chukchi and East Siberian Seas

Contemporary knowledge regarding the distribution and migrations of the belugas in the Russian Eastern Arctic is mostly based on reports made by the Native inhabitants and incidental observations from ships and planes. The various researchers who have studied the question disagree on migration paths, the location of the summer feeding grounds and the wintering grounds of the belugas in the Chukchi and East Siberian Seas, and also on the question of the population identification of the animals observed here, compared with the belugas found in the northern part of the Bering Sea and the Laptev Sea. Most researchers agree however that it is in this area that we find in the summer those belugas wintering both in the northern Bering Sea, and in the polynyas north of the East Siberian and Chukchi Seas.

The observations I conducted on the northern shores of Chukotka between 1985 and 1988 and again in 2000, and on Wrangel Island between 1989 and 1998, as well as the database available from the Wrangel Island State Reserve for the period 1979-1988, together with the reports from the reserve rangers and the local hunters in northern Chukotka, show that in the western Chukchi Sea and the eastern East Siberian Sea, belugas show up only in the fall (in September and October). They appear by the shores of Wrangel Island from the end of September to mid-October (lim 09/09-10/19) in groups of between 5 and 200 animals. The short period (4 to 15 days) during which they are observed near Wrangel Island and the direction of their migration to the east attest to the fact that the belugas are actually traveling here during their fall migration.

If we analyze incidental aerial observations of belugas (1971-1995) in the Chukchi and East Siberian Seas, the results confirm that the massive influx of belugas in the western part of the Chukchi Sea, in the eastern part of the East Siberian Sea, and in the adjacent waters of the Arctic Basin, happens only in September and October. It is also to be noted that in September they are found dispersed all over a large body of water, but in October they concentrate in huge herds of over 100 animals and regroup around Wrangel Island. In July and August only one sighting of belugas was made in this area. The dates at which sightings of belugas were made in the Wrangel Island area coincide with the migration period in this region for Beaufort Sea belugas (Richard et al., in press). Therefore, it can be concluded that the western part of the Chukchi Sea and the eastern East Siberian Sea do not serve as a permanent or summering habitat for the belugas, but that this is an important area for the fall movements and feeding of the Chukchi-Beaufort population.

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D.I. Litovka

Observation results on the migration and distribution of belugas in Anadyr Bay in 2000

The present work is a compilation of data from published literature and materials gathered during the author's own field observations from 1985 to 2000.

In 2000, at the author's initiative, a program was started to increase the coastal observation points for monitoring belugas in Anadyr Bay by inviting 12 school children to participate, financed by the Chukotka ecological association Kaira-Club with support from the WWF and the Humanitarian Aid Committee from Alaska.

The migration of the belugas and counts of locally observed concentrations were the object of special coastal observations between June 13 and October 12, 2000. From the time the ice broke up (in the first 10 days of June) until it froze again (in the first half of December), belugas were sighted in all accessible parts of the Bay. During the summer, they were seen mostly in the estuaries of large and medium-size rivers (Avtokuul, Tretia, Vtoraya, Anadyr, Velikaya, Kanchalan, Gyrmekuul, Tavaivaam), Melkaya Bay, Kanchalan Bay, and the Onemen and Kanchalan Sounds. The largest groups concentrate during the most active salmon runs in the narrowest part of the Bay between the city of Anadyr and Observation Cape; in the area of Dyonisius Cape, Tolsty and Tonky Capes, the Large Seal spit, and around the Aliumka island; and in the waters of the city of Anadyr.

Our observations showed part of the beluga population enters the Bay, goes around Geka Cape and stays around Geka Beach and Gniloi Ugol ("Rotten Point") during the entire summer, while other groups go deep into the Bay, swimming in the channel. The latter often linger for a short time in the numerous coves and openings in the above-mentioned capes and spits, and then head directly for the estuary of the Anadyr River, and move up the Anadyr River (belugas have been spotted 275 km upriver), the Velikaya River (over 100 km upriver), and the Kanchalan River (over 45 km upriver).

In 2000, the first belugas were recorded on the third day after the ice opened in the Bay. After June 19, a significant increase in the number of belugas coming to this area was noted, reaching its peak between June 20 and 26. The highest concentration of belugas for the entire period was obtained on June 22. The increasing numbers of belugas by Geka Beach is explained by a massive run of saffron cod (navaga). In the Anadyr region, this is very probably linked to the spawning migrations of whitefish and Arctic char. Some smaller peaks were observed on July 3-4, July 11, July 17, and July 20-21.

Between July 21 and August 4, a second peak was observed (the maximum on August 3). Then we observed a constant and lengthy decline in numbers, which lasted until August 25. This period coincided for the most part with the salmon runs.

A short-lived increase in numbers was recorded during the second week of September. This can be the result of the fall spawning salmon runs. Further in the fall, insignificant

increases in numbers were observed, the peaks occurring on September 17-18, September 20-22, and October 8. Between peaks, the number of belugas varied between a few to a few dozen individuals per day, and this lasted until the slush ice started forming. Our last observations of belugas in the Bay were made on October 26, 2000, the latest observation on record having been on November 11, 1995.

The experts estimate the number of belugas in Anadyr Bay during the spring-summer-fall season in 1986 at 3,000 individuals. By comparing the counts obtained by G.A. Pikharev and G.P. Smirnov respectively with our own, extrapolation shows a significant reduction in the numbers of the local beluga herd in Anadyr Bay.

The research done on the Anadyr Bay belugas is fragmentary. Scientific research needs to be done in the following areas: coastal counting, aerial surveys, radio tagging (the technology is available in Anadyr), and hydroacoustic research. Particular attention should be paid to the study of the sex, age, measurement, and weight of Anadyr Bay belugas, and also to the morphological characteristics of the body and the internal organs and bone structures when Native hunting takes place in the Bay.

L.F. Lowry

Alaska Beluga Whale Committee surveys of beluga whales

Aerial surveys of beluga whales were flown in Bristol Bay in June-July 1993 and 1994. Thirteen surveys were flown, of which nine completely covered the survey area in good sighting conditions. Whales occurred principally in Kvichak and Nushagak bays. The number of whales counted on good surveys ranged from 269 to 443 in 1993 and 265 to 503 in 1994. The mean counts for the two survey years were virtually identical (359 versus 357). For the two years of surveys combined the overall mean count was 358 (s.d.=82.2, n=9). An estimate of the actual abundance of the Bristol Bay stock based on the overall mean count and partly corrected for animals that were likely to have been missed during the survey is 1,107. This estimate is likely to be somewhat conservative. A comparison with data collected from a similar survey in 1983 suggests that the number of whales in this area has been stable (Frost and Lowry 1999).

The first systematic aerial surveys of beluga whales in the Norton Sound/Yukon Delta region were flown during May, June, and September 1992, and June 1993-1995. During the May 1992 surveys, all of the survey area was covered with pack ice and only a few belugas were seen. In June 1992-1994, many whales were seen in the region of Pastol Bay and the Yukon River Delta, with a few animals seen in eastern Norton Sound. In June 1995 whales were seen off the Yukon River as well as throughout central Norton Sound. In September 1992, whales were more dispersed and occurred both off the Yukon Delta and in coastal waters of northern Norton Sound. Beluga density estimates were calculated for June 1992 surveys using strip transect methods, and for June 1993-1995 using line transect methods. In 1995, fog precluded surveying the entire area during a single series of surveys so separate estimates were made for early and late June. Density estimates varied from 0.074 to 0.619

belugas/km^2. Correction factors were applied to account for animals that were missed during the surveys. For the present, the best estimate of abundance for the eastern Bering Sea beluga stock is 17,675 (95% confidence interval 9,056-34,515) based on counts made in early June 1995. This estimate is likely to be conservative. There are no previous abundance estimates that can be used to evaluate population trend (Lowry et al. 1999a).

In 1996-1998, aerial surveys of beluga whales were flown in the eastern Chukchi Sea. Surveys were flown on 10 days in 1996, 4 days in 1997, and 9 days in 1998. In 1996 belugas were seen on most surveys with a peak count of 1,035 on 30 June. In 1997, belugas were seen only on one day with a peak count of 130 on 7 July. In 1998 the peak count was 1,172 on 6 July. During 1996 and 1998 peak counts, belugas were seen both nearshore and offshore in sea ice. When the 1998 count was made, four of five whales that had been equipped with satellite tags near Point Lay were more than 200 km to the northeast of the main concentration, far from the area covered by the surveys. Counts from 1996-1998 surveys should not be used for estimating population abundance because of the unknown fraction of animals in the ice that were not counted, and a lack of suitable correction factors. At the present time, the best estimate of population size for the eastern Chukchi Sea beluga stock is 3,710, derived from counts made in 1990. Counts of whales in the Kasegaluk Lagoon area made during 1978-1998 show no evidence of changes in abundance (Lowry et al. 1999b).

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V.V. Melnikov

Beluga distribution and migration in the Chukchi Sea and the northern part of the Bering Sea

Between 1990 and 2000, observations have been conducted on the seasonal migrations of marine mammals from the highest capes of the Chukotka Peninsula. Between 1992 and 1996, and in 1999-2000, this work was done under an agreement between the Department of Wildlife Management of the North Slope Borough in Alaska and the Naukan Cooperative of the Chukotka Autonomous District of Russia and the Yupik Association

of Chukotka. The results of this work give information regarding the distribution and the seasonal migration of the beluga whales in the waters of the Chukotka Peninsula.

This work showed that during the winter, the belugas stay in coastal waters, in polynyas by the ice edge, and in the openings formed under the action of dominant northerly winds on the leeward side of the Chukotka Peninsula coastline.

In April, belugas were seen in the polynyas by the shorefast ice and in ice fissures near the entire eastern and southern coasts of the Chukotka Peninsula. As they exit the Gulf of Anadyr, the belugas start to show a constant tendency to follow a northward movement towards the direction of the spring migration. In the Cape Dezhnev area in the Bering Strait, during this month, while the number of belugas grows noticeably compared with the month of March, a definite movement to the north cannot be asserted. It is only in May, in the Bering Strait region, that we definitely noticed a constant northward movement among the belugas.

Therefore, the spring migration of the belugas in the waters of the Chukotka Peninsula starts in April in the Gulf of Anadyr. It expands in May by the eastern shores of the Chukotka Peninsula, and usually ends by mid-June around the area of Cape Dezhnev. The migration path of the belugas from the Gulf of Anadyr and further towards the Bering Strait shows that the belugas wintering in the northern part of the Gulf of Anadyr belong most probably to the animals whose feeding areas are located in the Arctic Basin seas.

Those observations show an almost complete absence of belugas in the Chukotka Peninsula waters in both the Bering Sea and the Chukchi Sea during the summer. This indicates that the feeding area of the belugas in the winter in this area is linked in the summer with the Beaufort Sea, and possibly with openings in the ice pack and polynyas in the northern part of the Chukchi and East Siberian Seas.

In the fall, the migrating belugas travel in the Chukchi Sea from the ice edge mostly towards the eastern part of the peninsula's northern coast and further down towards the Bering Strait. In the years with limited ice formation, the belugas follow along the coastline in the area from Netten Cape and Cape Serdse-Kamen to the Bering Strait, and further into the Bering Sea. In years when the ice forms early, the migration corridor along the northern coast of the Chukotka Peninsula is limited by the capes at Inchoun, Uelen, and Dezhnev. Past Cape Dezhnev, the belugas obviously split into two groups, one that travels towards St. Lawrence Island, and another that follows the Chukotkan coast towards the Gulf of Anadyr. The migration of the belugas along the Chukotka Peninsula is linked most probably to the concentration of Arctic cod that gather here before the ice forms.

S.E. Moore

Beluga distribution, movements, and habitat selection in the Beaufort Sea, Alaska

Aerial survey data from 1980-1991 for beluga whales, gray whales, and bowhead whales were analyzed to distribution, movements, and habitat selection. In spring, beluga distribution extended from the waters north of St. Lawrence Island in the Bering Sea, along nearshore leads between Point Hope and Point Barrow in the eastern Chukchi Sea, to offshore leads east of Point Barrow in the Beaufort Sea. Sighting rates in the northern Bering Sea were relatively uniform throughout April and peaked in mid-May. In the eastern Chukchi Sea, cumulative sighting rates peaked in early May. In the Beaufort Sea, cumulative rates were relatively uniform through mid-May with peaks near the end of the month. During random transect surveys in summer in the Beaufort Sea, the annual mean depth of beluga whale sightings ranged from 1,615 meters to 1,931 meters, suggesting that belugas were seen more often over the continental slope than in continental shelf habitats (Moore et al. 1993). Waters over the continental slope and the Arctic Basin typically had moderate to heavy sea ice. Bowhead and gray whales, in contrast to belugas, selected inner continental shelf habitats with light to no sea ice. Belugas depth habitat varied significantly between summer and fall, but ice cover habitat did not (Moore et al. 2000). In fall, belugas selected slope habitat without regard to ice conditions or to inflow conditions in the Bering Strait. The reasons for this habitat selection are not known (Moore 2000).

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N.I. Mymrin

The participation of Native Peoples from the Chukotka Peninsula in the monitoring of Bering Sea biological resources

Since 1991, a monitoring program to study the marine mammals in the coastal zone of the Chukotka Peninsula has been conducted by Native hunters. Their observations are made either from shore or from their boats on a daily basis all year round in 8 to 10 villages of the Chukotka Peninsula. Ludmila Ainana has served as Director of the Yupik Association all these years. Over 9 years, information has been gathered on the migrations, distribution, and numbers of some species of marine mammals by the shores of Chukotka. These include: gray whale, bowhead whale, beluga, humpback whale, orca,

minke whale, fin whale, walrus, and several types of seal. Besides population size and migration patterns, the Native observers also note the weather and ice conditions.

These marine mammal observations continue, and receive financial support from the U.S. National Park Service, the North Slope Borough, and the Federal Inspection for the Conservation of Marine Biological Resources (Magadan, Russia).

N.I. Mymrin

Contemporary distribution and migration of the beluga in the southeast coastal regions of the Chukotka Peninsula

This report is based on materials provided by the Yupik Association and the Naukan Cooperative, gathered by Natives hunters who worked as observers in five villages on the Chukotka Peninsula (Enmelen, Nunligran, Sireniki, Chaplino, Uelen) during the period 1997-1999.

Three basic behavior types were determined among the belugas by the Chukotka coastline: spring migration, when the animals travel towards the Bering Strait to the north and almost do not feed; the fall migration, in a reverse direction, when the belugas often feed; and feeding behavior.

The spring migration takes place in April-May, the fall migration in November-December. The feeding movements are most often observed in the fall and in the winter. In the summer there are practically no belugas in this area.

During the spring migration, the belugas as a rule move north in small groups of 100-300 animals. Large concentrations (1,000-2,000) are seen in the fall and the winter when they migrate south or when they are feeding.

The report gives an estimate of the number of belugas migrating by the shores of Chukotka. The number is between 3,800 and 5,500 animals (based on the 1997-1999 observations).

The number of belugas seen is correlated with the ice concentration in the Bering Sea. If the ice is minimal or absent during the period between July and September, the number of belugas near the Chukotka Peninsula is minimal. More often than not, there are no belugas at all.

G.P. Smirnov and D.I. Litovka

Seasonal distribution and migration of the beluga whales in the Gulf of Anadyr

The Far-Eastern beluga (*Delphinapterus leucas dorofeevi* Klumov et Barabash, 1935) is the most common and numerous species of cetacean in the Gulf of Anadyr. Its migration paths and seasonal distribution in this region have been insufficiently researched, and research has been based mostly on interviews with the local population and coastal observations.

The published data contains mostly registered sightings of the animals in various parts of the Gulf of Anadyr, without any analytical interpretation of the wintering grounds and the migration paths of these particular groups of beluga populations. One exception is the work of Huntington and Mymrin (1996), which contains information regarding the intensity and the direction of beluga migrations in the coastal waters of the Chukotka Peninsula. However, the work of these authors encompasses only the northeastern coast of Gulf of Anadyr and the Bering Strait area.

The materials for the present work were compiled by the authors between 1985-1988 and 1995-2000. In 1987, we conducted aerial surveys and observations of marine mammals in the Gulf of Anadyr from an IL-14 fixed-wing airplane (February-March) and a MI-8 helicopter (June). Observations were also conducted aboard ships in October 1987, October 1995, July-August 1997, and July-August 2000 in the Gulf of Anadyr, and numerous observations of belugas were also made from smaller craft in the Gulf of Anadyr and Anadyr Bay.

The analysis of our materials, taking into account the dearth of published materials, shows that in the winter (December to April), the belugas can be found anywhere in the waters of the Gulf of Anadyr. Individual animals and small groups (between 3 and 15 animals) were found in narrow openings between the compact ice in the central and northeastern part of the Gulf, while in the south and southwest, there were large groups (between 30 and 100 animals) and in some cases, even gigantic concentrations of belugas (up to a thousand or thousands of animals). It is quite interesting to note that on February 20, 1987, we saw a gigantic herd of belugas that we estimated at between 5,000 and 7,000 individuals, in 70%-90% ice cover, approximately 70 km east of Cape Navarin. Large groups of animals were found in or near this area by previous authors. It is quite possible that the majority of Bering Sea belugas winters here. The waters around Cape Navarin are well-known for their high biological productivity. In addition, strong currents and high winds ensure in this area a constant movement of the ice, which favors local movements of the belugas.

The belugas also winter in the area of the Sireniki polynya, as confirmed by our latest research, the constant observations of the Native hunters, and the published data. The available data allows us to assume that in some years, the number of belugas wintering in the region can reach several hundred individuals. This region is also characterized by its

high biological productivity and favorable hydrological conditions, represented by the presence of a permanent polynya that remains open practically all winter.

In the central and northern parts of the Gulf of Anadyr, the winter season sees the formation of compact ice masses, alternating with narrow crevices oriented most of the time along the parallels. It is possible that, because of this, this region offers less favorable conditions for the belugas to winter, although the latest data show that belugas are able to continue their activities successfully even under compact ice cover.

In April-May, large groups of belugas move from the Cape Navarin area to the north and northwest. Until Anadyr Bay opens, the whales concentrate in the region of Cross Bay and the northwest coast of the Gulf of Anadyr, from where they migrate south by the end of May or early June to the bottleneck of Anadyr Bay. Some of the animals arrive from the south, along the southwestern coast of the Gulf of Anadyr, lingering for some time by the entrances to the lagoons located to the south of the Bay. In Anadyr Bay, the belugas go through the broken ice, and on the second or third day show up by the city of Anadyr. Large groups enter the Bay almost simultaneously, from the north as well as from the south. During the summer and fall, this group of belugas dwells in the Anadyr Bay basin. Only rarely, smaller groups sometimes appear in Cross Bay and in the Tymna Lagoon area, where they obviously come for a short period of time from Anadyr Bay. A large part of the belugas leaves Anadyr Bay in the spring and moves along the northeastern coast to the Bering Strait and the Chukchi Sea.

Therefore, the Gulf of Anadyr population of belugas splits in the spring in two separate groups, one of which stays to spend the summer in Anadyr Bay, while the other migrates to the Chukchi Sea. As a result of these circumstances, it is possible to raise questions about intra-population differentation for the Anadyr beluga and the degree of winter localization of individual groups. The answers to these questions might be found through telemetric surveys of the migrations, successfully conducted by Canadian and American specialists.

Together with the telemetry, it would make sense to organize genetic monitoring (tissue sampling by biopsy or from killed animals) in Anadyr Bay and in the coastal villages in the Gulf of Anadyr. In order to pinpoint the areas of seasonal concentrations of the belugas, and determine the population size, it would be necessary once every 3 to 5 years to proceed with aerial surveys and observations from ships in the Gulf of Anadyr, and also to set up constant coastal monitoring of the beluga migration with the help of the hunters. Particular attention should be paid to summer research on the belugas in Anadyr Bay, where it is technically easier to use sophisticated research technologies (hydroacoustics, telemetry, photo identification, etc.).

Reference

Huntington, H.P., and N.I. Mymrin. 1996. *Traditional ecological knowledge of beluga whales: an indigenous knowledge pilot project in the Chukchi and northern Bering Seas*. Anchorage, Alaska: Inuit Circumpolar Conference. 88p.