Marine Mammal Protection Act and

Endangered Species Act Implementation Program

1995

Annual Reports of research
carried out on the
population biology of
marine mammals by the
National Marine Mammal Laboratory
to meet the
1994 amendments to the
Marine Mammal Protection Act and
the Endangered Species Act

Submitted to the
Office of Protected Resources
National Marine Fisheries Service
1335 East-West Highway
Silver Spring, MD 20910

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center
National Marine Mammal Laboratory
7600 Sand Point Way Northeast
Seattle, WA 98115-0070

November 1996

MMPA/ESA Implementation Program
Annual Report for 1995

Reporting Center: Alaska Fisheries Science Center
National Marine Mammal Laboratory

Administrative Office: Office of Protected Resources
National Marine Fisheries Service

Page No.:

Beluga Whales:

1. Rugh, D.J., K.E.W. Shelden, R.P. Angliss, D.P. DeMaster, and B. Mahoney
Aerial surveys of beluga whales in Cook Inlet, Alaska, July 1995. 1

Gray Whales:

2. Hobbs, R.C., D. J. Rugh, J. M. Waite, J.M. Breiwick, and D.P. DeMaster
Preliminary estimate of the abundance of gray whales in the 1995/96 southbound migration. 13

3. Rugh, D.J., J.A. Lerczak, R.C. Hobbs, J.M. Waite, and J.L. Laake
Offshore distribution of gray whales migrating past a shore station in 1995 and 1996. 25

4. Shelden, K.E.W. and J.L. Laake
Aerial surveys of southbound migrating eastern Pacific gray whales. 37

5. Shelden, K.E.W., D.J. Rugh, and S.A. Boeve
Gray whale calf sightings collected by the National Marine Mammal Laboratory during southbound migrations, 1952-95. 49

Harbor Seals:

6. Withrow, D.E. and T.R. Loughlin
Abundance and distribution of harbor seals (*Phoca vitulina richardsi*) along the north side of the Alaska Peninsula and Bristol Bay during 1995. 67

7. Withrow, D.E. and T.R. Loughlin
Haulout behavior and a correction factor estimate for the proportion of harbor seals missed during molt census surveys near Cordova, Alaska. 89

Humpback Whales:

8. Mizroch, S.A. and L.S. Baraff
Assessment of photographic quality for capture-recapture estimates based on photo-identification data. 117

9. Mizroch, S.A., D. Glockner-Ferrari, D. Salden, H. Bernard, J. Mobley, and L.S. Baraff
Report of a pilot study to estimate abundance, within-season residency, and rate and direction of movement of humpback whales in Hawaiian waters, winter 1995. 131

10. Mizroch, S.A., R.C. Hobbs, D. Mattila, L.S. Baraff, and N. Higashi
A new survey protocol for capture-recapture studies in humpback whale winter grounds. 163

Other:

11. Gerber, L.R. and D.P. DeMaster
Criteria for determining Endangered Species Act status of large whales. 177

AERIAL SURVEYS OF BELUGA WHALES IN COOK INLET, ALASKA, JULY 1995

David J. Rugh, Kim E. W. Shelden, Robyn P. Angliss[1], Douglas P. DeMaster,

National Marine Mammal Laboratory
Alaska Fisheries Science Center, NMFS, NOAA
7600 Sand Point Way NE
Seattle, Washington, 98115

and Barbara Mahoney

Alaska Regional Office, NMFS, NOAA
222 W 7th Ave., Box 43
Anchorage, Alaska, 99513

Abstract

The National Marine Mammal Laboratory (NMML), in cooperation with the National Marine Fisheries Service's (NMFS) Alaska Regional Office, Alaska Beluga Whale Committee (ABWC), and Cook Inlet Marine Mammal Council (CIMMC), conducted aerial surveys of the beluga whale population in Cook Inlet, Alaska, 18-26 July 1995. This survey provided a thorough coverage of the perimeter of the inlet (1388 km) as well as 493 km of offshore transects. All historical use areas were searched one or more times, and 21% of the entire inlet was searched. The 40 hr survey was flown in a twin-engine, high-wing Aero Commander at 244 m (800 ft) altitude and 185 km/hr (100 kts). Throughout this survey, multiple independent observers searched for and counted whales on the coastal (left) side of the plane (where most sightings occur). A single observer and a computer operator/data recorder were on the right side. After finding groups of beluga whales, a series of aerial passes were made to allow at least two pairs of observers to make 4 or more counts of whales. Each pass was also videotaped and photographed for more precise counts later. Most (77%) of the sightings occurred between 0.5 and 1.5 km from the aircraft ($\bar{x}$ = 1.1 km, S.D. = 0.54) near the outer limits of the typical search area, at approximately 1.3 km. All groups of >20 whales (88% of the belugas in Cook Inlet) were seen in the upper Inlet near the mouth of the Susitna River, which is typical of their summer distribution. The sum of the median counts from each site was 338 beluga whales.

Introduction

Aerial surveys are the established method used to collect distribution and abundance data

---

[1]Current address: Office of Protected Resources, NMFS, 1335 East-West Hwy., Silver Spring, Maryland, 20910.

for beluga whales in Cook Inlet (Klinkhart, 1966; Calkins, 1984; Calkins *et al.*, 1975; Murray and Fay, 1979; Withrow *et al.*, 1994; Rugh *et al.*, 1995). A technique, referred to as the racetrack method, was introduced during the July 1993 survey to improve the consistency of effort among observers and to include replicate counts made between successive aerial passes over the same group (Withrow *et al.*, 1994).

The objectives of the aerial surveys were to: 1) make a complete search for beluga whales around the perimeter of Cook Inlet; 2) conduct systematic transects through the center of Cook Inlet; and 3) circle groups of belugas for video documentation and aerial estimations of group sizes. The aircraft was also available to support the vessel-based tagging operation by searching out beluga groups or by helping locate lost radio tags (Lerczak, 1995; Waite *et al.*, 1996). Aerial survey procedures were kept consistent with those used in previous studies (e.g., Rugh *et al.*, 1995). Although video cameras have been used in the past, in 1995 an emphasis was placed on documenting each aerial pass. In addition, a still camera with motordrive was added to the protocol to help determine the proportion of gray to white whales in view.

Summary counts from the aerial effort, in combination with correction factors established through tests such as the paired observer effort, video documentation, and surface timings based on tagged whales, will be combined in a separate manuscript to calculate the total number of beluga whales in Cook Inlet.

Methods

Survey Aircraft

The survey aircraft, an Aero Commander 680 FL (N7UP), had twin-engines, high-wings, 10-hr flying capability, and a five-passenger plus one pilot seating capacity. There were bubble windows at most observer positions, maximizing the search area. An intercom system allowed communication among the observers, data recorder, and pilot. A selective listening control device was used to aurally isolate the observer positions, and observers were visually isolated from each other enough to avoid being cued to a sighting. Positional data were determined through the aircraft's Global Positioning System (GPS) interfaced with the laptop 386 computer. Flights were conducted during daylight hours between 09:30 and 21:30 from 18-26 July 1995.

Aerial Records

General descriptions of the aerial operations (startup and shutdown times, names of participants, survey accomplishments, etc.) were kept in a master log. Other data were entered into the onboard computer, including routine updates of locations (via the aircraft GPS), percent cloud cover, sea state (Beaufort scale), glare (on the left and right), visibility (on the left and right), and each start and stop of a transect leg. Observer seating positions were recorded each time they were changed, generally every 1-2 hours to minimize fatigue.

Aerial Tracklines

Coastal surveys were conducted on a trackline 1.5 km offshore. The offshore distance was monitored with an inclinometer such that the shoreline was generally 10° below the horizon while the aircraft was at the standard altitude of 244 m (800 ft). Ground speed was approximately 185 km/hr (100 kts). The coastal surveys included searches up rivers until the

water appeared to be less than 1 m deep, based on the appearance of rapids and riffles.

Offshore transects were flown across the inlet in a sawtooth pattern designed to cross over coastal waypoints approximately 30 km apart, starting from Anchorage and zigzagging to the southern limits of Cook Inlet (between Cape Douglas and Elizabeth Island)(Fig. 1). We did not attempt to synchronize the aerial surveys with low tides because of the broad geographical range, and because tide heights throughout Cook Inlet are highly variable.

Search Technique

Observers searched forward and laterally, but not behind the wing line. The search area for observers on the shore side of the aircraft was bounded by the shoreline, 1.3 km (10°) from the trackline. On offshore transects, the search focused on a zone approximately 10° or more below the horizon (1-2 km from the aircraft) and 10° to 60° to the left (or right) of the trackline. The steepest angles observers could search were 81-86°, depending on the height of the observer relative to the window frame, but there may have been little search effort expended at angles exceeding 75° (0.07 km off the trackline). Therefore a blind zone of 0.14 km (140 m) existed along the trackline. Search effort in the typical viewing area, 10° to 60° off the trackline, 1-2 km ahead of the aircraft, would have resulted in a reduced effort within 0.4 km of the trackline, possibly lowering sighting rates in a 0.8 km wide swath directly under the aircraft.

Sighting Records

Immediately on seeing a beluga group, each observer reported the sighting to the recorder. This provided time and location of the aircraft for calculations of initial sighting distances. As the aircraft passed abeam of the whales, the observer reported the inclinometer angle, whale travel direction, and notable behaviors. With each sighting, the observer's position (left front, left rear, etc.) was also recorded. To maintain the independence of the search effort, visual barriers prevented observers from seeing each other, and headsets did not allow them to hear each other, but they could be heard by the recorder, and the recorder was able to selectively repeat their sighting information to confirm accuracy. The survey trackline was maintained until the whale group was out of sight; then the aircraft returned to the group. If one observer missed seeing a group on transect, there was no cue to the sighting until the aircraft banked on its return to the group. The pilot and data recorder did not cue observers to the presence of whales. The whale group location was established at the onset of the aerial passes by flying a criss-cross pattern over the group, recording starts and stops of sighting perimeters. The perimeter point closest to the aircraft's location at the initial sighting was used to calculate the sighting distance.

Counting Techniques

The racetrack method consisted of an oval flown around the longitudinal axis of a whale group, turning well beyond the ends of the group. Whale counts were made on each pass along the long axis of the oval. Groups were circled at least four times for each of two pairs of observers on the left; therefore, there were 8 or more separate counts per group. Counts began and ended on a cue from the left front observer, starting when the group was close enough to be counted and ending when it went behind the wing line. This provided a record of the duration of each counting effort. The observers made independent counts and individually scored their results

along with the date, time, pass number, and quality of the count. The quality of a count (graded 1 through 5) was a function of how well observers saw a group, rated 1 if no glare, whitecaps, or distance compromised the counting effort, and rated down to 5 if it was not practical to count whales on that pass. To maximize the independence of each observer's estimates, notes were not compared until after all of the aerial surveys were completed.

For large whale groups, counting techniques involved a rapid tally from left to right, mentally registering each animal as fast as possible or counting by fives or tens. Large groups were counted on a single visual pass, only looking back slightly to include new surfacings near the counting focus. This gave only a few seconds of search time on any one beluga's location. It was easier to keep track of surfacings in dispersed or small groups, allowing slightly more time to count. Generally counts consisted of the number of visible whale backs, but on occasion wakes or mud plumes ("contrails") were included in a count (and noted in comments). The effort was to maximize the accuracy of the count, not the precision.

When groups were circled, the right front observer moved to the co-pilot's (left) seat to use a video camera through an open window. The camera was set on manual focus and operated at maximum useable shutter speeds (1/1000 to 1/10,000 sec, depending on available light). Date and time were recorded directly onto the video image. For compact, small groups of whales, magnification was adjusted to keep the entire group in view throughout the pass. Dispersed groups were best documented by maintaining the camera in a set position and at a constant magnification, thus sweeping through the group as the plane passed by.

A still camera (Nikon F2), with 135 mm lens and Fuji 400 Provia film, was used in the left rearmost position. This position had an openable window that allowed the camera to be fired perpendicular to the trackline. Prior to each aerial pass over a whale group, a slate shot (photographing a sheet of paper indicating date, group, and pass number) was taken by each camera.

Following each flight, data were examined carefully for apparent errors (GPS updates, appropriate comments, etc.), and any additional information noted by observers was included. The survey trackline was mapped for quality control of the location data.

Analysis

In 1994 and 1995 video images of whale groups were studied in the laboratory, and counts of beluga whales were made to compare to the infield counts (see Waite and Hobbs, 1995). Analysis of both the aerial counts and counts from the video tapes are described in Hobbs *et al.* (1995) for 1994 data. Hobbs *et al.* (1995) and Waite *et al.* (1996) describe tagging operations used to establish corrections for whales missed during aerial counts of beluga whales.

Results

Survey Effort

A total of 39.98 hr of aerial surveys were flown in Cook Inlet 18-26 July 1995. All of these surveys (13 flights, 1.12 to 6.95 hr each) were based out of Anchorage with refueling stops in Homer and Kenai when we surveyed the lower inlet. Systematic search effort was conducted for 20.57 hr, not including time spent circling whale groups, transiting without a search effort, or periods with poor visibility. Visibility and weather conditions affected survey effort to some

degree in Turnagain Arm and in parts of the lower inlet; during a total of 2.05 hr (9% of the total effort) one or more observers considered the visibility poor.

Aerial Tracklines

The first survey, on 18 July, was a reconnaissance flight targeting river mouths of the Susitna Rivers, an area where beluga whales have been found during previous surveys. On 18, 19, and 21 July, thorough coastal surveys were flown along the perimeter of upper Cook Inlet north of East and West Forelands, including Knik Arm, Turnagain Arm, and the lower portions of the McArthur, Beluga, and the Susitna Rivers (Fig. 1). On 20 July the survey covered the east shore of Cook Inlet from Pt Possession nearly to Homer before fog banks forced the survey north on a series of cross-inlet transects. The survey then continued to areas of known concentrations of belugas in order to conduct counts. Cook Inlet was surveyed to its southern limits on 22 July, including Elizabeth Island on the east and Cape Douglas on the west, where winds made for marginal sighting conditions around some headlands. On 26 July a flight was made to the Susitna River delta to video tape whale groups while they were also being video taped from survey vessels.

The Cook Inlet aerial surveys covered 1388 km of coastal waters - virtually all waters within 3 km of shore - and 493 km of offshore waters (Fig. 1). Based on a 2.2 km (1.5 + 1.5 km less the 0.8 km blind zone beneath the aircraft) transect swath, the surveys covered 4139 sq km, which is approximately 21% of the 19,863 sq km surface area of Cook Inlet. However, these surveys covered nearly 100% of the coastal area in which beluga whales were expected.

Distance to Initial Sighting

Distances between the aircraft and a beluga group at the moment of the initial sighting ranged from 0.43 to 2.06 km in 1995, with a mean sighting distance of 1.08 km (n = 12; sd = 0.54). Most (77%) of the initial sightings occurred between 0.5 and 1.5 km from the aircraft. When combined with data from 1994, sighting distances ranged from 0.00 to 3.19 km, with an overall mean of 1.30 km (n = 28; sd = 0.68). These distances, binned in half km increments, were symmetrical around the 1.0-1.5 km bin (7%, 21%, 39%, 21%, 11%, respectively). There was no evident correlation between sighting distance and group size ($R^2 = 0.005$; $F = 0.15$, $P = 0.70$). Minimum distances between the aerial trackline and a beluga group showed that in 5 of 14 instances, the trackline went over the group, and in 2 instances the groups were more than 1 km off the trackline.

Aerial Estimates of Beluga Group Sizes

Aerial estimates of group size were reviewed for differences as a function of count quality, subjectively rated from 1 through 5. Each series of aerial passes and each observer was treated as an independent sample. Mean estimates of each quality rating were compared to all higher ratings. Accordingly, estimates for quality 5 (n = 4) were on average 74% of all higher qualities; quality 4 (n = 14) was 58% of qualities 1, 2, and 3; quality 3 (n = 72) was 72% of 1 and 2; and quality 2 (n = 19) was 81% of quality 1. Only quality 1 and 2 estimates were used in the following analysis.

Aerial counts of beluga whales are shown in Table 1, and sighting locations are shown in

Figure 2. These counts were the medians of each observers median count on multiple passes over a group. The consistency of locations of resightings between survey days, particularly the whales near the Susitna Rivers and whales in Chickaloon Bay, allowed us to combine results among survey days, assuming whales stayed near their respective areas throughout this 9-day survey period. Therefore, using the highest median count from each site, the sum of the counts was 338. This sum is not corrected for missed whales. Calculations for whales missed during these aerial counts and an estimate of abundance will be developed in a separate document (Hobbs *et al.*, 1996).

Discussion

Survey methods for the 1995 study were consistent with those used in 1994 (Rugh *et al.*, 1995). The 1994 and 1995 studies were the most thorough and intense surveys yet conducted for beluga whales in Cook Inlet. Generally, beluga whale sightings were of white backs as the whales surfaced, although often surface disturbances were included in the counts. The latter sighting cues may have been of small, dark gray whales, such as calves or yearlings, which were under represented in the aerial counts (Hobbs *et al.*, 1995). The number of beluga whales counted at the surface was inconsistent between aerial passes. This was in part due to changes in visibility, such as glare, but also due to changes in the amount of time the group was counted. Although there was not a constant number of animals in view, as might be expected if there was a random surfacing rate, we did not observe an apparent synchrony in surfacings either. Calkins (1979) described waves of three sub-groups surfacing in synchrony within a larger group such that the first group is resurfacing as the third group submerges.

Whale groups could sometimes be seen over 3 km away, but most intial sightings were at the limit of the typical search zone: 10° below the horizon or 1.3 km from the aircraft. By keeping the aerial trackline 1.3 km offshore, the survey optimized opportunities for seeing belugas. When passing river mouths, observers often looked upriver well above 10°, with a reasonable chance of seeing groups if they were large. As described by Caughley (1974), sightability is more a function of the size of the search area than it is strictly of the distance to the target, that is, the effect of image size. The proximity of the aircraft to belugas did not seem to reduce sighting opportunities as the whales showed no apparent reaction to the survey aircraft. This is consistent with observations in other years (Withrow *et al.*, 1994; Rugh *et al.*, 1995) and may be due to habituation to the dense air traffic in the area.

In none of the recent surveys (1993, 1994 and 1995) have there been sightings of belugas far from shore or beyond shallow coastal deltas. Although some sightings in Figure 2 appear to have been well out in Cook Inlet, they were usually within 1-2 km of exposed tidal flats. In every case, beluga whales were seen on the shore side of the aircraft during transects; sometimes whale groups were so large they were seen from both sides of the aircraft, but no group was entirely on the open water side of the trackline. Also, because 26% of the survey effort was on offshore transects, there is strong evidence that the beluga distribution in summer in Cook Inlet is highly stratified. When the available survey years are compared (1993-5), there is a notable consistency in site selection by beluga whales, particularly near the Susitna River Delta (from Beluga River to the Little Susitna River) and a small group of approximately 20 whales in Chickaloon Bay (Fig.

2). Other small groups (<20 whales each) were sometimes found in Knik Arm, Turnagain Arm, Kachemak Bay, Iniskin Bay, McArthur River, and Big River. The concentration near the Susitna River Delta consists of most of the beluga whales in Cook Inlet (91% of aerial counts in 1994 and 88% in 1995). Calkins (1984) also found the majority of his beluga sightings were near the Susitna, with other sightings in Redoubt Bay (n = 26) and south of Kasilof River (n = 25). This concentration near the Susitna apparently lasts from mid-May to mid-June (Calkins, 1984) or later and is very likely associated with the migration of anadromous fish, particularly eulachon (*Thaleichthys pacificus*) (Calkins, 1984; 1989). Whales seen in July 1995 were more dispersed than in June 1994, but in all of the survey seasons, beluga whales were concentrated near river mouths. The whales appeared to be more densely concentrated at low tides and became more dispersed across the shallow delta flats at high tides.

Calkins (1979:40) indicated that beluga whales were "seen throughout the year in the central and lower Inlet." Other sightings have been made even further south near Kodiak Island in March and July (Harrison and Hall, 1978; Murray and Fay, 1979), Shelikof Strait (Murray and Fay, 1979; Leatherwood *et al.*, 1983), in or near Prince William Sound (Murray and Fay, 1979; Harrison and Hall, 1978), and in Yakutat Bay (Calkins and Pitcher, 1977; Murray and Fay, 1979; R. Ream, NMFS, NMML pers. commun.), perhaps as occasional visitors from Cook Inlet (Calkins, 1989). These sightings indicate that, at least some of the time, there are beluga whales in the northern Gulf of Alaska outside of Cook Inlet. However, no sightings of belugas were made during many intensive aerial surveys around the Alaska Peninsula (Brueggeman *et al.*, 1989; Frost *et al.*, 1983; Harrison and Hall, 1978; Leatherwood *et al.*, 1983; Murie, 1959; NMFS unpubl. data) supporting the hypothesis that the Cook Inlet stock is not widely dispersed.

The sum of median counts made during the July 1995 aerial observations in Cook Inlet was 338 beluga whales. Using the same procedure of summarizing median estimates from the highest seasonal counts at each site, NMML data from earlier studies indicated index counts of 200 beluga whales in June 1991, 255 in June 1992, 344 in June 1993, 287 in July 1993, 157 in September 1993, and 279 in June 1994. Only the 1993-95 surveys provided thorough coverage of Cook Inlet, but all of these surveys included coverage of the Susitna River delta where most of the whales occur. The process of using medians instead of maximum counts reduces the effect of outliers (extremes in high or low counts) and makes the results more comparable to other surveys which lack multiple passes over whale groups. Medians or means are also more appropriate than maximums when counts will be corrected for missed whales. Not until the respective correction factors have been applied will absolute abundances or inter-year trends be calculated.

Acknowledgements

Funding for this project was provided by the Marine Mammal Assessment Program, NMFS, NOAA. Rod Hobbs was the principal investigator of the overall study of Cook Inlet beluga whales in 1995. Our pilot, Tom Blaesing of Commander N.W., Ltd., more than met the requirements of flying these surveys; his ideas, aircraft modifications, and personal investment went a long way toward making this project successful. Kuvlela Andrews, Josephine Dizon, Delice Calcote, and Ruth Cassidy, all representatives of the Cook Inlet Marine Mammal Council, joined the aerial team on one or more survey days and provided their sighting data. The ABWC

provided partial support for observers, as did the Alaska Region Office, NMFS, and the National Marine Mammal Lab, NMFS. Janice Waite and Rod Hobbs reviewed this document.

References

Brueggeman, J.J., Green, G.A., Grotefendt, R.A., Tressler, R.W. and Chapman, D.G. 1989. Marine mammal habitat use in the North Aleutian Basin, St. George Basin, and Gulf of Alaska. Chp.14 in L.E. Jarvela and L.K Thorsteinson (eds.) Proceedings of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information Update Meeting, Feb.7-8, 1989, Anchorage, Alaska. NOAA, Ocean Assessments Div., Alaska Office, Fed. Bldg, U.S. Courthouse, Rm A13, 222 W.Eighth Ave., #56, Anchorage, AK 99513-7543.

Calkins, D.G. 1979. Marine mammals of lower Cook Inlet and the potential for impact from Outer Continental Shelf oil and gas exploration, development and transport. Alaska Dept. Fish and Game. 89 pp.

Calkins, D.G. 1984. Belukha whale. Vol. IX in: Susitna hydroelectric project; final report; big game studies, Alaska Dept. Fish and Game. Doc. no. 2328.

Calkins, D.G. 1989. Status of belukha whales in Cook Inlet. Chp 15; pp 109-112 in Jarvela, L. E. and L.K. Thorsteinson (eds) Proceeding of the Gulf of Alaska, Cook Inlet, and North Aleutian Basin Information update meeting, Feb. 7-8, 1989. OCS Study, MMS 89-0041.

Calkins, D.G. and Pitcher, K.W. 1977. Unusual sightings of marine mammals in the Gulf of Alaska. Abstract, Proceedings of the Second Conf. on the Biol. of Mar. Mammals, San Diego, Calif.

Calkins, D.G., Pitcher, K.W. and Schneider, K. 1975. Distribution and abundance of marine mammals in the Gulf of Alaska. Rep. for USDC/NOAA. Alaska Dept. Fish and Game, Anchorage, AK. 67 pp.

Caughley, G. 1974. Bias in aerial survey. J. Wildl. Manage. 38(4):921-933.

Frost, K.J., Lowry, L. F. and Burns, J.J. 1983. Distribution of marine mammals in the coastal zone of the Bering Sea during summer and autumn. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 20:365-562.

Harrison, C.S. and Hall, J.D. 1978. Alaskan distribution of the beluga whale, *Delphinapterus leucas*. Canadian Field-Nat. 92(3):235-241.

Hobbs, R.C., Waite, J.M. and Rugh, D.J. 1996. Preliminary estimate of abundance of beluga whales in Cook Inlet, Alaska, from 1994 and 1995 aerial surveys and tagging studies. Unpubl. doc. submitted to Sci. Comm. Int. Whal. Commn (SC/48/SM7).

Hobbs, R.C., Waite, J.M., Rugh, D.J. and Lerczak, J.A. 1995. Abundance of beluga whales in Cook Inlet based on NOAA's June 1994 aerial survey and tagging experiments. Unpubl. doc. submitted to Sci. Comm. Int. Whal. Commn (SC/47/SM11).

Klinkhart, E.G. 1966. The beluga whale in Alaska. Alaska Dept. Fish and Game, Juneau, Fed. Aid Wildl. Restor. Proj. Rep. Vol. VII, Proj. W-6-R and W-14-R. 11pp.

Leatherwood, S., Bowles, A.E. and Reeves, R.R. 1983. Aerial surveys of marine mammals in the Southeastern Bering Sea. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 42(1986):147-490.

Lerczak, J.A. 1995. Radio-tagging of belugas in Cook Inlet, Alaska, June 1994. Unpubl. doc. submitted to Int. Whal. Commn (SC/47/SM9).

Murie, O.J. 1959. Fauna of the Aleutian Islands and Alaska Peninsula. U.S. Fish and Wildlife Serv., North Am. Fauna. No. 61.

Murray, N.K. and Fay, F.H. 1979. The white whales or belukhas, *Delphinapterus leucas*, of Cook Inlet, Alaska. Unpubl. doc. prepared for June 1979 meeting of the Sub-committee on Small Cetaceans of the Sci. Comm. of the Int. Whaling Comm. College of Env. Sci., Univ. Alaska, Fairbanks. 7pp.

Rugh, D.J., Angliss, R.P., DeMaster, D.P., and Mahoney, B.A. 1995. Aerial surveys of belugas in Cook Inlet, Alaska, June 1994. Annual Rept. to MMPA, Office of Protected Resources (F/PR) NOAA. 17pp.

Waite, J.M. and Hobbs, R.C. 1995. Group count estimates and analysis of surfacing behavior of beluga whales from aerial video in Cook Inlet, Alaska, 1994. Unpubl. doc. submitted to Int. Whal. Commn (SC/47/SM14).

Waite, J.M., Lerczak, J.A., and Hobbs, R.C. 1996. Field report for vessel operations in Cook Inlet, Alaska, July 1995. Unpubl. doc. submitted to Int. Whal. Commn (SC/48/SM9).

Withrow, D., Shelden, K. and Rugh, D. 1994. Beluga whale (*Delphinapterus leucas*) distribution and abundance in Cook Inlet, summer 1993. Annual Rept. to MMPA, Office of Protected Resources (F/PR) NOAA. 31 pp.

Table 1. Summary of counts of beluga whales made during aerial surveys of Cook Inlet in July 1995. Medians from experienced observer counts were used from aerial passes where observers considered visibility good or excellent. Dashes indicate no survey, and zeros indicate that the area was surveyed but no whales were seen. Sites are listed in a clockwise order around Cook Inlet.

	Flight dates in 1995						
Location	18 July	19 July	20 July	21 July	22 July	24 July	Counts
Turnagain Arm	0	0[a]	---	0	---	---	0
Chickaloon Bay	17	16	10	18	---	---	18
Pt. Possession	0	0	0	---	0	---	0
Kenai River	---	---	0[b]	---	0	---	0[b]
Kachemak Bay	---	---	---	---	0[a]	---	0[a]
Iniskin Bay	---	---	---	---	0	---	0
Big River	---	---	---	---	14	2	14
McArthur River	1	4	0	---	0[a]	2	4
Shirleyville	0	2	0	---	0[a]	0	2
Beluga River	0	0	0	0	0	0	0
Susitna Delta [c]	299	155	177	189	---[d]	199	299
Little Su River	---	0	0	0	0	0	0
Knik Arm	0[b]	0	---	1	---	---	1
Total							338

(a) Visibility was compromised in some places due to local winds.
(b) Possible beluga whale sighting in this area.
(c) Includes all groups seen east of Beluga River and west of Little Susitna River.
(d) Large beluga group seen but too disperse for good counts.

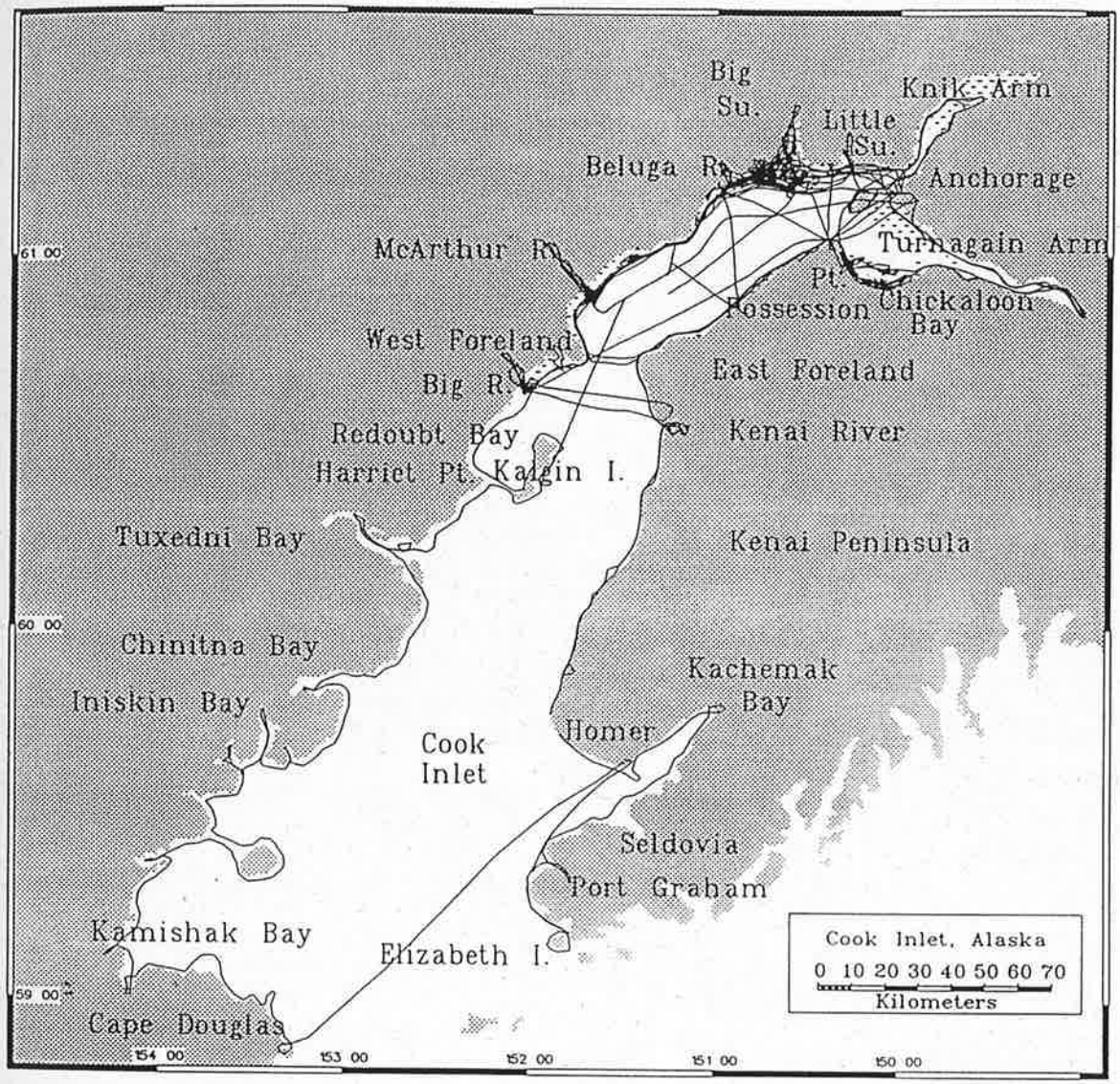

Fig. 1. Aerial survey tracklines for 18-26 July 1995 covering the coastal and offshore areas of Cook Inlet. Dashed areas indicate mud flats exposed at low tide.

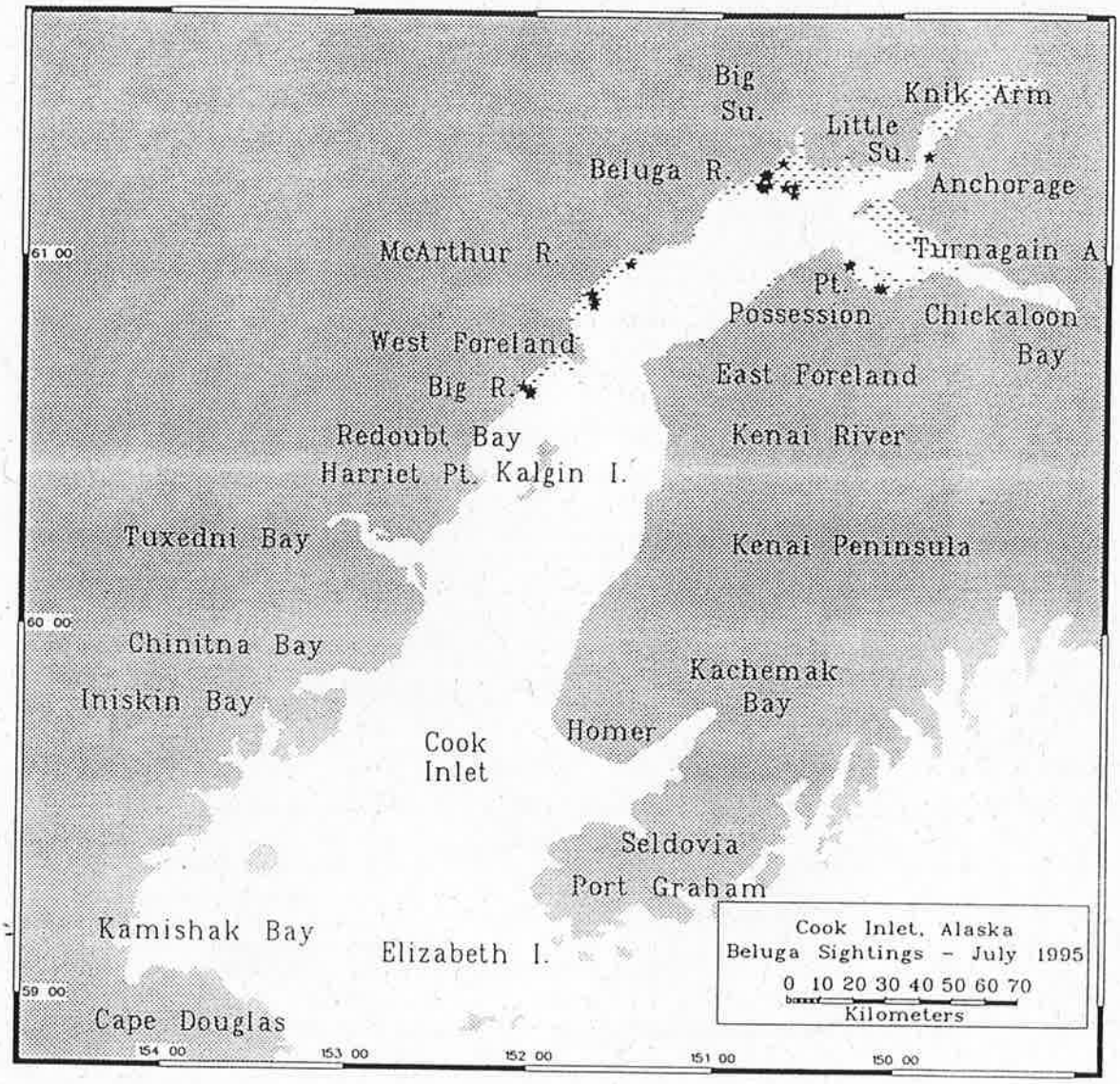

Fig. 2. Beluga whale groups seen during aerial surveys of Cook Inlet 18-26 July 1995.