Photo-identification of Beluga Whales in the Susitna River Delta, Upper Cook Inlet, Alaska

Final Report of Field Activities in 2013

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National Fish and Wildlife Foundation

ConocoPhillips Alaska, Inc.

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Photo-identification of Beluga Whales in the Susitna River Delta Upper Cook Inlet, Alaska

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EXECUTIVE SUMMARY

More information about Alaska's endangered Cook Inlet beluga whale (CIBW) population (*Delphinapterus leucas*) is needed to promote its recovery and conservation. The CIBW photo-identification catalog and associated surveys from nine field seasons (2005–2013) provide information about the distribution, movement patterns, and life-history characteristics of individually identified CIBW, including mothers with calves. This report summarizes field effort and photo-identification surveys conducted in the Susitna River Delta in 2013.

Surveys of the Susitna River Delta of Upper Cook Inlet, Alaska were conducted from a small vessel in May – August 2013 under National Marine Fisheries Service (NMFS) Marine Mammal Protection Act (MMPA)/Endangered Species Act (ESA) Scientific Research Permit # 14210. CIBW sightings and environmental conditions were recorded during the surveys, and whales were photographed with a digital camera and zoom lens. Locations of CIBW groups and survey routes were mapped and figures were prepared showing survey routes, group location, group size, and group color composition for each survey conducted in 2013. All photographs taken in 2013 were archived and are awaiting funding to be cataloged and analyzed.

Seven beluga whale groups were encountered and photographed during seven survey days in 2013. Group size in the Susitna River Delta in 2013 ranged between 12 and 200 whales per group, with a mean group size of 102.2 whales. For all 2013 Susitna River Delta surveys combined, there were slightly more white whales (50%) than gray whales (40%, excluding calves and neonates), and the average group was composed of 9% calves and 0.5% neonates. Calves were seen in all groups encountered in the Susitna River Delta in 2013. Neonates were first seen July 31 (surveys began May 27). Traveling (including suspected feeling combined with traveling) was the most frequently observed primary group activity in 2013. Diving (including suspected feeding combined with diving) was the most frequently observed secondary group activity. Dead belugas were not encountered in the Susitna River Delta by LGL biologists or others in 2013. A rope-entangled live beluga was photographed in the Susitna River Delta throughout the 2010–2013 field seasons.

The seasonal pattern of CIBWs in the Susitna River Delta during the 2013 field season was consistent with patterns found in previous years of this study. The occurrence of large beluga groups in the Susitna River Delta relative to groups found in other areas of Cook Inlet was also consistent with patterns reported by NMFS from previous aerial surveys. The mean group sighting rate in 2013 was lower than in previous years of the study (2012–2005). This relatively low daily group-sighting rate for 2013 may have been a function of larger group size, which was larger in 2013 than in previous years of the study.

Whale groups did not appear to be segregated by age-class or color, and all of the groups encountered in 2013 in the Susitna River Delta contained both white and gray whales, as well as calves. A slightly higher percentage of calves and a lower percentage of neonates were observed in 2013 compared to previous years. Our observations continue to indicate that calving for CIBWs in the Susitna River Delta begins in mid-late July/early August, with an annual variation of up to two-weeks. Timing of neonates

coincides with the timing of maximum group size. During 2007–2013, the first neonates of the season were always seen at the Susitna River Delta, and were later seen in Knik Arm and Turnagain Arm. Within the Susitna River Delta, neonates were seen in the mouths of and between the Susitna River and Little Susitna River; distinct "nursery group" areas were not seen within the Susitna River Delta.

Project results are presented in reports that are available at alaskafisheries.noaa.gov/protectedresources/whales/beluga/research.htm#ci. Project results from 2005–2012 were presented as talks and posters at the 2014 Alaska Marine Science Symposium and the 2014 NMFS CIBW Science Conference.

Fieldwork in the Susitna River Delta from 2013 was completed August 13. Photographs taken in the Susitna River Delta in 2013 are waiting for additional funding before they can be processed and entered into the catalog. A summary and synthesis of results of all photo-identification surveys of Cook Inlet conducted 2005–2013 will be presented in a comprehensive report, to be issued at a future date. Plans for 2014 include May–August photo-identification surveys of the Susitna River Delta, including cataloging of the photographs taken during these surveys.

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INTRODUCTION

Alaska's Cook Inlet beluga whale (CIBW) population (*Delphinapterus leucas*) is considered a distinct population segment (DPS) by the National Marine Fisheries Service (NMFS) due to geographic and genetic isolation. A steep decline in the CIBW population occurred in the late 1990s, and the population was designated as depleted in 2000 under the Marine Mammal Protection Act (MMPA). In 2008, NMFS listed the CIBW population as endangered under the Endangered Species Act (ESA; NMFS 2008a). As a result of the ESA listing, NMFS was required to designate critical habitat (i.e., habitat deemed necessary for the survival and recovery of the population) and to develop a Recovery Plan for CIBW. In addition, the ESA mandates that all federal agencies consult with NMFS regarding any action that is federally authorized, funded, or implemented, to ensure that action does not jeopardize the continued existence of the endangered species or result in the destruction or adverse modification of its designated critical habitat.

Many information gaps and uncertainties are associated with our current understanding of the CIBW population's lack of recovery following the cessation of an unsustainable level of hunting (NMFS 2008b). More information on annual abundance estimates of age-specific cohorts, habitat preferences, life history characteristics associated with population growth (births, calving intervals, age at sexual maturity, etc.), and sources of stress and mortality (natural and human-induced) is needed to promote recovery and conservation of the CIBW population. Data describing CIBW residency and movement patterns, habitat use by mothers and calves, and assessment of behavior will aid in the identification of movement corridors and locations of habitats for feeding, calving, and rearing of young.

Available sources of information used to understand habitat use include the distribution of beluga whales sighted from annual aerial surveys, tidal flow models, and movement data from 15 satellite-tagged individuals from 1999 to 2002 (Rugh et al. 2000, 2004, 2005, 2006; Hobbs et al. 2005, 2008, 2012; Goetz et al. 2007; NMFS 2008a; Shelden et al. 2008, 2009a&b, 2010, 2011, 2012). This information is key in characterizing and understanding habitat needs, as is information on beluga movement and residency patterns obtained from land-based observational studies of CIBWs in Upper Cook Inlet (Funk et al. 2005, Prevel-Ramos et al. 2006, Markowitz and McGuire 2007, Markowitz et al. 2007, Nemeth et al. 2007). Land- and vessel-based photo-identification surveys (McGuire and Bourdon 2012; McGuire and Kaplan 2009; McGuire et al. 2008, 2009, 2011a&b, 2013a&b, 2014) are also used to characterize distribution and movement patterns of individual beluga whales, and results of these surveys complement information from aerial surveys and tagging-tracking studies conducted by NMFS. The CIBW photo-identification study has been ongoing since 2005, and has demonstrated that a large number of beluga whales in Upper Cook Inlet possess distinct natural marks that persist across years, and that these marks can be effectively identified and re-sighted with digital photography. The photo-identification catalog and associated surveys from nine field seasons (2005–2013) provide information about the distribution, movement patterns, and life-history characteristics of individually identified beluga whales, including mothers with calves (McGuire and Bourdon 2012; McGuire and Kaplan 2009; McGuire et al. 2008, 2009, 2011a&b, 2013a&b, 2014).

METHODS

Field Surveys

Survey effort

Dedicated surveys and opportunistic sampling of the Susitna River Delta of Upper Cook Inlet, Alaska (Figures 1 and 2) were conducted from a small vessel in 2013. Survey schedules varied according to those combinations of season, location, and tide that provided the greatest likelihood of detecting whales. These combinations were derived from results from NMFS aerial surveys (Hobbs et al. 2008; Shelden et al. 2008, 2009a&b, 2010, 2011, 2012) and other studies of CIBWs (Funk et al. 2005, Markowitz et al. 2007, Markowitz and McGuire 2007, McGuire et al. 2008, Nemeth et al. 2007, Prevel-Ramos et al. 2006). General routes were followed (Figure 2), although deviations were made depending on where beluga groups were encountered. Surveys generally lasted six hours, although the duration of surveys depended on hours of daylight, tidal conditions, if whale groups were encountered, and size and behavior of whale groups. The Susitna River Delta (Figure 2) was surveyed May through August during low tide. The Port of Anchorage was included in all of these surveys because the survey vessel was always launched from the small boat ramp at this location. Additional beluga photo-identification surveys in 2013 were conducted in Knik Arm, Turnagain Arm, Chickaloon Bay, and Kenai River Delta, and those results are presented in a separate report (McGuire et al. 2014). A summary and synthesis of results of all photo-id surveys of Cook Inlet conducted from 2005 to 2013 will be presented in a comprehensive report, to be issued at a future date.

Vessel surveys

Photographs of CIBWs in the Susitna River Delta were taken from the *R/V Leucas*, a 4.9 m (16 ft) inflatable Proman 9 Zodiac® powered by a 4-stroke 50 hp Yamaha motor. The *Leucas* usually carried one skipper and one observer/photographer. Vessel position was recorded with a Garmin™ GPS (Global Positioning System) Map 76C. Survey routes were determined by tidal stage, water depth, and navigational hazards, and were designed to maximize the probability of encountering whales. Surveys were not appropriate for line-transect methodology designed to estimate abundance. A whale group was only approached once per survey and usually followed in the manner described by Würsig and Jefferson (1990): the research vessel approached slowly, parallel to the group, and matched group speed and heading in order to obtain images of lateral sides of individuals while minimizing disruption of the group. At times the boat drifted with the engine off, or was at anchor with the engine off, and whales were photographed as they passed by. Researchers noted the position of whales relative to the vessel and GPS-logged tracks were used to estimate approximate whale group positions. All vessel surveys were conducted under NMFS MMPA/ESA Scientific Research Permit # 14210.

Field data

Standardized data forms were used to record beluga whale sightings and environmental conditions. For each beluga whale group sighting, observers recorded: time of day, group size, GPS position of the vessel, magnetic compass bearing to the group, estimated distance of the vessel from the group (distance at first detection, and minimum distance to individual whales), water depth (under the vessel), group formation, direction of travel, movement patterns, average distance among individuals, and any human activities near the sighting.

For groups with multiple records on a single day, the best record was selected at the end of the survey, which was either the highest count (for groups that merged), or the count considered by both observers to be the most accurate. Group size was usually difficult to determine and counts provided estimates rather than actual number of whales in the group.

Behavioral data were collected using focal group sampling (Mann 2000). Behavior was recorded as activities (i.e., states: behavior patterns of relatively long duration, such as prolonged activities) or events (i.e., behavior patterns of relatively short duration, such as discrete body movements or vocalizations; Martin and Bateson 1993). Group activity was sampled at the beginning and end of each group encounter, and every five minutes during the encounter. Events were noted as they were observed throughout the group encounters; although it should be noted the observers were focused on photographing whales, not sampling all events. Activities were classified into primary and secondary activities. Primary activities appeared to be the dominant behavior of the group, and secondary activities occurred sporadically during primary activities. Behavioral activities were defined as follows:

Traveling – directed movement in a linear or near-linear direction, transiting through an area, usually at a relatively high speed.

Diving – movement directed downward through the water column.

Feeding Suspected – chasing or apparently chasing prey, as evidenced by bursts of speed, lunges, and/or focused diving in a particular location, or by fish jumping out of the water near belugas.

Resting – little or no movement, body of animal visible at or near the surface.

Milling – non-linear, weaving or circular movement within an area.

Socializing – interactions among whales indicated by physical contact observed at the surface, or by audible vocalizing of multiple whales.

Body color (white or gray) and relative size/age-class (calf, neonate) of whales in the group were recorded. Calves were usually dark gray, relatively small (i.e., <2/3 the total length of adult belugas), and usually swimming within one body length of an adult-sized beluga. Observers noted if any calves appeared to be neonates (i.e., newborns, estimated to be hours to days old) based on extremely small size (1.5 m [5 ft]), a wrinkled appearance due to the presence of fetal folds, and uncoordinated swimming and surfacing patterns.

Environmental data were collected hourly or when conditions changed. Environmental variables recorded included Beaufort sea state, swell height, cloud cover, visibility, wind speed and direction, air temperature, water temperature at the surface, water depth, and habitat type (e.g., mudflat, bay, mid-channel, river mouth, depositional bank, erosional bank, island, and shoal).

Digital photographs of beluga whales were collected using digital SLR camera with a zoom telephoto auto focus lens. Typical settings included shutter speed priority, dynamic auto-focus, 800 ISO, and shutter speed of 1,000 or greater. Photographs were taken in RAW (not compressed) format and stored on compact flash memory cards.

Analyses of Data from Field Surveys

Locations of beluga whale sightings and survey routes were mapped in ArcGIS™ 10.2 (http://www.esri.com) and figures were prepared showing survey routes, group location, group size, and group color composition for each survey conducted. Primary and secondary behaviors of beluga whale groups, group size and color composition, and presence of calves and neonates were compared among survey days.

Archiving of Photographs

All RAW format photographs were downloaded from the camera's compact flash memory card onto a computer hard drive and archived to DVDs to preserve the original data before any further processing. Copies of photographs were then reformatted into JPEGs (JPEG files are smaller than RAW files) for more-efficient processing. All photographs taken in 2013 were archived due to budget restrictions, and will be analyzed and cataloged at some point in the future, pending additional funding.

Database Development

We continued to work with a database specialist to consolidate all photo-identification data (2005–2013) into a single, comprehensive, and integrated database, and to aid in management of photos during the cataloging process. Data from surveys included the survey route, environmental conditions, and group size, color, and behavior. Data associated with each photograph included the "metadata", such as the original camera settings, the time the original photograph was taken, and the dates and locations when photos were taken.

RESULTS

Surveys

Survey effort and number of whales and whale groups encountered in 2013

Seven beluga whale groups were encountered and photographed during seven survey days in 2013 (Table 1). Maps of whale group sighting locations and survey routes in 2013 are presented in Appendix A. The fieldwork completed in 2013 brings the project total to 101 photo-identification surveys conducted in the Susitna River Delta over nine consecutive field seasons (Table 1), with 158 group sightings.

Group size in the Susitna River Delta in 2013 ranged between 12 and 200 whales per group (Table 2). The largest of these groups were seen on July 22 and July 31 (each with 200 whales; Table 2). A mean of one group per survey was observed in 2013, with a mean group size of 102.2 whales (Table 3).

Color composition, and age class of groups encountered during surveys in 2013

Color and age-class composition of all groups varied by survey date (Table 2). For all 2013 Susitna River Delta surveys combined, there were slightly more white whales (50%) than gray whales (40%, excluding calves and neonates), and the average group was composed of 9% calves and 0.5% neonates (Table 4).

Calves were seen in all groups encountered in the Susitna River Delta in 2013 (Table 2). Neonates were first seen July 31 (surveys began May 27), and were only seen in two of the seven groups. These groups with neonates occurred in the same locations that groups without neonates had occurred before July 31 (Figure 3 and Table 2).

Behavior of whale groups in the Susitna River Delta in 2013

Traveling (including suspected feeding combined with traveling) was the most frequently observed primary group activity in 2013 (Table 5). Diving (including suspected feeding combined with diving) was the most frequently observed secondary group activity.

Dead and entangled belugas encountered in 2013

Dead belugas were not encountered in the Susitna River Delta by LGL biologists or others (NMFS, unpublished data) in 2013. A rope-entangled live beluga that was photographed throughout the 2010–2012 field seasons (McGuire and Bourdon 2012) was also photographed in 2013 in the Susitna River Delta (Figure 4). NMFS and the Alaska Marine Mammal Stranding Network have been updated annually with sighting information and photographs of this entangled whale.

DISCUSSION

Whales Encountered During Surveys

The seasonal pattern of CIBWs in the Susitna River Delta during the 2013 field season was consistent with patterns found in previous years of this study (McGuire and Bourdon 2012; McGuire and Kaplan 2009; McGuire et al. 2008, 2009, 2011a&b, 2014) and in other studies (Moore et al. 2000; Hobbs et al. 2005; Nemeth et al. 2007; Shelden et al. 2008, 2009a&b, 2010, 2011, 2012); groups are large in mid-late May, become smaller in June through mid-July, then peak in late July through mid-August. These patterns are likely in response to patterns of seasonal migrations of anadromous fish into the Susitna River (eulachon migration in May, followed by salmon migration in late July–early August; NMFS 2008b) on which the belugas feed. Photo-identification surveys in 2013 were not conducted in the Susitna River Delta between June 3 and July 21 due to the low probability of encountering large cohesive groups to photograph. The occurrence of large beluga groups in the Susitna River Delta relative to groups found in other areas of Cook Inlet was consistent with patterns reported by NMFS from aerial surveys conducted in June and August of multiple years (Shelden et al. 2010, 2011, and 2012).

The mean group sighting rate (number of groups encountered per survey) of one group per survey day in 2013 was lower than in previous years (1.8, 1.3, 1.5, 1.3, 1.5, 2.0, 4.9, and 2.4) in 2012, 2011, 2010, 2009, 2008, 2007, 2006, and 2005, respectively. This relatively low daily group-sighting rate for 2013 may have been a function of larger group size. Mean group size during photo-identification surveys of the Susitna River Delta in 2013 was 102.2, compared to 43.5 in 2012, 53.6 in 2011, 44.2 in 2010, 38.1 in 2009, 62.9 in 2008 and 13.5 in 2007. The pattern of seeing larger and fewer groups of beluga whales was also reported by Shelden et al. (2008, 2009a) during aerial surveys in June 2009 and 2008 compared to June 2007.

Color and Age Composition of Groups

Whale groups did not appear to be segregated by age-class or color, and all of the groups encountered in 2013 in the Susitna River Delta contained both white and gray whales, as well as calves. Although not quantified, observers on the survey vessel had the impression that white whales were more likely to be detected than gray whales, as gray whales tended to blend with the turbid gray waters of Cook Inlet. This suspected bias in detection towards white whales seemed greater with distance from the observer. Behavioral differences between white and gray belugas, however, may have resulted in an opposite bias. Observers also had the impression that gray animals were more likely to approach the survey boat and to remain near the boat. Therefore, although white belugas were more likely to be detected at a distance, gray whales may have been more likely to be photographed from vessels. Environmental conditions, most notably ambient light, may also have resulted in some variability in color assigned to whales during surveys.

Calves were found in all of the groups seen in the Susitna River Delta in 2013 and composed 9% of the average group, while neonates made up less than 0.5% of the average group. Compared to previous years, this was a slightly higher percentage for calves and a lower percentage of neonates; average groups consisted 6–8% calves and 1–3% neonates 2007–2012 (neonates not distinguished from calves 2005–2006).

The timing and location of beluga whale calving in Cook Inlet is not well documented in the literature (Hobbs et al. 2008). Groups of belugas in the Canadian Arctic were found to have seasonal differences in proportions of calves, juveniles, and adults (Smith et al. 1994), which were used to determine seasonality of calving. Based on the presence of calves sighted in summer aerial surveys, Calkins (1983) speculated that calving might occur between mid-June and mid-July in the larger estuaries of western Upper Cook Inlet. Our observations continue to indicate that calving for CIBWs in the Susitna River Delta begins in mid-late July/early August, with an annual variation of up to two-weeks; neonates were first seen on July 31 in 2013, July 20 in 2012, July 27 in 2011, July 16 in 2010, August 1 in 2009, July 24 in 2008, and July 27 in 2007. The first year we sub-classified calves as neonates was 2007. The "calf" category used during field surveys 2005–2006 did not differentiate newborn calves from those now known to be one- and two-year old calves (determined photographically by sighting histories of calves of identified mothers; McGuire et al. 2008), which suggested that any peak in newborn calf numbers may not have been captured in the data recorded during these earlier field surveys. Timing of neonates coincides with the timing of maximum group size. The largest groups per year encountered during photo- identification surveys of Upper Cook Inlet 2011–2013 were recorded on July 27 in 2011, July 20 in 2012, and July 22 and July 31 in 2013, all in the Susitna River Delta.

During 2007–2013, the first neonates of the season were always seen at the Susitna River Delta, and were later seen in Knik Arm and Turnagain Arm (McGuire et al. 2014). Within the Susitna River Delta, neonates were seen in the mouths of and between the Susitna River and Little Susitna River; distinct "nursery group" areas were not seen within the Susitna River Delta.

Behavior

The distinction among behavioral categories was somewhat artificial as the terms only described behaviors seen when the whales were briefly at the surface. In reality, it is likely that whales were simultaneously feeding, diving, and traveling as they pursued and captured prey. The largest group recorded during the study (2005–2013) consisted of 205 whales seen July 20, 2012; this audibly vocal group was traveling, milling, socializing, and suspected to be feeding (whales were seen making waves against the shore and in shallow water, which may have been caused by pursuing prey at high speed in short bursts). The next-largest groups encountered during photo-identification surveys consisted of 200 beluga whales encountered in the Susitna River Delta on July 22, 2013 and again on July 31, 2013; behavior of each group was recorded as traveling and suspected to be feeding. Whales were much easier to photograph when feeding or traveling than when diving. Feeding and traveling animals remained at the surface longer, had higher surfacing profiles, and exhibited less response (attraction or

avoidance) to the survey vessel, whereas diving animals often remained submerged for long periods of time and were unpredictable in their surfacing locations and patterns.

Progress Made in 2013 and Dissemination of Project Results

Progress made in 2013 was measured in terms of the number of field surveys conducted, the number of groups of whales photographed, the number of whales identified, and improvements in survey and data processing techniques. Project results are presented in reports that are available at: alaskafisheries.noaa.gov/protectedresources/whales/beluga/research.htm#ci.

Project results from 2005–2012 were presented as talks and posters (Figure 5) at the 2014 Alaska Marine Science Symposium and the 2014 NMFS CIBW Science Conference. Communication of project results and collaboration with colleagues continue to be productive and remain project priorities. Examples of existing partnerships include: the exchange of information with NMFS about beluga locations during aerial (NMFS) and vessel (LGL) surveys during the field season; informing NMFS-AK of dead belugas (in some cases securing the carcass until NMFS is able to respond) and assisting with necropsies; informing the NMFS Office of Law Enforcement of suspected cases of beluga poaching and harassment; circulating photographs of injured or infected belugas to the Alaska Marine Mammal Stranding Network for expert opinion; exchange of whale sighting reports, photographs, and sighting history with wildlife biologists at the Joint Base Elmendorf Richardson and other researchers in Cook Inlet, and making project data available to the NMFS Alaska Region Office of Protected Resources for use in management decisions, including ESA consultations.

Project Status and Future Work

Fieldwork in the Susitna River Delta from 2013 was completed August 13. Photographs taken in the Susitna River Delta in 2013 are waiting for additional funding before they can be processed and entered into the catalog. A summary and synthesis of results of all photo-identification surveys of Cook Inlet conducted 2005–2013 will be presented in a comprehensive report, to be issued at a future date. Plans for 2014 include May–August photo-identification surveys of the Susitna River Delta, including cataloging of the photographs taken during these surveys.

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Table 1. Total photo-identification survey effort and beluga whale group encounters 2005–2013, Susitna River Delta, Upper Cook Inlet, Alaska.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	*9 -Year Total*
Number Photo-identification Survey Days	17	16	4	8	15	14	11	9	7	***101***
Number Groups Encountered	40	20	14	9	17	22	14	15	7	***158***
Range of Surveys	30 May – 21 Oct	12 May – 5 Oct	28 Jun – 27 Jul	21 May – 6 Aug	19 Jun – 6 Oct	26 May – 31 Aug	17 May – 12 Oct	23 May – 17 Aug	27 May – 13 Aug	
Season Survey Span (Months)	5	5	1	3	4	3	5	3	3	

Table 2. Group size, color, composition, and total belugas sighted during vessel surveys in the Susitna River Delta in 2013. Group numbers were assigned by day. (Neonates are separate from calf total. Unknown = beluga of unknown color and size.)

Date	Beluga Group #	# White	# Gray	# Calves	# Neonates	# Unknown	*Total Beluga Sightings*
27 May	1	25	20	5	0	0	50
02 June	1	40	30	10	0	0	80
11 July	1	65	60	18	0	0	143
22 July	1	110	80	10	0	0	200
31 July	1	95	85	17	3	0	200
05 August	1	17	8	5	1	0	31
13 August	1	5	5	2	0	0	12
Total 2013	**7**	**357**	**288**	**67**	**4**	**0**	**716**

Table 3. Photo-identification survey effort and beluga whale groups encountered in 2013 in the Susitna River Delta, Upper Cook Inlet, Alaska.

Susitna River Delta	**2013**
Number of Surveys	7
Total Number of Beluga Whale Groups	7
Total Number of Beluga Whale Sightings	716
Mean Number of Groups per Survey	1
Mean Number of Whales per Survey	102.2
Mean Number of Whales per Group	102.2

Table 4. Percent color composition of beluga whale groups sighted during surveys conducted in 2013 from vessels in the Susitna River Delta, Upper Cook Inlet, Alaska.

Date	**Survey Method**	**# Beluga Sightings**	**% White**	**% Gray**	**% Calves**	**% Neonates**	**% Unknown**
2013	vessel	716	50	40	9	0.5	0

Table 5. Summary of primary and secondary activities of beluga groups encountered in 2013 during photo-identification surveys in the Susitna River Delta, Upper Cook Inlet.

		Percent of all Group Activity Recorded per Area					
Year	**Group Activity**	**% Traveling**	**% Milling**	**% Suspected Feeding**	**% Diving**	**% Socializing**	**% Unknown**
2013	primary	80	14	6	0	0	0
	secondary	28	0	29	43	0	0

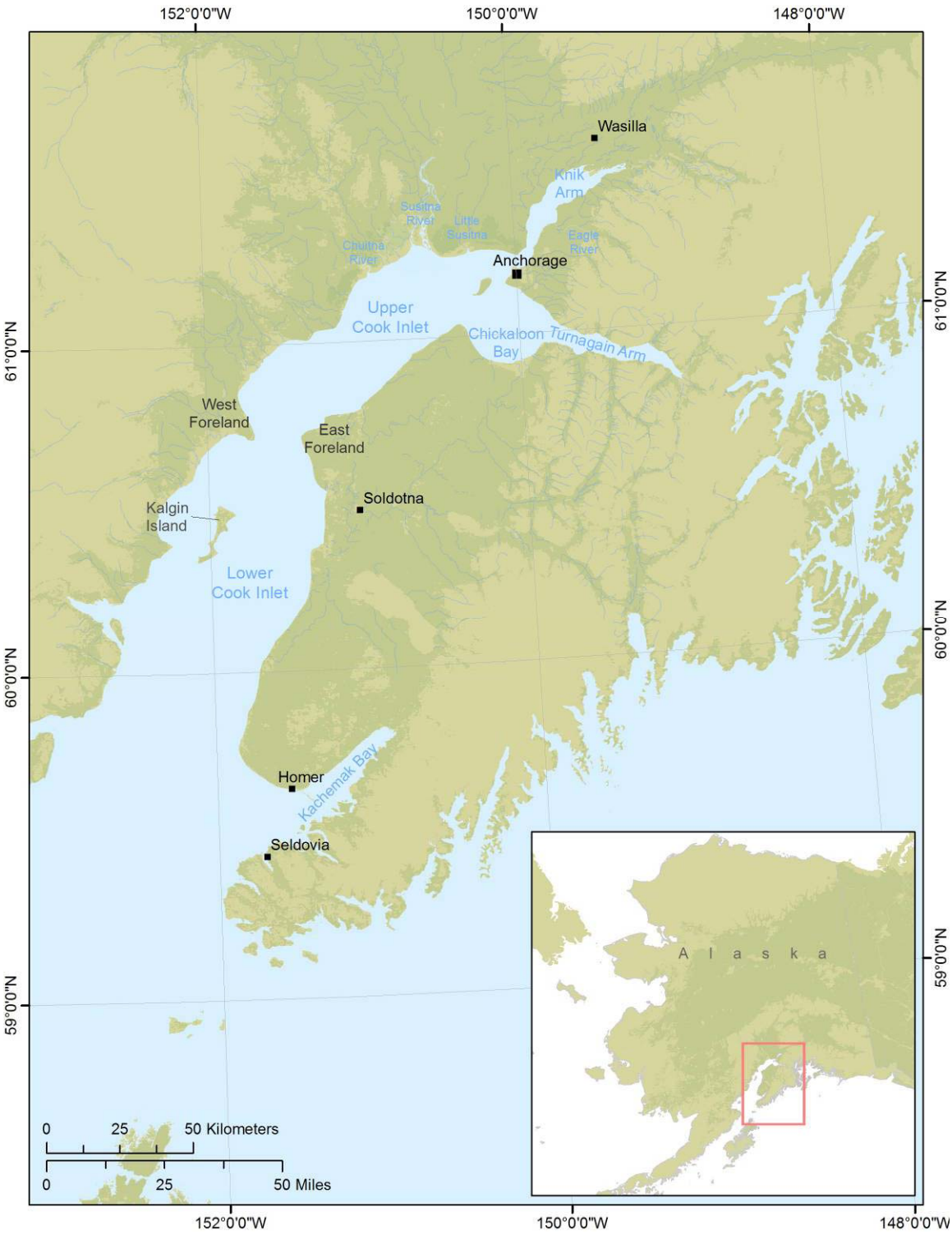

Figure 1. Map of Cook Inlet, Alaska, showing major features discussed in text.

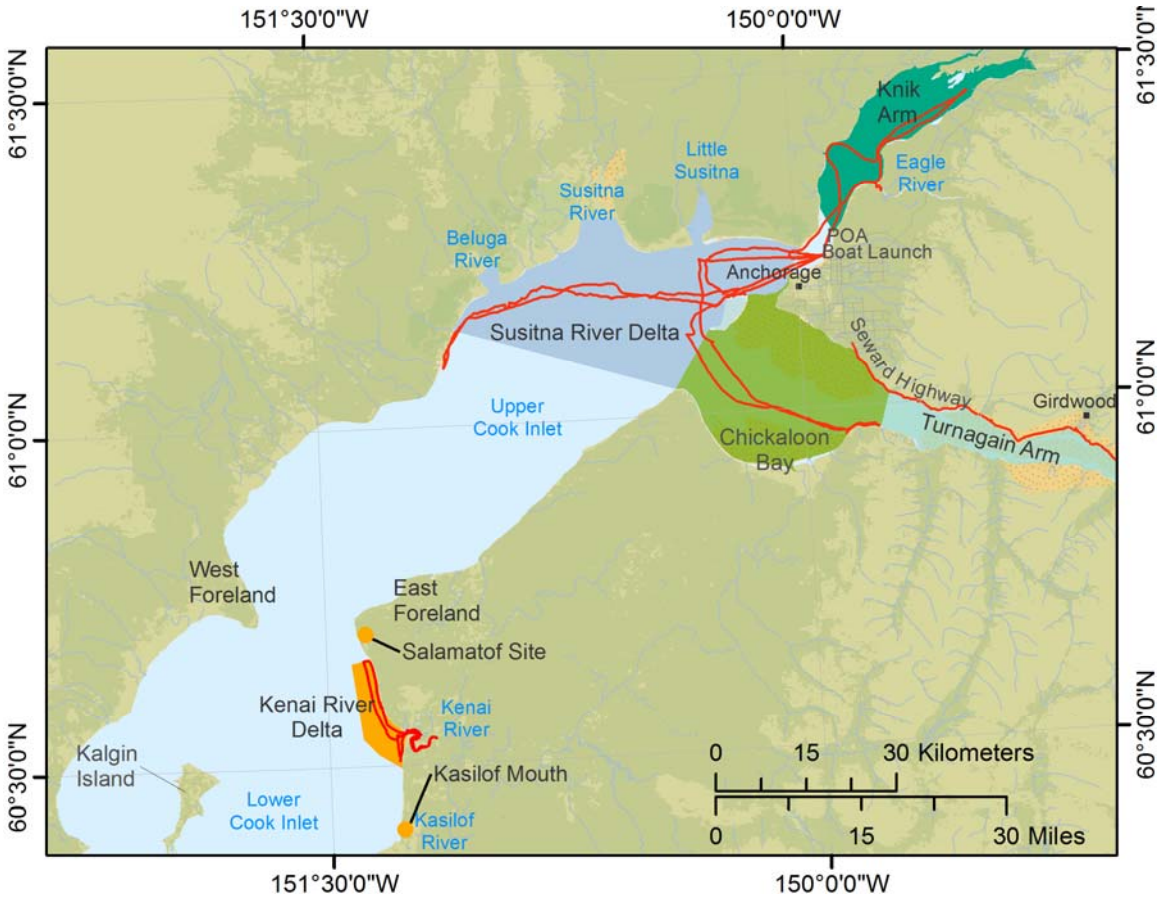

Figure 2. Map of Middle and Upper Cook Inlet, Alaska, showing boundaries of sub-areas within the study area and the general routes used 2005–2013. The Kenai River Delta study area was added in 2011. This report is limited to surveys conducted in the Susitna River Delta.

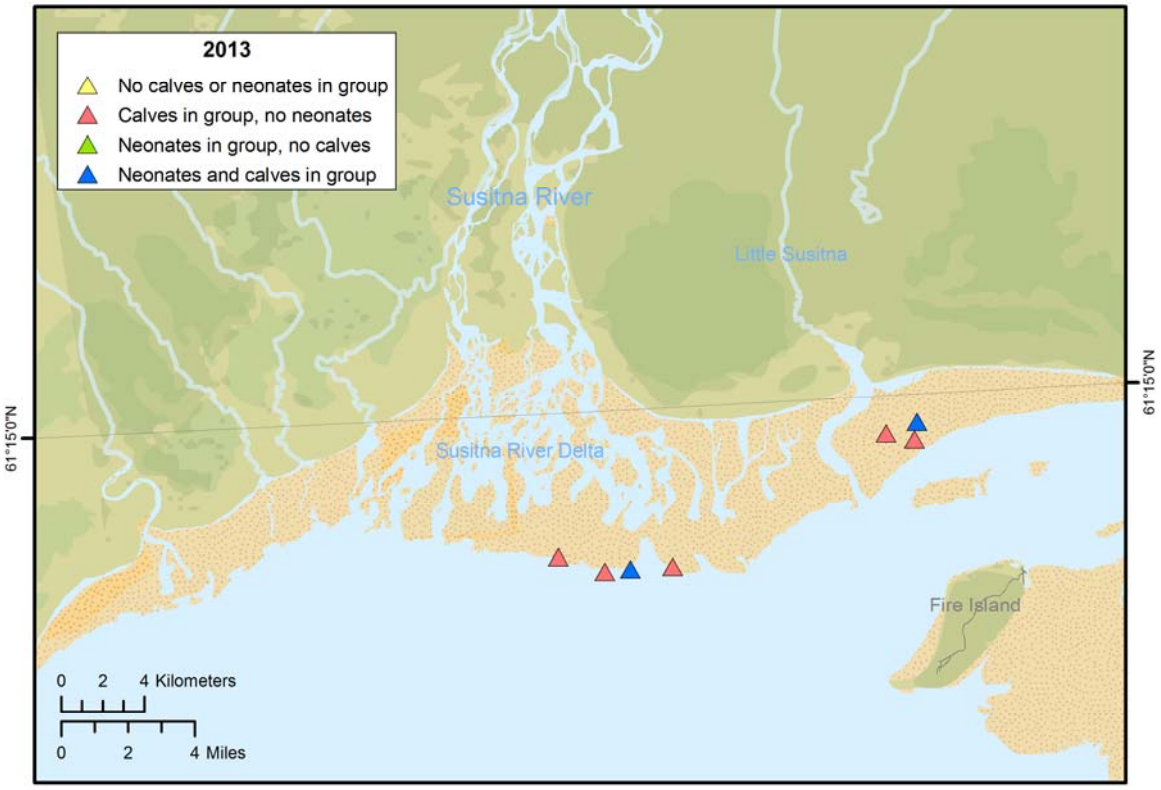

Figure 3. Location of groups with and without calves and neonates encountered during vessel-based photo-identification surveys of the Susitna River Delta, Upper Cook Inlet, Alaska in 2013.

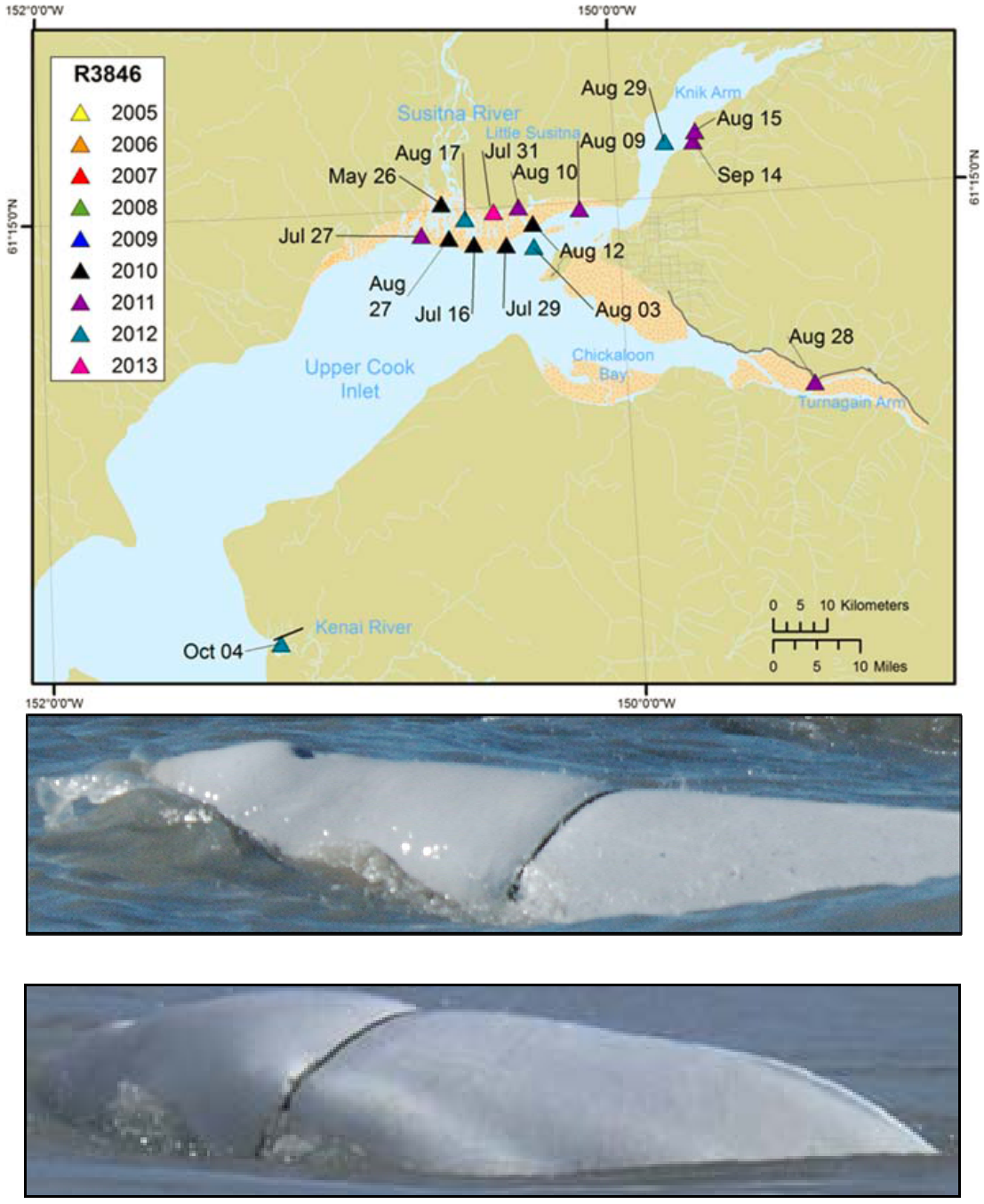

Figure 4. Sighting history and left-side photographs of an entangled beluga whale, R3846, during the 2005–2013 field seasons in Cook Inlet, Alaska. Whale color differences in the photographs are due to different ambient lighting conditions. The whale identification was confirmed by matching scars on the whale's body that are visible in the photo-processing program. This whale was not seen before 2010. The upper photograph is from July 16, 2010 and the bottom photograph is from July 31, 2013.

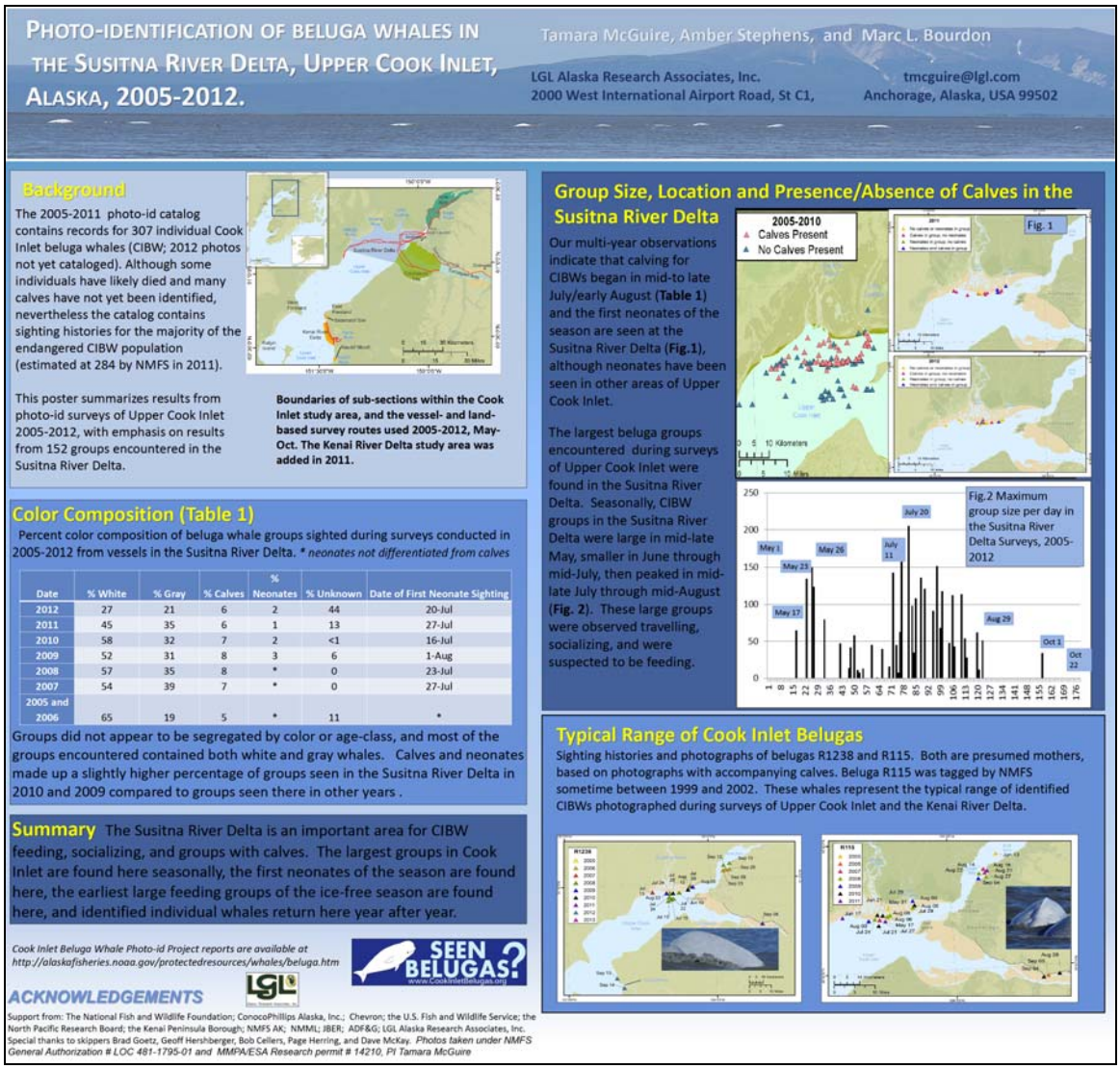

Figure 5. Project poster presented at the Alaska Marine Science Symposium and the NMFS Cook Inlet Beluga Science Conference (both in 2014 in Anchorage, Alaska).

APPENDIX A

BELUGA WHALE GROUPS ENCOUNTERED DURING VESSEL-BASED SURVEYS CONDUCTED IN THE SUSITNA RIVER DELTA, UPPER COOK INLET, ALASKA.

DAILY SURVEY TRACKS AND LOCATIONS OF WHALES,

2013 FIELD SEASON

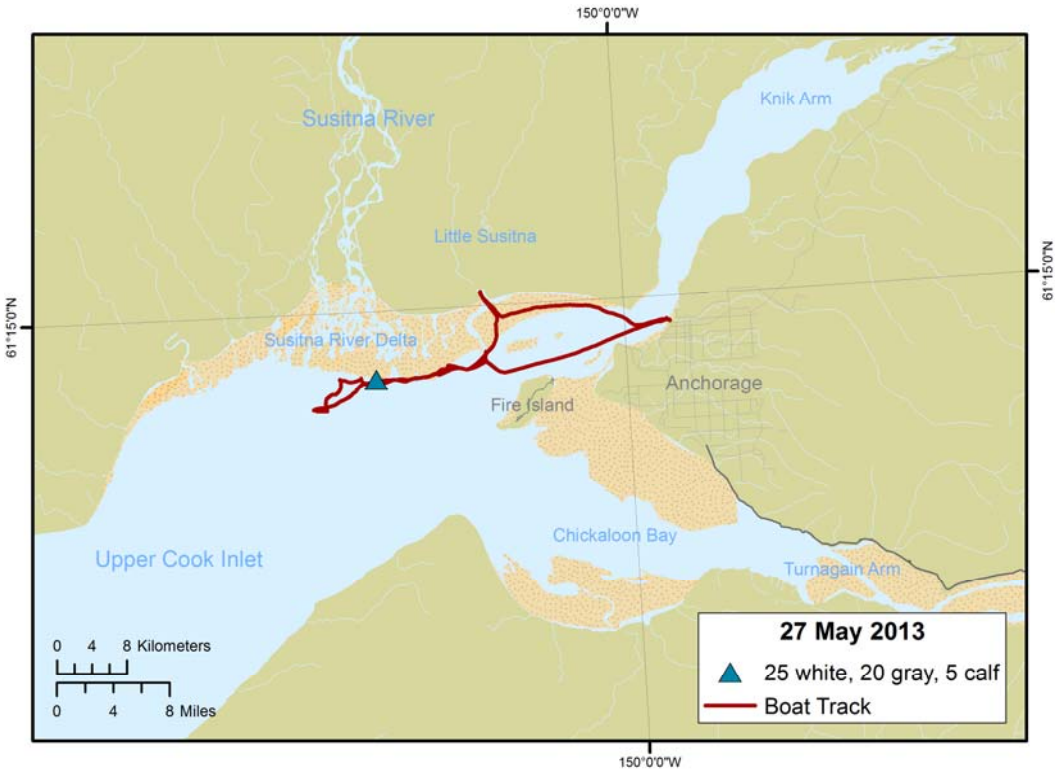

Figure A1. Route and beluga whale group(s) encountered during the vessel-based survey route of May 27, 2013 in Upper Cook Inlet, Alaska.

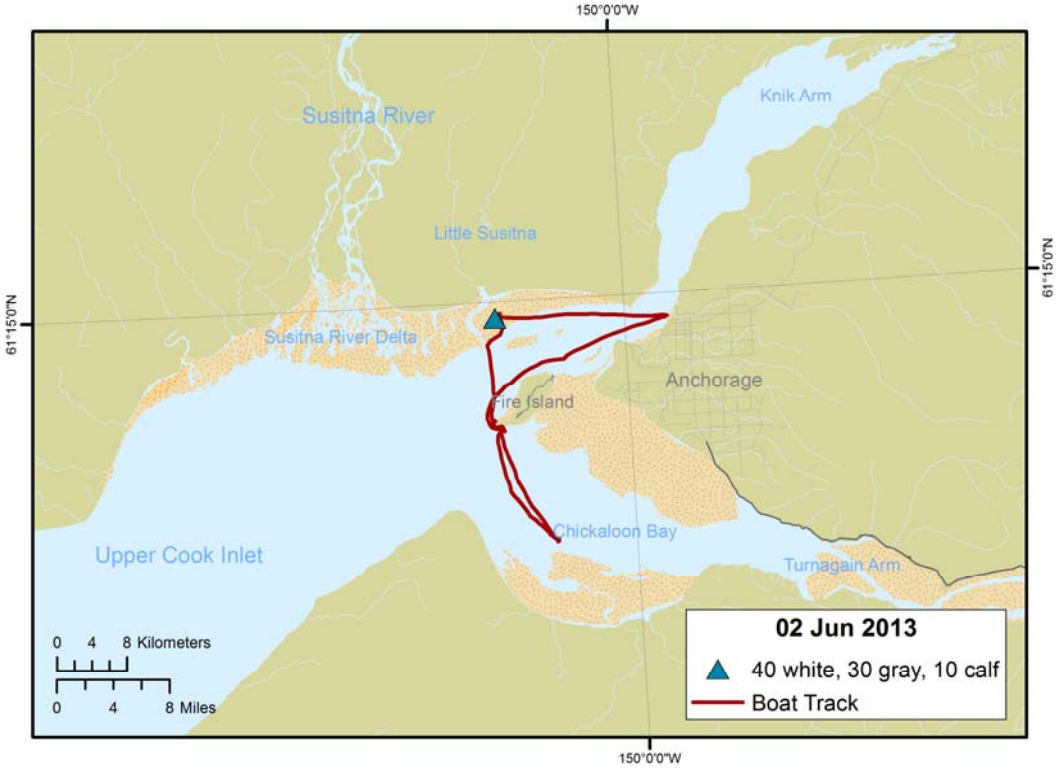

Figure A2. Route and beluga whale group(s) encountered during the vessel-based survey route of June 2, 2013 in Upper Cook Inlet, Alaska.

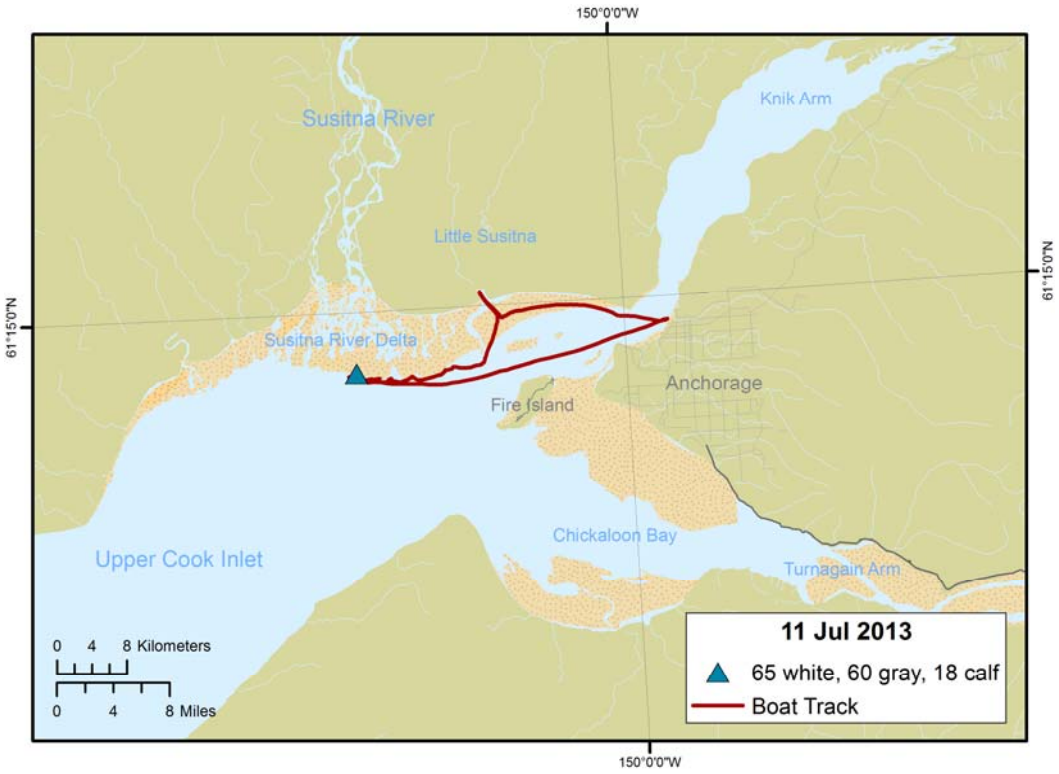

Figure A3. Route and beluga whale group(s) encountered during the vessel-based survey route of July 11, 2013 in Upper Cook Inlet, Alaska.

Figure A4. Route and beluga whale group(s) encountered during the vessel-based survey route of July 22, 2013 in Upper Cook Inlet, Alaska.

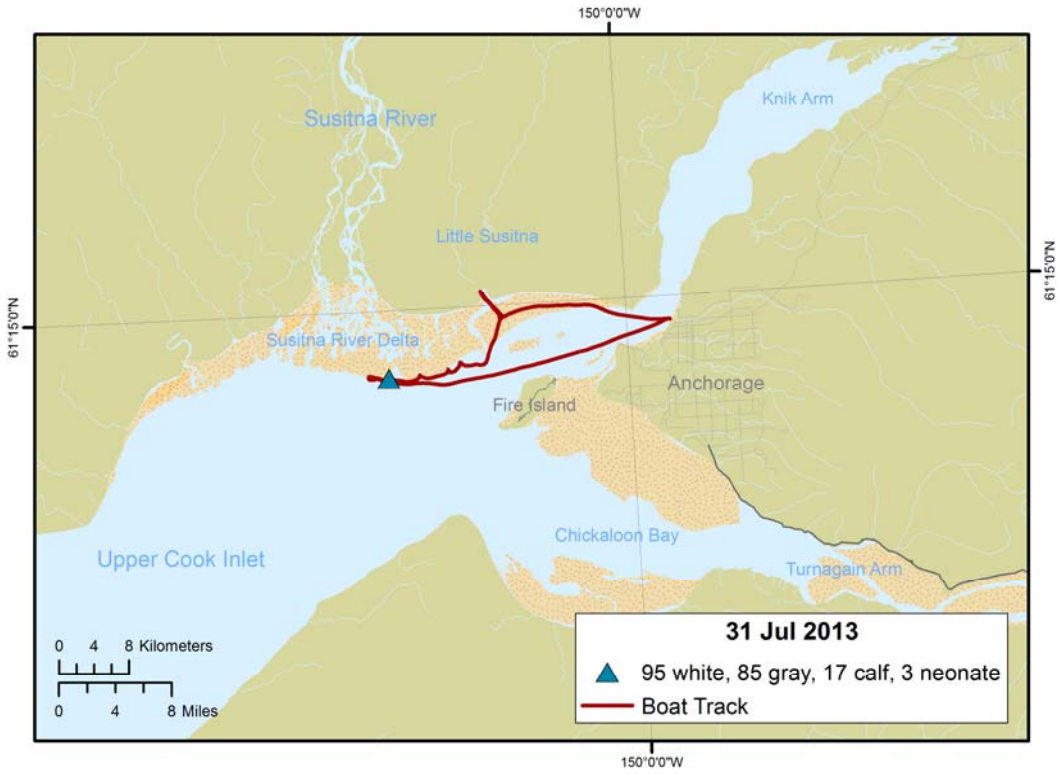

Figure A5. Route and beluga whale group(s) encountered during the vessel-based survey route of July 31, 2013 in Upper Cook Inlet, Alaska.

Figure A6. Route and beluga whale group(s) encountered during the vessel-based survey route of August 5, 2013 in Upper Cook Inlet, Alaska.

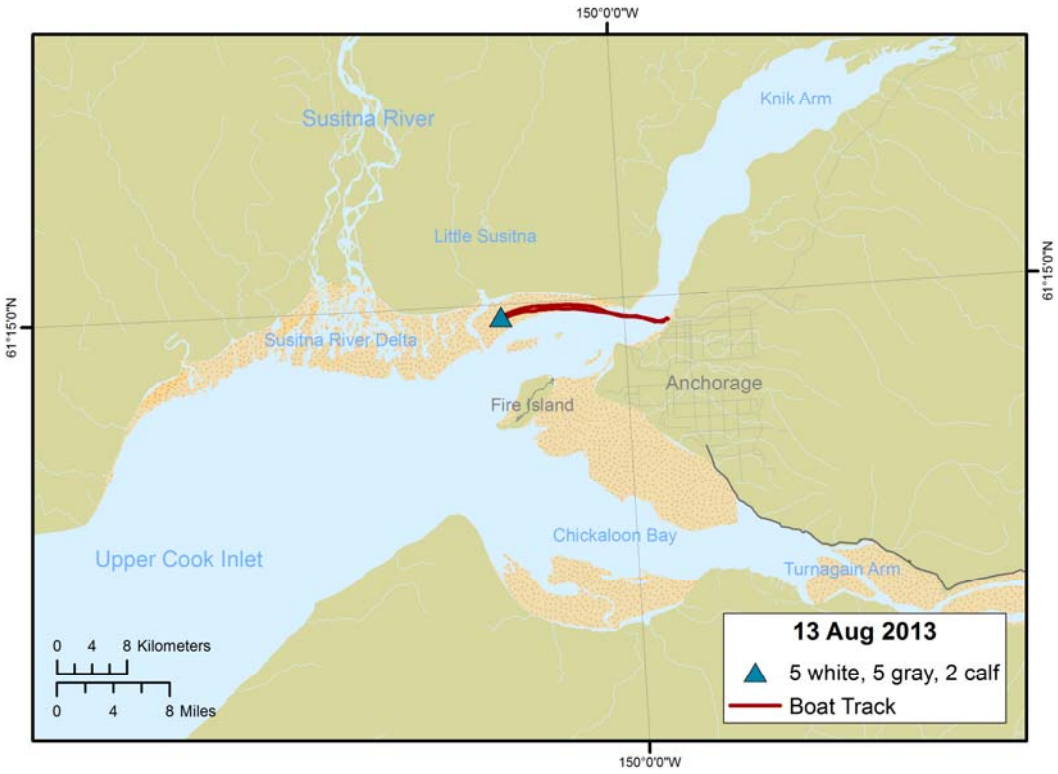

Figure A7. Route and beluga whale group(s) encountered during the vessel-based survey route of August 13, 2013 in Upper Cook Inlet, Alaska. This survey was cut short because of deteriorating weather conditions.