THE ECOLOGY, STATUS AND STOCK IDENTITY OF BELUGA WHALES, *DELPHINAPTERUS LEUCAS*, IN YAKUTAT BAY, ALASKA

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SUMMARY

A field project was conducted in the summer of 2005 to study the little known group of beluga whales, *Delphinapterus leucas*, in Yakutat Bay, Alaska. A genetic investigation was also initiated to establish the origins, genetic composition and stock status of these whales, and a thorough review of documented sightings was undertaken. This study was conducted in association with a separate study of Traditional Ecological Knowledge (TEK) of beluga whales in the Yakutat area.

A combination of aerial, shore- and boat-based surveys sighted beluga whales on most days between 5/3/05 and 5/19/05. Most sightings were in the upper reaches of Disenchantment Bay, and the maximum number observed was 12 whales. Group size ranged from 1-12 individuals. Group composition varied from all adult groups to mixed-age groups. No newborn calves were observed. Three discrete high-use areas were identified in the intensively surveyed area of upper Disenchantment Bay. The first, a remote, protected bay located between the Hubbard and Turner Glaciers, appeared to be used primarily for rest, socialization and possibly molting. The second, the waters at the face of the Turner Glacier, appeared to be an important feeding location. The third was a narrow strip along the shore between the first two and appeared to be primarily a transit corridor. Although tide and time-of-day may have played a role in beluga whale behavior, no clear diurnal or tidal patterns were evident. Other areas may have been used beyond the observation range of this study.

An analysis of all documented sightings to date revealed that beluga whales have been observed in Yakutat Bay in all months except December and January. Most sightings were in Disenchantment Bay during spring and summer, suggesting seasonal patterns of habitat use. The regular observation of belugas in these waters in summer from 1997-2005 and the observation of a newborn calf in 2002 indicates the existence of a discrete, reproductive group of beluga whales some 1,000km distant from the nearest summering group in upper Cook Inlet.

Two tissue biopsies for genetic analysis were collected via kayak, bringing the total number of samples collected in Yakutat since 2002 to six. Genetic fingerprinting based on 8 independent microsatellite loci revealed that the samples came from at least 5 individuals. The analysis of sequence variation within 410bp of the mtDNA control region revealed that all individuals possessed the same mtDNA haplotype, one that has also been found in other areas of Alaska, including Cook Inlet. Although small sample size precluded meaningful statistical analyses of differentiation for either marker type, mtDNA haplotype #2 occurs at a much lower frequency in Cook Inlet and other stocks. The microsatellite analysis suggests that the Yakutat whales may be relatively more closely related than whales sampled in other areas. These preliminary genetic results indicate that the sampled whales are unlikely to be a random sample of the Cook Inlet population. This, taken with the sighting data and behavioral observations suggests that a small group of beluga whales may be resident in the Yakutat Bay region year-round, and that these whales are reproductive, have a unique ecology and a restricted seasonal home range.

More research on the beluga whales of Yakutat Bay is required to confirm these initial conclusions, and to address several important ecological and management-related issues. Continuing the surveys and field observations will improve estimates of abundance, group size and diurnal behaviors. Satellite telemetry must be considered if we hope to improve our understanding of habitat use and get detailed information on seasonal movements and dive behavior, including whether these whales leave Yakutat Bay, visit Cook Inlet, and have a unique foraging ecology associated with tide water glaciers. Biopsy efforts should continue in order to learn more about stock structure, genetic diversity, abundance and kinship from molecular genetic analysis. The blubber and skin from these samples should also be used in molecular studies of diet, reproduction and contaminants. A thorough review for historical and pre-historical records of beluga whales in the Yakutat region should be initiated in collaboration with continuing TEK studies, including the search for any osteological material that could be used in an 'Ancient DNA' study.

INTRODUCTION

A recent series of sightings of beluga whales in Yakutat Bay (Fig. 1), a deep glacial fiord over 600km southeast of Cook Inlet, suggests that there may be a small but well-established sub-population of beluga resident in this area. Prior to 2002, only 8 records existed of belugas in Yakutat Bay (Laidre et al., 2000). This paucity of documented sightings has been interpreted as evidence that beluga whales are not resident in Yakutat Bay but are more likely occasional visitors from Cook Inlet (Calkins, 1983; Hubbard et al. 1999; Laidre et al., 2000). Since 2002, however, a small group of beluga whales (n=5-10) has been seen each spring and fall in Disenchantment Bay at the head of Yakutat Bay (Fig.s 1 and 2). The location and behavior of this group, and its close proximity to actively calving glaciers challenges the accepted views on the ecology, distribution and stock structure of beluga whales in Alaska, and thus necessitates further investigation. A dramatic increase in the number of cruise ships visiting Disenchantment Bay in recent years also highlights the need to asses potential impacts of human activities, including noise pollution, waste-water disposal and disturbance, on what may be one of the smallest geographically distinct groups of cetaceans in North America.

Stocks of beluga whales in Alaska have been defined primarily on the basis of demographic and geographic distinctness among summering groups (O'Corry-Crowe et al., 1997; Angliss and Lodge, 2002). A small, isolated population inhabits the relatively shallow waters of Cook Inlet (N_{min}=278, NMFS unpublished data, R. Hobbs, in prep.) probably year-round, and is currently listed as depleted under the US Marine Mammal Protection Act (Angliss and Lodge, 2002). The sightings of whales in Yakutat Bay question current assessments of the range and stock structure of belugas in the Gulf of Alaska. Current understanding of the ecology of beluga whales has been shaped, in part, by their apparent universal reliance on warm, shallow nearshore habitats in summer. The Yakutat belugas, by contrast, are the only group in Alaska that is associated with cold, glacial waters in summer. As such it likely has a unique ecology, and management decisions for this group cannot be made using information from other stocks.

A pilot study of the Yakutat belugas was begun in 2002 and: (1) demonstrated the utility of video and aerial surveys to estimate group size and composition, (2) developed a method to collect skin biopsies for genetic analyses from free-swimming belugas using kayaks and air rifles, and (3) initiated a project to document local knowledge of whales in the region (O'Corry-Crowe and Kinzey, 2002; O'Corry-Crowe, 2003; W. Lucey, unpublished data). This study revealed that the whales congregated in a small area of open water between the Hubbard and Turner Glaciers, and that groups consisted of adults, juveniles, and in one instance, a newborn calf. Interviews with a number of Tribal elders revealed regular sightings of belugas in the area as far back as the 1930s. A recent TEK study has expanded on these initial interviews (E. Henniger and H. Huntington, pers. com.).

The objectives of this study are to conduct a 3-year investigation to document the status, range and stock identity of beluga whales in Yakutat Bay. Further, we intend to determine group structure, habitat use and foraging ecology, and estimate the reproductive output of these whales. The general approach will be to conduct a community-based research study where all aspects of the project will be vetted, coordinated and conducted by and in participation with the Yakutat Tlingit Tribe and the City of Yakutat. We will conduct this study in association with parallel studies of Traditional Ecological Knowledge and potential threats. This report summarizes our activities and findings from year 1.

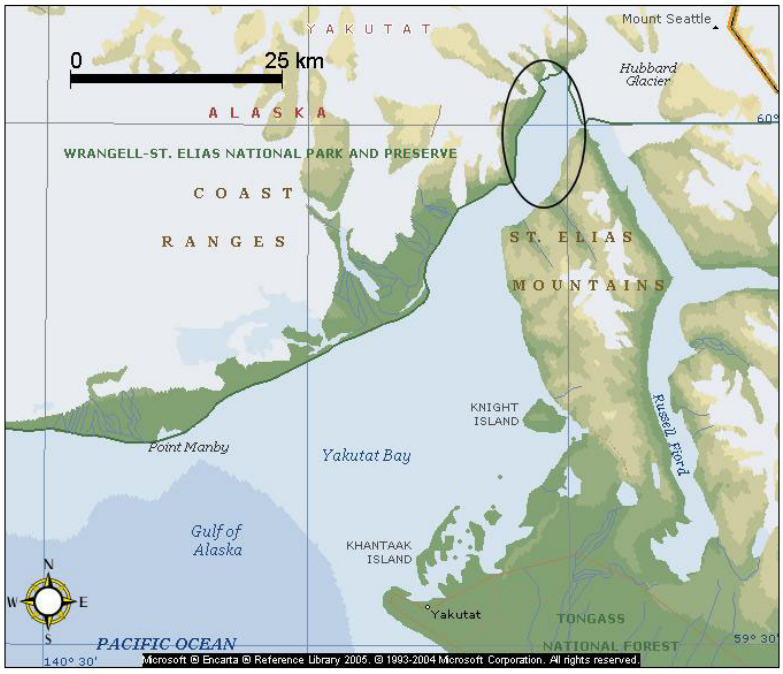

Figure 1. Yakutat Bay, Alaska. The black circle indicates the study area which encompasses the inner waters of Disenchantment Bay at the head of Yakutat Bay.

METHODS

1. FIELD PROJECT: MAY 3 TO MAY 19, 2005

1.1 Aerial Surveys

Aerial surveys for beluga whales were conducted in Yakutat and Icy Bays using a Cessna 206 (Alsek Air Service). The survey protocol was similar to that used in other studies of beluga whales (e.g., Hobbs et al., 2000, Rugh et al., 2000). The survey plane typically flew within 1 km of shore. Flights were approximately 4 hours in duration and were flown at altitudes ranging from 212 to 350 m with an average speed of 90 knots. Two to three observers as well as the pilot searched for whales. When animals were sighted, the plane circled the group and group size and composition, and the time and location of the sighting were recorded. Groups were also photographed whenever possible and (attempts at describing) general behavior patterns were made for each/most sighting. Observers also participated in a number of separate aerial surveys that were part of a detailed line-transect survey of harbor seals, *Phoca vitulina*, in Disenchantment Bay conducted by the National Marine Mammal Laboratory at the same time (J. Jansen and S. Dahle, pers comm.), and recorded any opportunistic sightings of whales.

1.2 Behavioral studies

A field camp was set up on Day 3 (5/5/05) (Fig. 2). Equipment and personnel were transported by skiff 62 km from Yakutat to the mouth of a small bay between the Hubbard and Turner glaciers. Aerial surveys identified this bay, referred to subsequently as Beluga Bay, as a likely location to observe animals. The camp was erected well above the surge line on a bluff that overlooked Beluga bay and a broad expanse of Disenchantment Bay.

Observations, photo-ID and video recording of whales were carried out from shore or less frequently from two-men inflatable kayaks. Three main observation posts (see Fig. 2) were established as follows:

1. Camp site overlook (N60°02.345'; W139°33.358') at 22 m elevation
2. Back of Beluga Bay (N60°02.656'; W139°33.672')
3. Turner Glacier (N59°59.917'; W139°36.237')

A number of other sites were used intermittently. Observation posts 1 and 2 were monitored daily by two teams of two observers which rotated after approximately 2 hours of effort. Observation post 3 was less frequently monitored as land access to it was limited by water streams and it was more accessible by kayaks.

Surveys for whales were carried out using 7X30 reticled Fuginon binoculars or the naked eye. Whenever whales traveled away from shore a 40 X spotting scope with tripod was also used. *Ad*

libitum observations were carried out intensively on the first days of observations and were continuously recorded throughout the study. Focal group sampling was applied whenever whale groups remained in sight. When beluga whales were sighted, the location, time, group size and composition, and presence of calves were recorded. Four general activity patterns: Traveling, Feeding, Resting and Socializing were recognized and documented. Traveling was defined as prolonged directional movement. Feeding was defined as milling at the surface interspersed with diving in a discrete location with little obvious interactions with con-specifics. Resting was defined as slow rolling in a non-directional pattern at the surface often in close association with con-specifics. Socializing was defined as any behavior that involved directed interactions among two or more individuals (e.g., spy hopping, tail slapping, tail waving, contact). When the whales were closer to shore, they were photographed using a Canon 20D digital camera with 300mm or 200mm zoom lens. The dorsal left side, encompassing the dorsal ridge, of the individual was photographed for a photo-ID catalogue. Video footage was also taken when possible.

1.3 Tissue Biopsy collection

Remote biopsy efforts were made from shore or from two-men inflatable kayaks at the end of daily observation effort, and most intensively on the last two days of field work to avoid disturbance during behavioral observations. A Barnett Wildcat crossbow with carbon fiber bolt with float and a 25mm aluminum biopsy tip, or an air rifle equipped with a Pneudart floating dart and biopsy tip were used on sample collection. Samples were then placed in vials containing 20% DMSO and salt, and labeled with appropriate field identification. Following completion of field work, samples were transported to the Southwest Fisheries Science Center and archived.

2. GENETIC STUDY

Total DNA was extracted from the skin biopsies using standard methods, and the hypervariable region of the mitochondrial genome was amplified and sequenced as outlined in O'Corry-Crowe et al. (1997). Both strands were sequenced and analyzed on an ABI 3100 Avant Automated Sequencer, and the data were edited and aligned with the Sequencher multiple sequence editor program. The samples were also screened for polymorphism at 8 independent microsatellite markers. The 8 loci screened were: 415/416, 417/418 and 468/469 (Schlötterer et al. 1991), EV37 and EV94 (Valsecchi and Amos, 1996), and DlrFCB3, DlrFCB5 and DlrFCB17 (Buchanan et al., 1996). Details of the molecular methods used can be provided upon request. Alleles were scored using the GeneMapper software and edited and formatted for analysis using the MSA program. Finally, gender was determined by PCR co-amplification of a section of the ZFX/ZFY gene and SRY gene according to the methods of Fain and LeMay (unpublished data) and Rosenberg and Mesnick (2001).

MtDNA diversity and population differentiation were estimated using the Arlequin 2.0 software. For microsatellite analysis, the proportion of shared alleles among individuals was calculated using SHARE-AL (G. O'Corry-Crowe, unpublished), and Hardy-Weinburg expectations were tested and population differentiation estimated in Genepop 3.1d (Raymond and Rousset, 1999).

3. REVIEW SIGHTING RECORDS.

A review of the scientific literature for sightings of beluga whales and of recent unpublished reports of belugas in Yakutat Bay was conducted and summarized.

RESULTS

1. FIELD PROJECT: MAY 3 TO MAY 19, 2005

1.1 Aerial surveys

Whales were first sighted in 2005 on March 25 by local pilot Dave Russell when 11 belugas were spotted in Beluga Bay (Table 1). A directed beluga whale survey was flown a month later (4/26/05), when at least 10 whales were identified at the same location. Four directed beluga whale surveys were flown during the May 2005 field project. Three were flown over Disenchantment Bay, two of which located beluga whales in Beluga Bay (5/3, n=10-12; 5/17, n=3-4). The fourth was a survey of Icy Bay on 5/15. No whales were sighted but locations were scouted for a potential future field camp. Beluga whales were sighted on three subsequent occasions during harbor seal aerial surveys of Disenchantment Bay between 5/24/05 and 5/31/05 (J. Jansen and S. Dahle, pers. comm.). Another 2 surveys (June, 6th, 7th; harbor seal survey plane) were flown later in the year, none of which recorded belugas.

1.2 Behavioral study results

Beluga whale observations were conducted from 05/05/05- 05/13/05 and from 05/18/05-05/19/05, adding up to 11 days of data collection. Systematic observations typically started at 9:00 and ended up at 19:00 amounting to approximately 110 hours of non continuous effort. For the first 9 days, the research team was based out of the Beluga Bay camp site (Fig. 2). The last 2 days were based out of the Esker Creek public cabin (Fig. 3) , from where an outboard engine skiff took the observers to the inner waters of Disenchantment Bay and into Beluga Bay.

Whales were sighted on all days, including the last two days of field work, when our focus switched to tissue biopsy collection. Group size ranged from 1-12 individuals. The larger groups were often dispersed into 2 or 3 smaller groups of 1-4 whales. During observations whale groups often remained close to shore (< 500 m), facilitating shore based behavioral observations. Group composition recording was quite challenging regarding the color of the animal. However, the presence of distinct grey animals was daily observed. Several whales were found to have extensive scaring on their backs and flanks. Most scars appeared to be superficial and may be due to rubbing on the stony substrate to remove dead skin. Photo-ID was challenging. The

contrast between light colored animals and dark water limited our ability to take clear images with enough detail of markings and color patterns. A number of individual whales with distinctive marking were seen on numerous days. Detailed analyses of photographs will be completed after a second year of data collection.

Habitat use and behavior

Belugas were most frequently observed in Beluga Bay which is a small, protected bay and relatively ice free. Whale groups were frequently observed in the early mornings (n = 5 sightings, off effort sighting records ranged from 5:30 am to 8:30 am) and late afternoons (n = 4, on effort sighting records ranged from 5:50 pm to 19:48 pm) and sporadically throughout the day. Group size in Beluga Bay ranged from 2 to 10 individuals and the animals were observed in typical resting and socializing behaviors, constantly interacting with each other. Furthermore, eight of the 14 sightings of belugas in Yakutat Bay from March to June that were made from cruise ships or planes were in this area. Belugas were also frequently observed at the face of Turner Glacier (n = 4, on effort sightings ranged from 12:30 pm to approximately 7:00 pm), which also appears to be a key site (Fig 2). Whales in that location were observed in smaller groups of 1 to 6 individuals and their typical behavior was characterized by long duration dives (60 sec up to 23 min). No intra-specific interactions among individuals were recorded in that location during behavioral observations. The long dives observed in this area could indicate that the whales use this area primarily for feeding. The area in between Turner Glacier and Beluga Bay was not systematically monitored, but whales were constantly seen steadily swimming SW-NW, indicating that this area could be an important traveling route between our main observation posts (Beluga Bay and Turner Glacier) (Fig 2). Whales were occasionally seen to linger at the mouth of Haenke stream, the midpoint along this corridor. A more detailed analysis of beluga behavior will be conducted after year three of the field project.

1.3 Tissue Biopsy Operations

Two new skin biopsys were successfully collected from free swimming beluga whales on May 18th, one with a crossbow the other with an air rifle. Those biopsy samples when added to the previously collected samples sum up to 6 Yakutat beluga whale tissue samples.

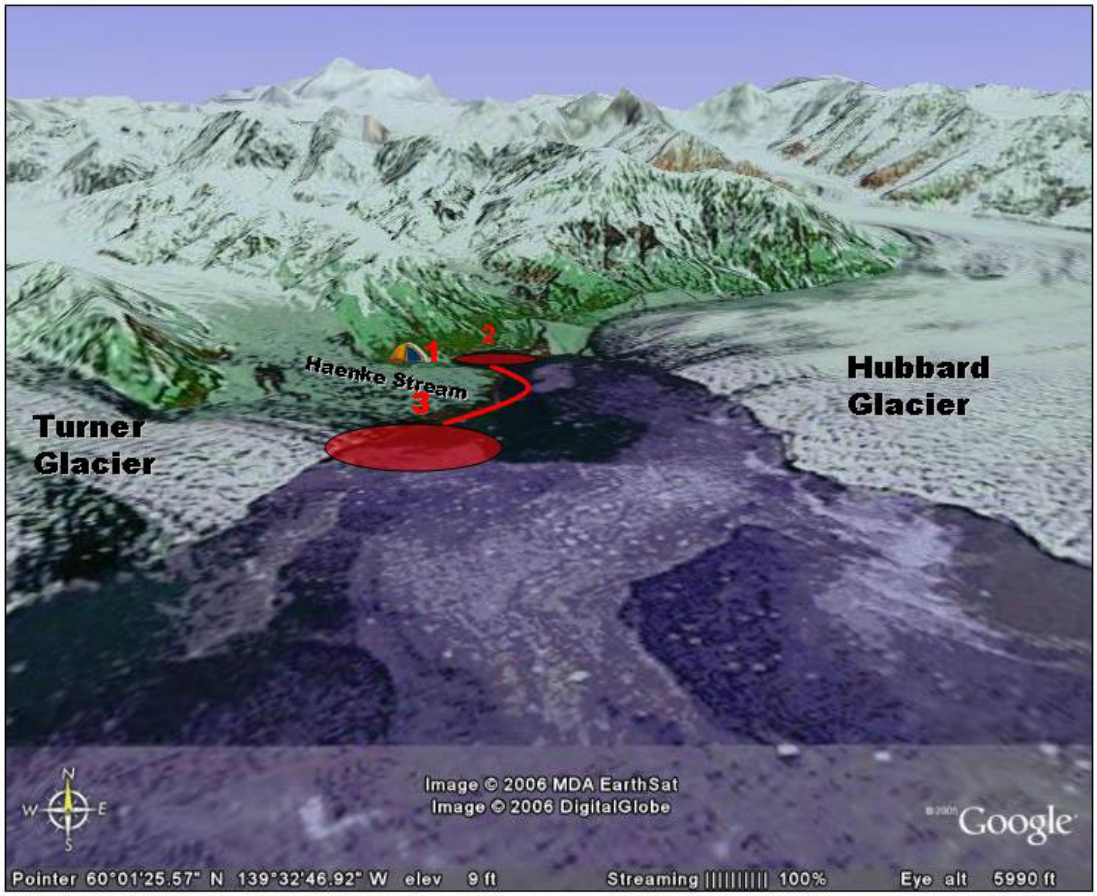

Figure 2. Yakutat Bay, Alaska. Field camp, observation posts and areas where most of beluga whale sightings occurred. The numbers 1, 2 and 3, indicate the three observation posts consistently used throughout the study to locate and observe beluga whales. The two circles indicate the areas where beluga whales were mostly observed (back of Beluga Bay to the north, and Turner Glacier). The arrow connecting the circles indicates beluga whale movements observed during the study. The camping site was settled by observation post #1.

2. GENETICS

The samples were archived (lab id numbers: 47174; 47175) and processed at the SWFSC genetic laboratory. All six samples were found to possess the same mtDNA haplotype, Haplotype # 2. Microsatellite analysis revealed that the six samples were from at least 5 individuals (Table 2). The mtDNA haplotype shared by all 5 animals has also been documented at other summering concentrations in Alaska, but at much lower frequencies. The proportion of shared microsatellite alleles among animals within Yakutat was high (mean=0.575) relative to the proportion of shared alleles between Yakutat and Cook Inlet whales (mean=0.375). Both these findings suggest that the Yakutat samples are from relatively closely related animals and are not a random sample of the Cook Inlet population. However, the small sample size from Yakutat precluded meaningful statistical analysis of population subdivision for either marker type.

3. REVIEW SIGHTING RECORDS.

A review of the scientific literature and recent unpublished reports of beluga whales sighted in Yakutat Bay revealed that beluga whales occurred in Yakutat Bay in all months except December and January (Table 1, Fig. 3). Most of the sightings were in Disenchantment Bay during the spring and summer, suggesting seasonal patterns of habitat use. A quantitative analysis of use, however, is difficult at this time as sighting effort varied greatly among seasons and years. Apart from a record of 21 or more whales sighted in Yakutat Bay in 1976, all sightings were of $\leq$ 12 individuals. Adults and calves have been reported and a calf of the year was recorded in 2002.

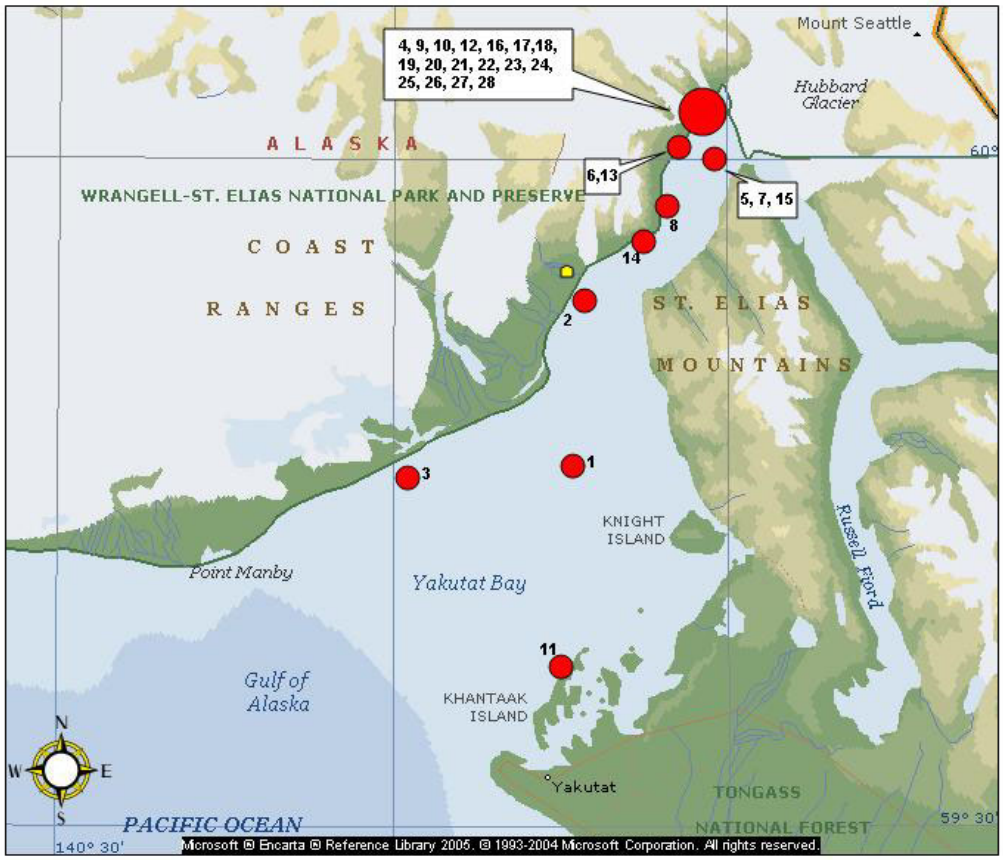

Figure 3. Beluga whale sightings in Yakutat Bay Alaska, 1976-2005. The locations of beluga sightings reported prior to 2002 are mostly as in Laidre et al. (2000). However, we made a number of corrections to the locations given in their Figure 1.The location of the Esker Creek cabin is marked in yellow.

DISCUSSION

A field project was conducted in the summer of 2005 to study the little known group of beluga whales, *Delphinapterus leucas*, in Yakutat Bay, Alaska. A genetic investigation was also initiated to establish the origins, genetic composition and stock status of these whales, and a thorough review of documented sightings was undertaken. This study was conducted in association with a separate study of Traditional Ecological Knowledge (TEK) of beluga whales in the Yakutat area.

A combination of aerial, shore- and boat-based surveys sighted beluga whales on most days between 5/3/05 and 5/19/05. The majority of sightings were in the upper reaches of Disenchantment Bay, and the maximum number observed was 12 whales. Group size ranged from 1-12 individuals, the larger groupings often dispersed into a number of smaller sub-groups. Group composition varied from all adult groups (large, white animals) to mixed-age groups (white and grey animals of various sizes). Occasionally, two or more small, grey animals were also observed together. No newborn calves were observed.

Although no quantitative analyses of range size or habitat use was conducted, three discrete high-use areas were identified in the intensively surveyed area of upper Disenchantment Bay. The first area, was a remote, protected bay located between the Hubbard and Turner Glaciers and appeared to be used primarily for rest and socialization, and possibly for molting. The second habitat was the waters at the face of the Turner Glacier. Whales were regularly seen to mill at the surface and perform dives, sometimes among floating ice bergs in this area. This area appeared to be an important feeding location. The third high-use habitat was a narrow strip along the shore between the first two. Whales were occasionally seen to linger near the mouth of a glacial stream at the midpoint of this route, although it appeared to be primarily a transit corridor. Although tide and time-of-day may have played a role in beluga whale behavior, no clear diurnal or tidal patterns were evident. Other areas may have been used beyond the observation range of this study.

An analysis of all documented sightings to date revealed that beluga whales occurred in Yakutat Bay in all months except December and January. Most of the sightings were in Disenchantment Bay during the spring and summer, suggesting seasonal patterns of habitat use. A quantitative analysis of use, however, is difficult at this time as sighting effort varied greatly among seasons and years. The consistent observation of belugas in Yakutat Bay each summer (May-June) from 2002-2005 is significant as beluga whales in Cook Inlet, the nearest location where beluga whales regularly occur, are primarily concentrated in the upper Inlet at this time, some 1, 000 km to the northwest.

Two tissue biopsies for genetic analysis were collected via kayak, bringing the total number of samples collected in Yakutat since 2002 to six. The analysis of sequence variation in 410bp of the mtDNA control region, revealed that all six samples were found to possess the same mtDNA

haplotype. This haplotype is also found in other areas of Alaska, including Cook Inlet (O'Corry-Crowe et al., 1997, 2000, unpublished). Although small sample size precluded meaningful statistical analyses of differentiation, Haplotype #2 occurs at a much lower frequency in Cook Inlet and other stocks. The samples were also analyzed for polymorphism at 8 independent microsatellite loci. Preliminary DNA fingerprint analysis indicates that the samples are from at least 5 individuals and that these individuals share, on average, a higher proportion of alleles at these loci than the average for other areas, suggesting that the Yakutat whales may be relatively more closely related. As with the mtDNA analysis, small sample size precluded meaningful analyses of population structure. These preliminary genetic results indicate that the sampled whales are unlikely to be a random sample of the Cook Inlet population. This, taken with the sighting data and behavioral observations suggests that a small group of beluga whales may be resident in the Yakutat Bay region year-round, and that these whales are reproductive, have a unique ecology and a restricted seasonal home range.

Methods assessment and future recommendations

- The camp's location facilitated behavioral observations with a high sighting success rate (whales were sighted in all days of field work). The use of Esker Creek public cabin did not seem to be a good alternative to the camp at Beluga Bay, being too far from the area most intensively used by the whales in May. This location may prove more ideal later in the year when belugas may use the shoreline between Point Manby and Bancus Point more frequently.

- Weather and general observation conditions were ideal during the whole study period, permitting data collection and a well functioning field camp. However, field camp conditions should be revisited as the weather showed to be a key factor for the success of the study. A more robust shelter, such as a portable/collapsible cabin, would be needed in difficult weather conditions.

- The observation posts worked really well as observation platforms which enabled excellent coverage of nearshore waters. Two observers per post in a two hour rotation system were necessary when whales had to be followed/photographed/ filmed. More observers might be required if a broader area needs to be systematically covered.

- Kayaks were extremely useful in accessing areas surrounded by streams such as Turner Glacier. Two-men kayaks were also the best platform for biopsy dart shooting, with one pilot and one shooter on board. Biopsy attempts from shore were not as effective.

- The success of this project was due in large part to the cooperation of several agencies, Federal, State and local, and the assistance we received from many personnel.

More research on the beluga whales of Yakutat Bay is required to confirm the initial conclusions reported here, and to address several important ecological and management-related issues.

Aerial, boat and shore-based surveys must continue to improve estimates of abundance, group size and composition, and to document diurnal and seasonal behaviors and monitor disturbance. Surveys should extend to other glacial fords along the outer coast, especially those less frequented by humans such as Icy Bay. The lack of any real survey effort in these locations to date represents a substantial gap in our knowledge of beluga whales in this region. A second year of Photo-ID is required to validate this method as a useful tool in estimating site fidelity, population size and association patterns. Satellite telemetry will ultimately be required to get detailed information on habitat use, seasonal movements and dive behavior, including whether these whales leave Yakutat Bay, visit Cook Inlet, and make deep dives in discrete locations such as the face of tide water glaciers. Biopsy efforts should continue in order to learn more about stock structure, genetic diversity, abundance (i.e., genetic marker-recapture studies) and kinship from molecular genetic analysis. The blubber and skin from these samples should also be used in molecular studies of diet, reproduction and contaminants.

Interviews with people who frequent Icy Bay would improve estimates of seasonal range and movement patterns and assist in planning future field work. A thorough search for historical and pre-historical records of beluga whales in the Yakutat region should be initiated in collaboration with continuing TEK studies, including the search for any osteological material that could be used in an 'Ancient DNA' study.

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APPENDIX 1

STUDY DESIGN AND BUDGET REQUEST, YEAR 1

A. Field camp, Disenchantment Bay

- Daily observations, coordinated with aerial surveys: – activity budgets, group size, group composition, association patterns, reactions to cruise ships and survey plane.
- Biopsy program: – genetics, fatty acid analysis and contaminants
- Photo-ID: – mark-recapture, association patterns
- Video: – behavior, group size and composition
- Set up a sighting network and hotline within the community

B. Molecular Genetic analysis, Southwest Fisheries Science Center, La Jolla

- DNA extraction, PCR, mtDNA sequence analysis, DNA fingerprinting, gender ID

Data analysis: - stock identity, kinship, genetic diversity, mark-recapture analysis of abundance

EXPECTED PRODUCTS: Annual reports, presentations of findings at scientific meetings and scientific manuscript(s)

EXPECTED COST AND TIME FRAME: The study is expected to take three years. Costs include salary for a field technician and a laboratory technician, travel, field equipment and supplies. Below is a breakdown for a single year.

Personnel	Biotech II, Biotech I, summer intern		$5,200
Travel	airfare, accommodation		$2,000
Field Camp	equipment, supplies, gas, film, etc.		$2,500
		Total	$9,700 X 3 = $29,100

Final Contribution year 1, Marine Mammal Commission $14,300

Table 1. Summary of beluga whale sightings in Yakutat and Disenchantment Bays, Alaska: 1976-2005.

	Date	Location	Group Size	Source[§]	Type[*]	Comments
1	5/31/1976	Yakutat Bay	21+5	Fiscus et al., Calkins and Pitcher	I	
2	4/20/1979	Esker Creek	6	Cox and Ranney	I	4 adults, 2 calves
3	7/15/1979	between Blizhini & Manby Pt.s	several	Mallot	I	
4	9/24/1993	Disenchantment Bay	2	Ream	I	
5	2/19/1997	Disenchantment Bay	10	Hubbard et al. (1999)	I	1 grey-white whale
6	07/1997	Disenchantment Bay	small pod	Adams Jr., B.	I	probably the same group
	08/20/97 - 08/25/97	W of Disenchantment Bay, S of Turner Glacier	1-5	Small and Lowry	I	
7	11/16/98 - 12/08/98	Disenchantment Bay	6-11	Molthen and Howard	I	
8	08/14/00 - 08/15/00	Bancus Point	4-8	Herter and Plafker	I	whales heading south
9	05/07/02 - 05/26/02	Disenchantment Bay	5	Jansen, J., Lucey, W., Adams Jr., B.	I	1 white, 2 medium white, 1 grey, 1 dark grey
10	09/19/02 - 09/20/02	Disenchantment Bay	6-7	O'Conner, P. , Lucey, W., Adams Jr., B., Sensmeier, R.	I	
11	3/24/2003	Khantaak Is. Yakutat Bay	1	Johnson, R.	I	
12	04/24/03 - 05/21/03	Beluga Bay, Disenchantment Bay	9	Russell, D., Lucey, W., Adams Jr., B., Adams Sr., B., Sensmeier, R., Moran, M., Lott, J.	I	
13	8/3/2004	Turner Glacier moraine	5 - 6	O'Conner, P., Rush, K.	I	cruise ship by Hubbard at the time. Belugas were just off shore moving to the north.
		south of Turner Glacier	9	O'Conner, P., Rush, K.	I	Later that day saw two groups from a location 0.5 miles down the shore, in early evening 100-200' off shore moving south.
	8/4/2004	south of Turner Glacier	5-7	O'Conner, P., Rush, K.	I	at same location as above, see aerial photo
14		0.25 mile NE of the Black Glacier drainage	12	O'Conner, P., Rush, K.	I	1.00pm
		0.25 mile NE of the Black Glacier drainage	4-6			in the evening
15	3/25/2005	Beluga Bay, Hubbard Glacier	11	Russell, D.	I	photos taken
16	4/26/2005	Beluga Bay, Disenchantment Bay	10 +	Endicott, N., Hartly, L.	D	dedicated beluga survey, may have been more than 10 whales took digital video. No whales sighted in any other location

[§] Sources prior to 2002 that do not have accompanying dates are unpublished sources that were originally reported in Hubbard et al. (1999) and Laidre et al. (2000).

[*] Surveys were by boat or plane. I= incidental beluga sighting; D=dedicated beluga survey.

Table 2. Continued.

17	05/03/05	Disenchantment Bay, Beluga Bay	10-12	O'Corry-Crowe, G., Bonin, C., Lucey. W.	D	7 white, 3 grey; photos taken
18	5/7/2005	Disenchantment Bay, Turner Glacier	4	Jansen, J.	I	Harbor seal survey plane
19	5/16/2005	Disenchantment Bay, Beluga Bay	3-4	Jansen, J.	I	Harbor seal survey plane
20	5/17/2005	Disenchantment Bay, Beluga Bay	4	Bonin, C., Dahle, S., Russell, D.	D	Pictures and video taken
21	5/17/2005	Disenchantment Bay, Beluga Bay	2	Jansen, J.	I	On board of the Cruise ship Harmony
22	5/22/2005	Disenchantment Bay, Beluga Bay	8	Jansen J.	I	1 dark grey and 2 light grey; Harbor seal survey plane
23	5/23/2005	Disenchantment Bay, Haenke River mouth	5-6	Henniger, E., Sensmeier, V., Dahle, S.	I	On board of the Cruise ship Infinity
24	5/24/2005	Disenchantment Bay, south of Haenke River mouth	6	Jansen, J., Dahle, S.	I	Harbor seal survey plane
25	5/26/2005	Disenchantment Bay, south of Haenke River mouth	3-4	Dahle, S., Libby	I	On board of the Cruise ship Summit
26	5/30/2005	Disenchantment Bay, Beluga Bay entrance	3	Jansen, J., Dahle, S.	I	Harbor seal survey plane
27	5/31/2005	Disenchantment Bay, south of Haenke River mouth	5-6	Jansen, J., Dahle, S.	I	Harbor seal survey plane
28	6/1/2005	Disenchantment Bay, Beluga Bay	4	Sensmeier, V., Libby	I	On board of the cruise ship Radiance of the Seas

Table 3. Summary of the six beluga whale biopsy samples collected in Yakutat Bay and two samples collected in Cook Inlet. The genetic information obtained from laboratory processing on mtDNA, microsatellite markers and gender-ID assays are presented. The genotypes for the eight microsatellite loci are presented as allele lengths in base pairs. Each allele is also given a color code. Individual #47174 matched individual #39954 for gender, mtDNA haplotype and for the 5 microsatellite loci scored for both samples.

Lab ID	Biopsy date	Location	Sex	MtDNA Haplotype	Microsatellite genotypes 415/416		417/418		468/469		EV37		EV94		D3		D5		D17	
28937	9/20/2002	Yakutat Bay	F	2	223	223	184	186	313	313	203	203	211	211	139	141	124	128	166	170
35355	9/28/2003	Yakutat Bay	M	2	225	225	184	186	313	313	203	205	211	219	141	153	124	130		
39953	5/1/2004	Yakutat Bay	F	2	223	225	184	184	313	313	203	205	211	219	153	153	130	130	166	170
39954	5/1/2004	Yakutat Bay	M	2	223	225	184	184	313	313	205	209	211	215	139	153	128	130	164	170
47174	5/18/2005	Yakutat Bay	M	2			184	184	313	313	205	209					128	130	164	170
47175	5/18/2005	Yakutat Bay	M	2	225	225	184	184	311	313	203	203	219	219	153	153	124	130	166	170
25494		Cook Inlet		1	225	225	190	192	307	313	195	203	211	211	139	141	124	124	156	156
25495		Cook Inlet		1	225	225	190	192	307	307	203	205	211	219	139	141	124	128	156	158