NORTH PACIFIC RESEARCH BOARD PROJECT FINAL REPORT

The continued development of a catalog of left-side digital images of individually identified Cook Inlet beluga whales *Delphinapterus leucas*: inclusion of data from 2009-2011.

NPRB Project 1210 Final Report

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ABSTRACT

LGL's Photo-identification study of endangered Cook Inlet beluga whales (CIBWs) *Delphinapterus leucas* has demonstrated that CIBWs possess persisting natural marks that can be identified and re-sighted photographically over long periods of time. The cataloged images of the right sides of CIBWs photographed between 2005 and 2014 have provided information about the distribution and movement patterns of 312 individual CIBWs and the population in general, including residency/movement patterns, habitat utilization, reproduction, injury, disease, and mortality. Funding from NPRB in 2009-2010 allowed us to catalog images of the left-sides of CIBWs photographed 2005-2008, and to develop a left-side catalog that contained records for 186 individual CIBWs. Continued NPRB funding in 2012 allowed the continued development of the left-side catalog. A total of 296 CIBWs have now been identified as individuals from left-side images, including 117 presumed mothers, with the inclusion of CIBWs photographed 2009-2011 and the addition of 110 new individuals to the catalog. Nine dead whales have also been identified as individuals in the left-side catalog. The development of the left-side catalog increased the existing information about identified CIBWs without requiring additional field work, research permits, or disturbance to the whales. Left-side catalog development allowed for greater representation of whales seen in Turnagain and Knik Arms, and increased the evidence that CIBWs do not display fidelity to any single area of Cook Inlet and that individuals move among areas and groups. All CIBWs are therefore likely exposed to multiple potential threats that may be endemic to certain areas of Cook Inlet.

KEY WORDS

Beluga whales, *Delphinapterus leucas*, Sub-arctic, Southcentral Alaska, Cook Inlet, photo-identification, movement, site fidelity, endangered species, marine mammal

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STUDY CHRONOLOGY

A proposal for this project (NPRB Project 1210) was submitted December 2011. The project was recommended for approval by NPRB in May 2012 and approved by the Secretary of Commerce the same month. The project began in December 2012. The original award period was December 2012-October 2014. A no-cost extension was granted to the project that extended the final project period until January 2015. Progress reports were submitted to NPRB on: January 15, 2013; July 15, 2013; January 15, 2014; and July 15, 2014. Financial reports were submitted quarterly in 2013 and 2014.

NPRB Project 1210 is a continuation of the work done for NPRB Project # 910. A proposal for this project was submitted December 2008. The project was recommended for approval by NPRB in April 2009 and approved by the Secretary of Commerce in May 2009. The project began in October 2009. The original award period was October 2009-October 2010. A no-cost extension was granted to the project that extended the final project period until December 2010, with the final project report due April 2011. Progress reports were submitted to NPRB on: January 15, 2010; April 15, 2010; October 15, 2010; January 11, 2011; and February 11, 2011. The final report was submitted March 2011 (McGuire et al. 2011b).

INTRODUCTION

Context for this Work

Alaska's Cook Inlet beluga whale (CIBW) *Delphinapterus leucas* population is considered a distinct population segment (DPS) by the National Marine Fisheries Service (NMFS) due to geographic and genetic isolation. A dramatic 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). The CIBW population was listed as critically endangered by the International Union for the Conservation of Nature in 2006 (IUCN 2006). After finding little evidence to demonstrate the population was recovering, in October 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 the CIBWs.

Many information gaps and uncertainties are associated with the current understanding of the CIBW population and its lack of recovery (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 behavior will aid in the identification of movement corridors and locations of grounds for feeding, calving, and rearing of young.

Available sources of information on CIBWs include the distribution of 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, Goetz et al. 2007, NMFS 2008a, Shelden et al. 2008, 2009a,b, 2010, 2011, 2012). This information plays a key role in characterizing and understanding habitat needs, as does 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 (photo-id) surveys (McGuire and Kaplan 2009, McGuire et al. 2008, 2009, 2011a,b, 2013a,b, 2014a,b) 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.

Photo-id has proven to be a reliable tool for characterizing abundance, residency, movements, social grouping, and life history of many marine mammal species in the wild (reviewed by Mann 2000), and has been used to study the distribution, population dynamics, and social structure of beluga whales in Canada's St. Lawrence Estuary (Michaud 1996), and the White Sea of Russia (Kryukova 2005). Photo-id surveys can be used to characterize distribution and movement patterns of individual beluga whales, which can augment information from aerial surveys and tagging-tracking studies. Photo-id is less invasive than tagging and capture, and natural marks persist much longer than tags (McGuire et al. 2014a).

The CIBW Photo-ID Project has been ongoing since 2005, and has demonstrated that a large number of CIBWs possess distinct natural marks that persist across years, and that these marks can be effectively identified and re-sighted with digital photography (McGuire et al. 2008). The photo-id catalog and associated surveys from ten field seasons (2005-2014) provide information about the distribution and movement patterns of 312 individually identified beluga whales in the right-side catalog, including mothers with calves (McGuire et al. 2011b, 2014a). While these studies have determined that belugas can be identified and tracked photographically, multiple, continuous years of fieldwork and photo-analysis are required to track individuals in order to determine movement patterns, habitat associations, social patterns, survivorship, and reproductive success. The inclusion of data from left-side photographs allows for the addition of individual CIBW data from geographic areas of Cook Inlet that have been under-represented in the right-side photo-id catalog and analysis. For example, Turnagain Arm and the mouth of Eagle River are land-based survey sites, and because of the CIBW movement patterns in these areas with respect to the tides (Funk et al. 2005, Markowitz et al. 2007, Markowitz and McGuire 2007), and the position of land-based access for photographers, the majority of the photographs taken here are of left-sides (McGuire et al. 2011b).

On a long-term basis, the CIBW Photo-ID Project provides data necessary to monitor and assess individual and population-wide characteristics such as length of mother/calf bonds, frequency of reproduction, and survivorship, and will allow for inter-annual comparisons of these characteristics. These long-term data will be useful to resource managers and stakeholders to help determine if the population is recovering, declining, or stable.

Reason for Work

LGL's CIBW Photo-ID Project catalog of digital images of the right sides of individually-identified beluga whales photographed over ten consecutive field seasons and the database of associated field surveys have provided information about the distribution and movement patterns of individually

identified beluga whales and the Cook Inlet population in general, including residency/movement patterns, habitat utilization patterns, reproduction, injury, disease, mortality, and abundance (McGuire et al. 2008, McGuire and Kaplan 2009, McGuire et al. 2009, 2011a,b, 2013 a,b, 2014a,b). Due to budget constraints, we had archived all photographs taken of the left-sides of beluga whales after 2005 and were unable to process and catalog these images. Funding from NPRB in 2009-2010 allowed us to catalog images of the left-sides of CIBWs photographed 2006-2008, and to examine and match the left-side images to those of whales cataloged in 2005, or to determine that they represent previously unidentified whales that should be added to the catalog. As of 2011, the left-side catalog contained records for 186 individual CIBWs photographed 2005-2008 (McGuire et al. 2011b). The further development of the left-side catalog with the addition of cataloging of left-side images from 2009-2011 adds data about movement, habitat use, reproduction, and mortality to our existing information about identified CIBWs, without requiring additional field work, research permits, or potential disturbance to the whales.

The **hypothesis** being tested is that photo-id methods can provide unique, useful ecological information about individual and population characteristics of CIBWs.

OBJECTIVES

The **objectives** of the CIBW Photo-ID study were to:

1. Continue to build a photo-id catalog of distinctively marked individual CIBWs, and to describe re-sight rates and discoveries of new individuals over time.
2. Describe population characteristics of CIBWs, including age-class distribution, residency/movement patterns, habitat association, behavior, and social group structure, and
3. Determine life history characteristics of CIBWs, such as length of mother/calf bonds, frequency of reproduction, and survivorship.

Objective 1 has been achieved for the photographs taken 2005-2011. All left-side photographs of acceptable quality have been cataloged. The left-side catalog contains 296 individually-identified CIBWs (Table 1, page 20). Re-sighting histories for these whales span 2005-2011 and 12 whales were seen in each of these years (Table 5, page 22).

We were successful in meeting Objective 2, although it is an ongoing process. We have described the general age-class distribution of CIBW groups encountered during boat- and land-based surveys conducted 2005-2011 (Figure 33, page 47; McGuire et al. 2008, 2009, 2011 a,b, 2013 a,b, 2014 a,b). We now have sighting records for 296 individually identified whales in the left-side catalog, and for

each of these whales we have information on residency/movement patterns, habitat associations, and social associations (Table 5, page 22; Figures 9-20, pages 23-34; Table 6, page 35; Figures 21-28, pages 36-43; Table 7, page 44; Table 8, page 45; Figure 33, page 47; Figures 34-61, pages 49-76, Table 9, page 77; Figures 63-71, pages 81-89). We also collected information on group behavior during boat- and land based surveys (behavioral data are not presented in this report, but can be found in McGuire et al. 2008, 2009, 2011 a,b, 2013 a,b, 2014 a,b, and McGuire and Kaplan 2009).

We are making progress in achieving Objective 3, although it will require several more years of study, given these are long-lived mammals that invest heavily in their offspring. We have preliminary data on mother/calf bonds, and frequency of reproduction (Table 7, page 44; Table 8, page 45; Table 9, page 77). Survivorship information is derived from individuals seen throughout the duration of the study (Table 5, page 22), from sighting records of whales equipped with satellite tags in 1999-2002 (Table 6, page 35), and from identifying dead belugas as individuals in the catalog (Table 10, page 80, Figures 63-71, page 81-89). In addition, we are documenting evidence of disease and trauma, including entanglement (Figure 77, page 92; McGuire et al. 2013b, 2014a).

It should be noted these three objectives are not limited to the current 2-year NPRB project to catalog the left-side photographs taken 2005-2011, but are also the objectives of the larger LGL CIBW Photo-ID Project that includes the combined right- and left-side catalogs and all surveys conducted 2005-2014 (with surveys planned into 2015 and possibly beyond).

METHODS

Field Surveys

Survey effort

Dedicated surveys and opportunistic sampling of portions of Upper Cook Inlet, Alaska (Figures 1 and 2) were conducted from a small vessel and from shore, 2005-2011. Survey schedules varied according to those combinations of season, location, and tide that provided the greatest likelihood of detecting whales. These combinations were determined by results from NMFS aerial surveys (Hobbs et al. 2008), 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), and incidental sightings of CIBWs reported to the CIBW Photo-ID Project from the public and colleagues. General survey routes were followed for each area, although deviations were made to each route depending on where beluga groups were encountered. The Susitna River Delta (Figure 2) was surveyed in late spring and summer

(May-August) during low tide. Knik Arm (Figure 2) was surveyed primarily in late summer/fall (August-October) during low tide. Turnagain Arm (Figure 2) was surveyed from the Seward Highway in late summer/fall (August-October) during high tide. Vessel-based surveys of Chickaloon Bay (Figure 2) were made in the spring and fall on those few days when wind conditions along Turnagain Arm were safe for boat activity. The Port of Anchorage was surveyed during all vessel-based surveys because the survey vessel was always launched from the small boat ramp at the Port of Anchorage. Boat- and land-based surveys of the Kenai River Delta (middle Cook Inlet) were conducted in 2011.

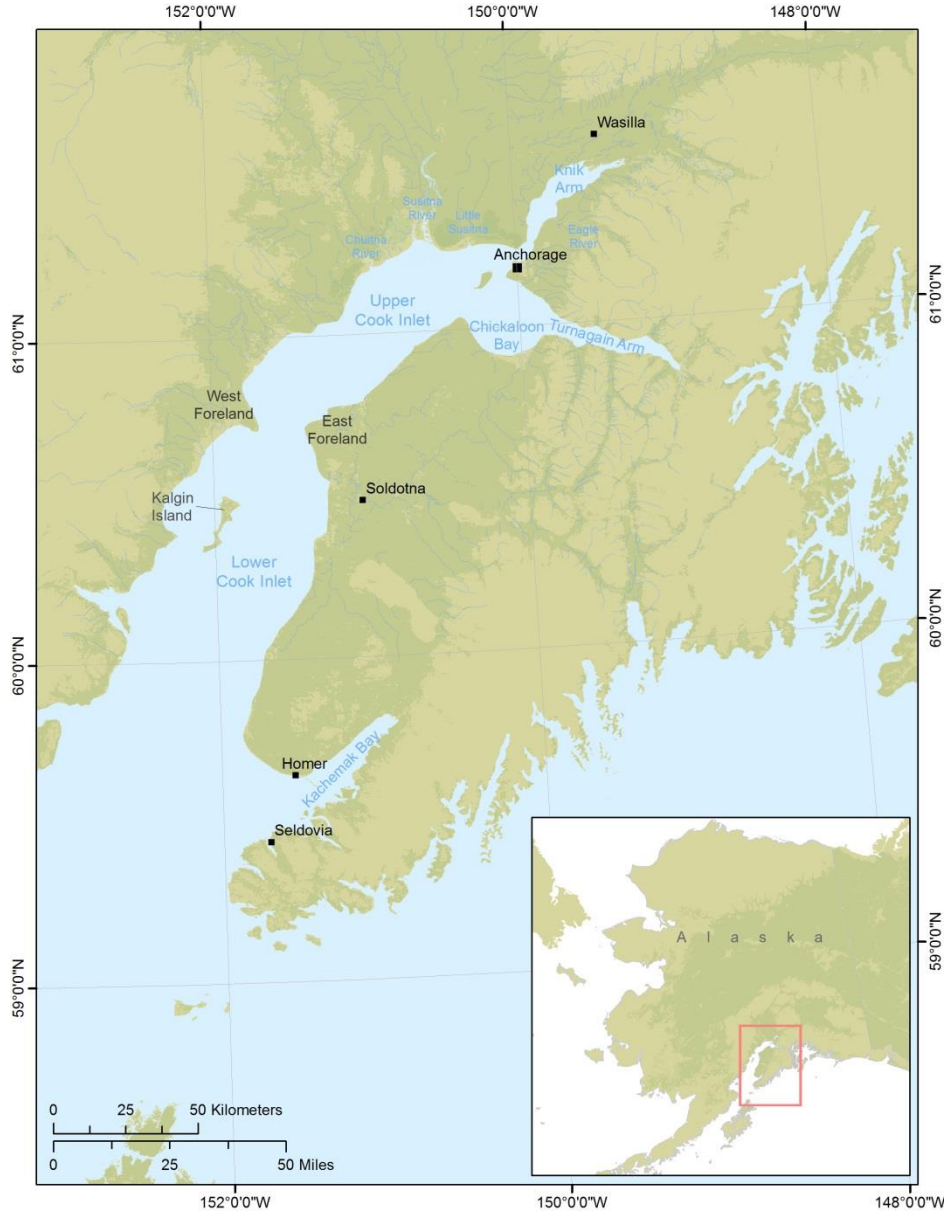


Figure 1. Map of Cook Inlet, Alaska, showing major features discussed in text.

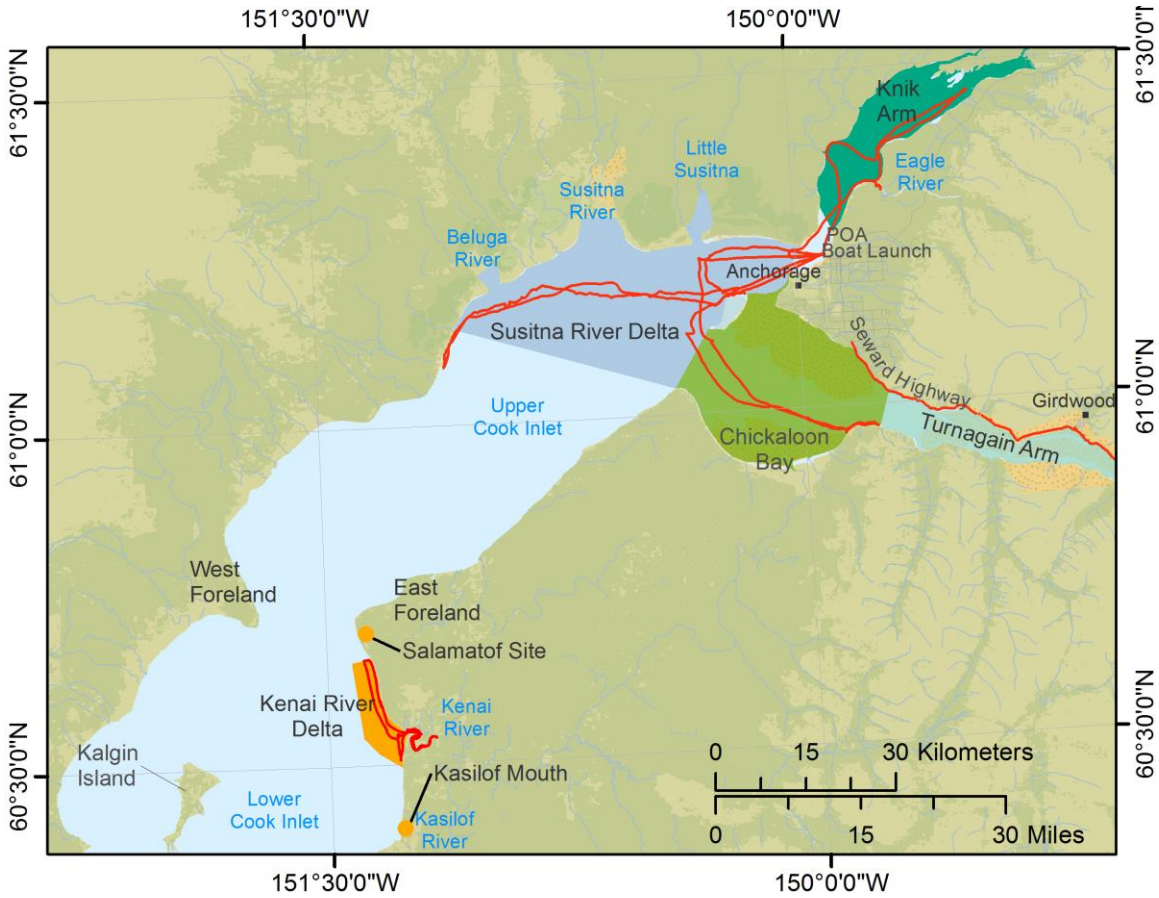


Figure 2. Cook Inlet, Alaska, showing shaded boundaries of sub-areas within the study area and the vessel- and land-based survey routes (red lines) used 2005-2011.

Vessel surveys

Vessel surveys were conducted primarily from the *R/V Leucas*, a 4.9 m (16 ft) inflatable Proman 9 Zodiac® powered by a 4-stroke 50 hp Yamaha® motor. Vessel surveys of Chickaloon Bay were conducted from an 8.5 m (28 ft) aluminum hulled Munson landing craft powered by two 140 hp 4-stroke engines. The landing craft was used when weather and sea conditions made the trip from the Anchorage small boat launch to Chickaloon Bay too dangerous for the smaller vessel. Although all boats carried safety "kicker" engines, the second engine on the landing craft proved to be a useful safety measure in the rough waters and shallow channels often encountered in Chickaloon Bay. A third boat, a Willie Predator 6 m (20 ft) aluminum river boat with a 50 hp Yamaha engine was used for surveys of the Kenai River and Delta. Vessels usually carried one skipper and one crew member. Vessel location was recorded continuously 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. Whale groups were approached once per survey and followed in the manner described by Würsig and Jefferson (1990), as permitted in the project's Scientific Research

Permit. The research vessel approached slowly, parallel to the group, matching group speed and heading in order to obtain images of the lateral sides of individuals while minimizing disruption of the group. Researchers noted the position of whales relative to the vessel and GPS-logged tracks were used to estimate approximate whale group positions. Vessel-based surveys were suspended during NMFS aerial surveys. All vessel surveys were conducted under NMFS General Authorization # 481-1795-01 from 2005-2008, and MMPA/ESA Scientific Research Permit # 14210 from 2009-2011.

Land-based surveys

Photographs of CIBWs were also taken from land-based observation stations along Turnagain Arm, the mouth of Eagle River, the lower reaches and mouth of the Kenai River, and occasionally from Salamantof Beach and the mouth of the Kasilof River. Surveys along Turnagain Arm generally began three hours before high tide, based on results from previous research conducted by LGL (Markowitz and McGuire 2007). Along Turnagain Arm, a single observer drove south and east on the Seward Highway from Anchorage and stopped at turnouts. The observer alternated searches for marine mammals with binoculars and the naked eye. When beluga whales were seen, the observer attempted to follow them along Turnagain Arm as they moved with the tide. Most photographs were taken from sites where whales approached closest to shore and that afforded relatively easy vehicle access. Land-based surveys in the Kenai River Delta were conducted from stationary sites during times when small-craft advisories, extreme low tides, or duck hunters firing weapons from boats prevented the safe deployment of the survey vessel. Land-based surveys at Eagle Bay were conducted in conjunction with biologists with Joint Base Elmendorf-Richardson (McGuire et al. 2013b).

Field data (vessel and land-based surveys)

Standardized data forms were used to record beluga whale sightings. For each beluga whale group sighting observers recorded: time of day, group size, GPS coordinates of the vessel, magnetic compass bearing to the group, and estimated distance of the vessel from the group (distance at first detection, and minimum distance to individual whales). 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.

Body color and relative size of whales in all groups were recorded as “white”, “gray”, “calf”, and “neonate”. 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.

Digital photographs of beluga whales were collected using a Nikon D70, 6.1 megapixel digital SLR camera and Nikkor 70-400 mm zoom telephoto auto focus lens, or a Nikon D300, 12.3 megapixel digital SLR camera with a Nikkor 70-400 mm 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. Photographs taken by the public and colleagues and shared with the CIBW Photo-ID Project were taken on a variety of cameras and cell phones.

Analyses of Data from Field Surveys

Locations of beluga whale sightings and survey routes were mapped in ArcGIS™ Version 10.2 (http://www.esri.com).

Processing of Photographs

All RAW format photographs were downloaded from the camera's 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. Photographs were sorted according to image quality using ACDSee photo software (http://www.acdsee.com). Photographs of unsuitable quality for identification (e.g., poor focus, whale obscured by splash, or too distant) were noted and archived, but not used for subsequent analyses. If distinguishing features of marks were obvious even in poor quality photographs, the photo was considered for inclusion in the catalog.

When an original field photograph contained two or more whales, each whale was cropped individually and given a separate file name. Cropped images were separated into left and right sides of whales. After 2005 and prior to the award of the NPRB research grant to develop a left-side catalog, only photographs of the right sides of the whales were further processed and cataloged, and left-side images were archived in order to conserve project funds. The left-side catalog of photographs was created in 2009 and 2010 with the grant for NPRB Project # 910 that allowed for the cataloging of archived left-side photographs taken during National Fish and Wildlife Foundation-sponsored field surveys 2005-2008.

Daily photo samples (i.e., all cropped photos taken on a single survey day) were sorted into temporary folders. Each temporary folder contained all of the cropped images taken of the same individual beluga on a single day, and was comprised of one to many images. Images within a temporary

folder may have been taken seconds or hours apart, and often showed different sections of the body as the beluga surfaced and submerged. Temporary folders were then examined to determine if there was a match to photographic records of individual belugas identified within that year or in previous years. If a match was made to a previous year in the catalog, the new photos were entered into the catalog.

Cataloging of Photographs

Markings used for photo-id of individual beluga whales consist of natural marks from conspecifics, pigmentation patterns, scars from injury or disease, and marks left from satellite tags attached by NMFS 1999-2002. Our research project depends on existing marks and does not apply marks to whales. Mark-type categories were created in order to facilitate cataloging. Locations of all visible marks were assigned to sections of the body (Figure 3) of each individual within the catalog. Computer software specialized for this species was developed to allow for computer-aided filtering of the database according to mark type and location.

As a beluga surfaces and submerges, different portions of its body are available to photograph. Side-profile photographs were most useful for matching marks used to identify individual whales. Profile images were divided into 11 sections along the right half of the whale (Figure 3); sections containing the head, tail, and ventral half of the whale were less commonly captured in photographs and were therefore less likely to provide identifying marks. "Profile completeness" was determined by the number of sections with high quality images; a side profile set was considered complete if it contained high quality images of all five sections of the dorsal half of the whale, beginning just behind the blowhole to the base of the tail. Whales with complete profile sets were considered to be individuals in the catalog. Another criterion that allows for the acceptance of a whale into the catalog is if two temporary whale folders that spanned 2 or more years were matched. All matches in the existing catalog were reviewed and verified by at least two experienced photo-analysts.

Figure 3. Body segments used when cataloging. The five shaded areas were the critical sections used in matching marks. Beluga illustration courtesy of Uko Gorter.

Sighting Histories

Sighting histories (i.e., dates and locations of sightings) were compiled for all belugas in the left-side catalog in order to examine residency and movement patterns. Sighting histories of a subset of the left-side catalog, consisting of all belugas that were photographed in all 7 years of the study (2005-2011), all belugas bearing scars from previous satellite tags, all identified dead belugas, and all belugas identified in both the right- and left-side catalogs (i.e., the "dual-side" whales), were plotted and presented graphically. Dual-side whales were identified by marks on both sides of their bodies and by marks that spanned both sides of the bodies (Figures 4 and 5). Locations of cataloged beluga whale sightings were mapped in ArcGIS™ Version 10.2 (http://www.esri.com). The study area was divided into subareas (Figure 2), and occurrence and movements of identified belugas among subareas were examined.

Figure 4. Photographs of an identified "dual-side" beluga, showing the left side (a), right side (c), and "dual" side (b) images that were used to link images and sightings records from the left and right sides of this whale. The "dual-side" image (b) is of the whale facing away from the photographer.

Figure 5. Dual-side photograph of a beluga used to link images and sightings records from the left and right sides of this whale. The image is of the whale facing away from the photographer.

Classification of Mothers and Calves in Photographs

Identified belugas were classified as presumed mothers in photographs if they appeared in the same photo-frame with a calf or neonate alongside them. Belugas were classified as calves in photographs if they were dark gray (although light-gray calves were also observed), relatively small (i.e., <2/3 the total length of adult belugas), and photographed alongside a larger beluga. Neonates were distinguished in photographs by visible fetal folds and often a "peanut-shaped" head. Sighting histories (i.e., dates and locations of sightings) were compiled for all left-cataloged mothers and calves. Sighting records for mothers included information on when the mother was photographed with and without a calf, as well as information on the relative size of the calf.

Information on Dead, Diseased, and Injured Individual CIBWs

Many photographs of CIBWs contain marks indicative of disease and injury (LGL 2009, McGuire et al. 2014a). Using the cataloging tools within the database application, marks were labeled

according to mark type and body segment in which they occurred (Figure 3). Beluga researchers, beluga hunters, orca researchers, and/or members of the Marine Mammal Stranding Network, including veterinarians, were consulted about possible sources of marks in photographs.

Identification of Dead Belugas

When informed of dead belugas by the Alaska Marine Mammal Stranding Network and authorized by NMFS, CIBW Photo-ID Project biologists photographed dead belugas while assisting with necropsies, or relied on other stranding responders to obtain photographs of dead belugas. The project developed a protocol for photographing dead belugas for identification marks that was distributed to members of the Alaska Marine Mammal Stranding Network. Photographs of dead belugas were examined for marks that could be used to compare to records in the 2005-2011 catalog. Sex and relative age (i.e., neonate, calf, adult) of dead whales were determined and entered into the records of cataloged individuals.

Database Development

We continued to consolidate all left-side photo-id data and photographs from 2005-2011 into a single unified database and interface (Figures 6 and 7). Survey data included amount of effort, survey route, environmental conditions, and sighting information such as whale locations, group size, color and age-class, 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 lighting conditions. Catalog data included the number of photos in the catalog, the dates and locations when photos were taken, the number of individual whales represented in the catalog, the number of unmatched temporary files, and the number of photos of whales with few or no visible markings. In addition to consolidating the data, all sorted and cropped left-side photographs of useable quality were imported into the database.

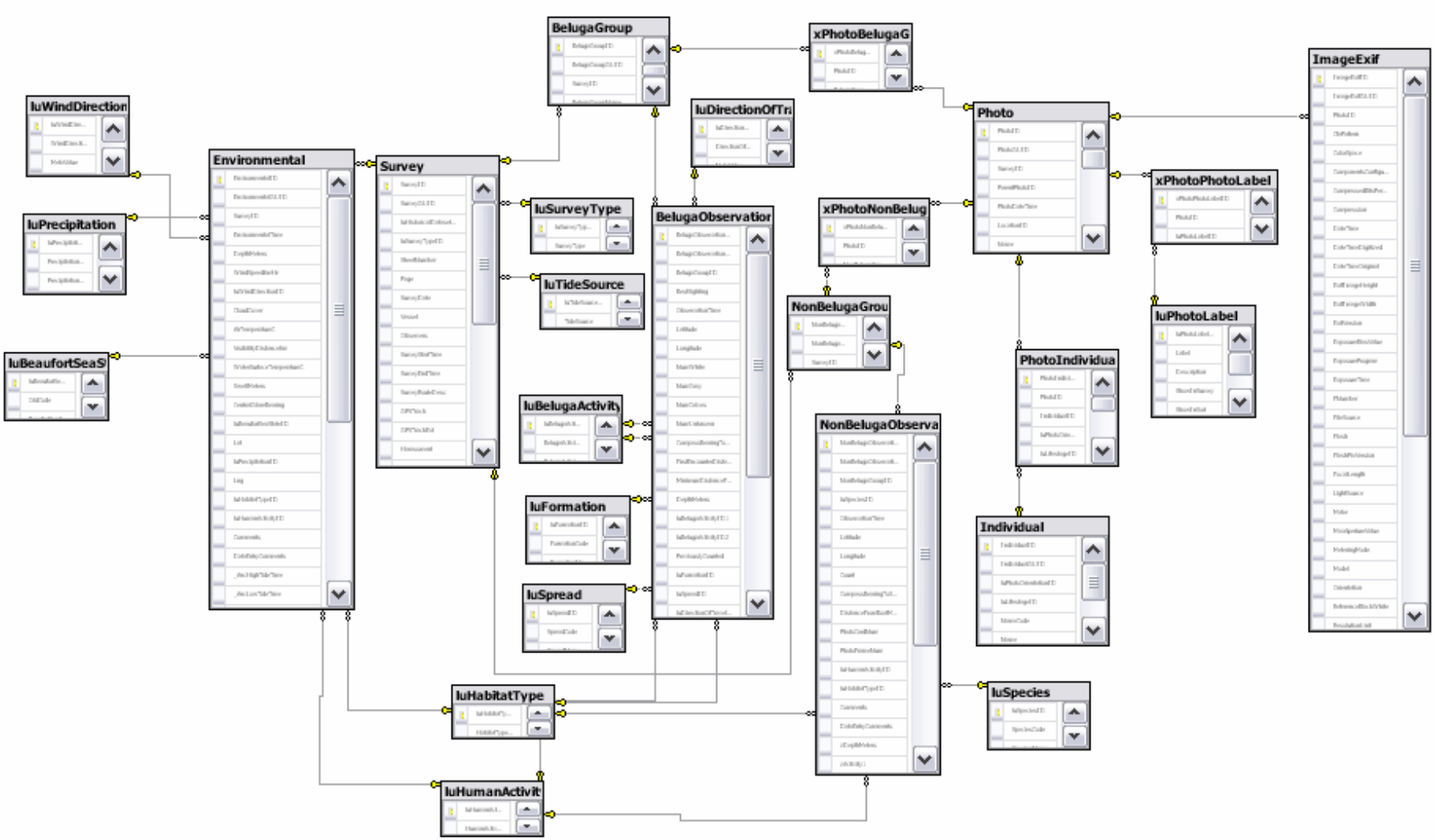


Figure 6. The structure of the CIBW Photo-ID Project database.

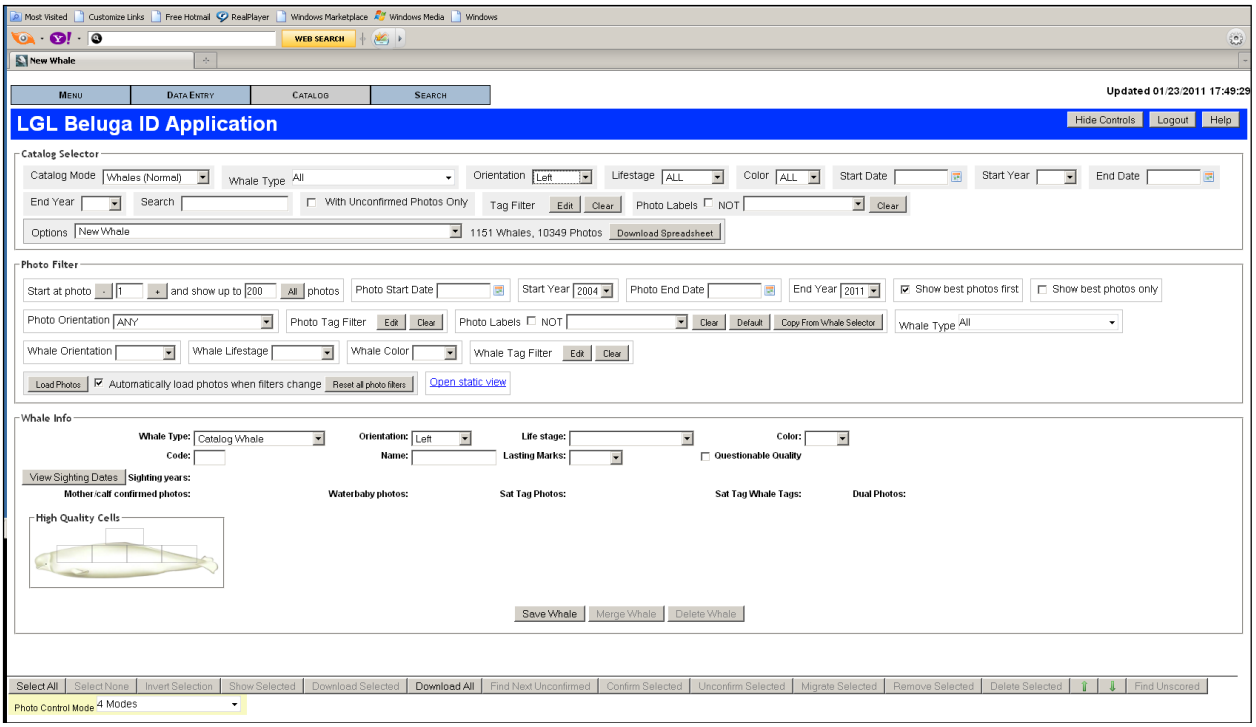


Figure 7. The individual whale information page for left-side whales in the CIBW Photo-ID Project database application.

RESULTS

Catalog Development and Current Status of the 2005-2011 Left-Side Catalog

We have completed cataloging left-side photographs taken 2009-2011 and have added them to the previous left-side catalog of photographs taken 2005-2009. In total, 164,738 photographs of whales were examined and inventoried. After identifying and removing photographs of unacceptable quality, insufficient body coverage, or images of right sides, cropped and sorted left-side images were organized into folders in preparation for cataloging. Consolidation of all project files and the right- and left-side catalogs into a single database and cataloging has been completed.

The 2005-2011 left-side catalog contains 15,330 photographs taken during 251 surveys in Upper Cook Inlet, Alaska (Tables 1 and 2), and consists of 296 individually identified whales. The current work funded by NPRB allowed us to add a total of 110 new individual CIBWs to the 2005-2011 catalog: 66 newly identified whales photographed 2009-2011 and 44 newly identified individuals photographed 2005-2008 (Table 1). In addition to the catalog, the 2005-2011 left-side photo-id database contains numerous folders of whales that are considered “temporary matches” (i.e., cannot be matched to images of cataloged whales and cannot be classified as cataloged individuals because of incomplete profile sets and/or single-year sightings).

Four hundred and eighty-one CIBW groups were photographed during 251 surveys 2005-2011 (Table 2). Survey effort was unevenly distributed among years and locations in Cook Inlet (Table 3); additional details on survey locations, survey effort, and group encounter rates, size, color/age composition, and behavior are presented in McGuire et al. 2011a, 2013a,b, and McGuire and Kaplan 2009. Survey effort was greatest in 2005 and more belugas were added to the catalog in 2005 than in following years (Table 1). For both right- and left-sides, the identification rate (number of beluga identifications/survey) was highest in the Susitna River Delta, followed by Knik Arm, and was much lower in Chickaloon Bay, Turnagain Arm, and the Kenai River Delta (Table 4). The overall sighting rate (all areas combined) was slightly higher for the right-side catalog (8.5 cataloged whales/survey) than for the left-side catalog (5.3 cataloged whales/survey; Table 4).

Table 1. Number of photo-id surveys, photographs, and individual whales added to the left-side photo-id catalog, 2005-2011.

Year	Photo-id Surveys	Photos Added	New Whales Added
*2005	49	2,114	137
2006	38	2,112	42
2007	23	797	26
2008	32	839	25
2009	32	706	11
2010	35	3,159	35
2011	42	5,603	20
Total	***251***	***15,330***	***296***

*Includes one photo of one whale from an incidental sighting in 2004.

Table 2. Total project survey effort and beluga whale groups photographed 2005-2011, Cook Inlet, Alaska.

	2005*	2006	2007	2008	2009	2010	2011	Total
Number Photo-id Survey Days	49	38	23	32	32	35	42	**251**
Number Photos Taken	44,878	21,244	4,193	13,222	20,817	31,292	29,092	**164,738**
Number Groups Photographed	125	97	41	53	47	55	63	**481**
Range of Surveys	14 Apr-21 Oct	12 May-5 Oct	28 Jun-27 Oct	21 May-28 Oct	19 June-24 Oct	9 May-15 Oct	17 May-22 Oct	
Season Survey Span (Months)	6	5	4	5	4	5	5	
Areas Surveyed	SRD, KA, TA	SRD, KA, TA, CB	SRD, KA, TA, CB	SRD, KA, TA, CB	SRD, KA, TA, CB	SRD, KA, TA	SRD, KA, TA, CB, KRD	

*Includes one photo of one whale from an incidental sighting in 2004.
SRD=Susitna River Delta
KA=Knik Arm
TA=Turnagain Arm
CB=Chickaloon Bay/Southeast Fire Island
KRD=Kenai River Delta

Table 3. The number of photo-id surveys conducted in Cook Inlet, Alaska, 2005-2011, according to area and year.

	Year							
Area	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	***Total***
Survey days	49	38	23	32	32	35	42	***251****
Susitna River Delta	17	21	4	8	15	14	11	***90***
Knik Arm	33	15	10	12	12	10	7	***99***
Turnagain Arm	1	6	8	12	12	15	17	***71***
Chickaloon Bay/Southeast Fire Island	0	1	1	2	1	0	2	***7***
Kenai River Delta	0	0	0	0	0	0	4	***4***

*More than one location was occasionally surveyed during a single survey day, therefore total surveys are not additive across locations.

Table 4. The number of photo-id surveys, sightings of catalog whales by side, and sighting rate by side for each area surveyed 2005-2011.

Area	**Surveys 2005-2011**	**Sightings of Right-side Catalog Whales**	**Sightings of Left-side Catalog Whales**	**Right-side Sighting Rate (Catalog Sightings/ Surveys)**	**Left-side Sighting Rate (Catalog Sightings/ Surveys)**
Susitna River Delta	90	1,000	670	11.1	7.4
Knik Arm	99	1,056	616	10.7	6.2
Turnagain Arm	71	55	34	0.8	0.5
Chickaloon Bay/ SE Fire Island	7	15	10	2.1	1.4
Kenai River Delta	4	3	0	0.8	0.0
Total	***251****	***2,129***	***1,330***	**Mean 8.5**	**Mean 5.3**

* More than one location was occasionally surveyed during a single survey day, therefore total surveys are not additive across locations.

Sighting Histories

Sighting histories of belugas 2005-2011

Of the 296 cataloged whales, 79 (27%) were identified in a single year, and 217 (73%) were identified in 2 or more years (Figure 8). Twelve individual belugas were identified in all 7 years of the study, and their individual sighting histories and photographs are presented in Table 5 and Figures 9-20.

Of the 12 individually identified belugas sighted in each of the 7 years of the study (Table 5), none were photographed exclusively in one survey area. All but one of the 12 belugas were photographed in both Knik Arm and the Susitna River Delta; 67 % of these were also seen in Turnagain Arm, and one was seen in the Chickaloon Bay/Southeast Fire Island area. All of the belugas identified in Turnagain Arm were also identified in Knik Arm and the Susitna River Delta. None of the belugas photographed in the Kenai River Delta in 2011 were identified by their left sides.

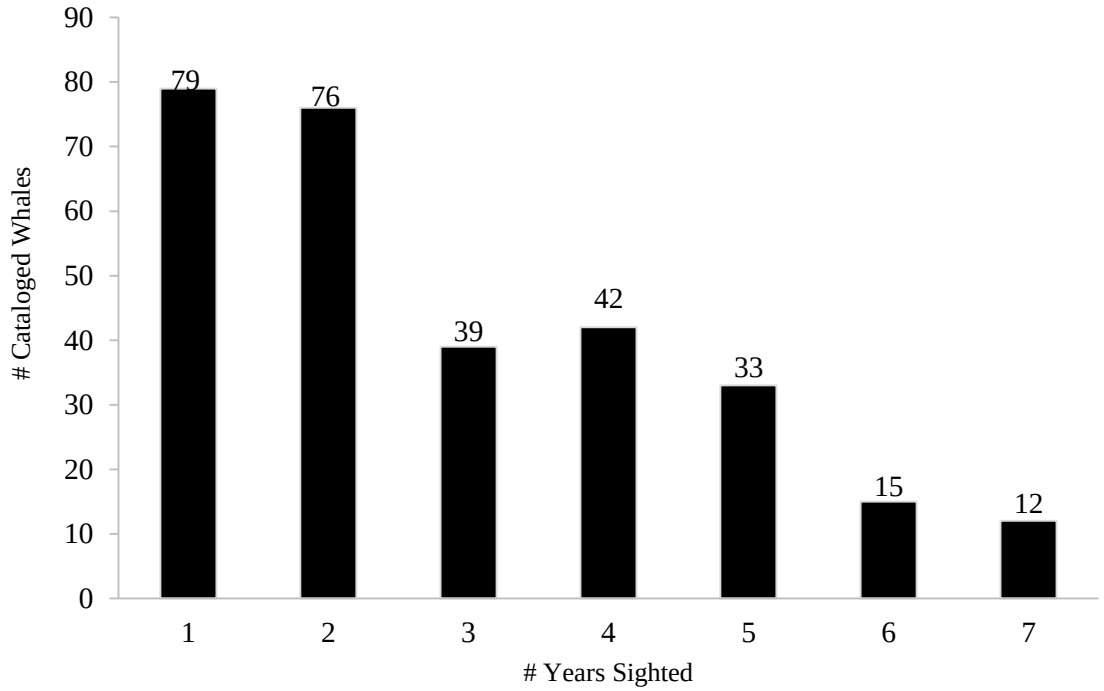


Figure 8. The number of years the 296 left-sided individual whales were re-sighted, 2005-2011.

Table 5. Sighting records of 12 left-sided individual beluga whales identified and cataloged each year, 2005-2011, according to location (P=photographed).

	Susitna River Delta	Knik Arm	Turnagain Arm	Chickaloon Bay/ SE Fire Island	Kenai River Delta
	# of Surveys	# of Surveys	# of Surveys	# of Surveys	# of Surveys
Whale ID	99	90	71	7	4
L265	P	P	P	P	
L286	P	P	P		
L363	P	P			
L401	P	P	P		
L429	P	P			
L493	P	P	P		
L501	P	P			
L1513	P	P	P		
L1772	P		P		
L2034	P	P	P		
L2278	P	P			
L2363	P	P	P		

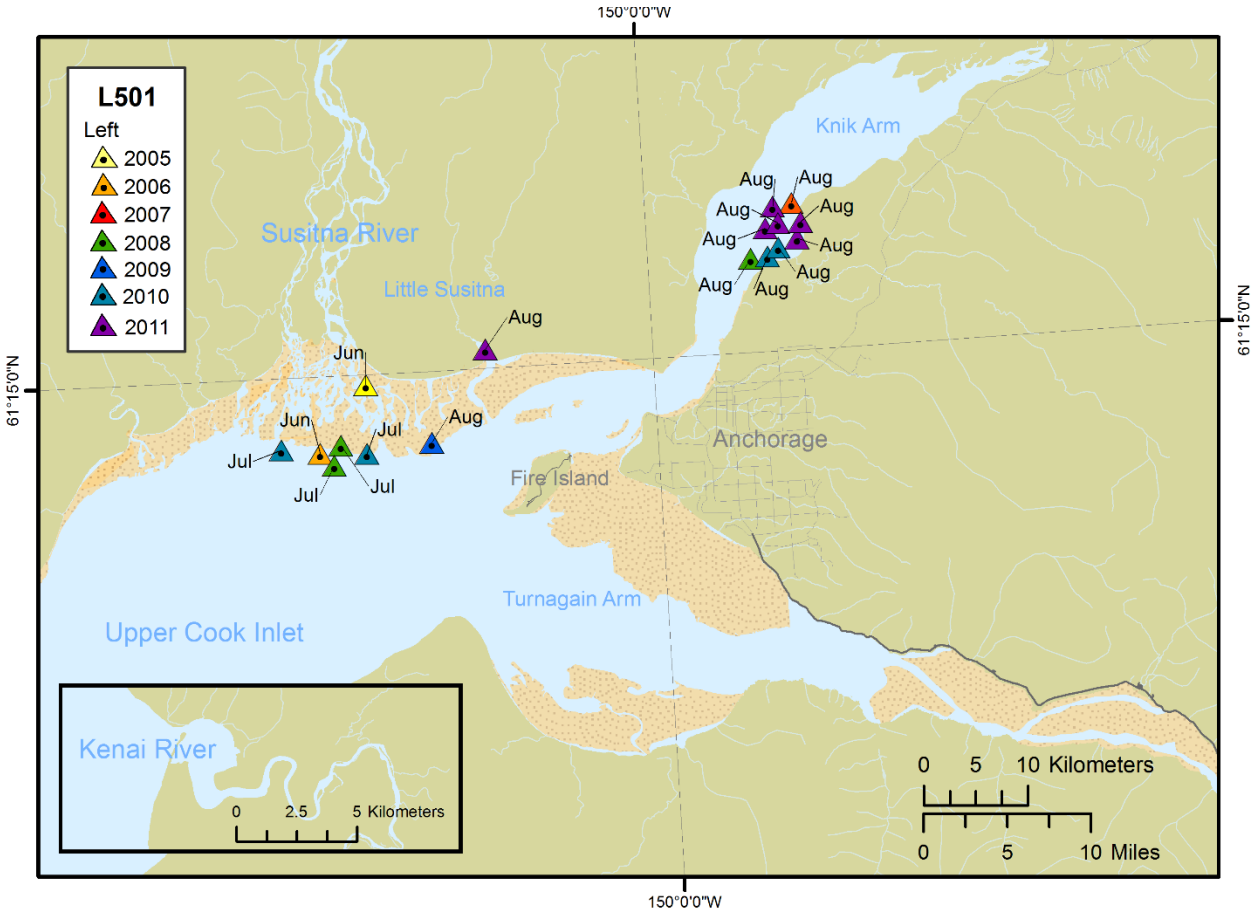


Figure 9. Sighting history and photograph of left-side beluga L501. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

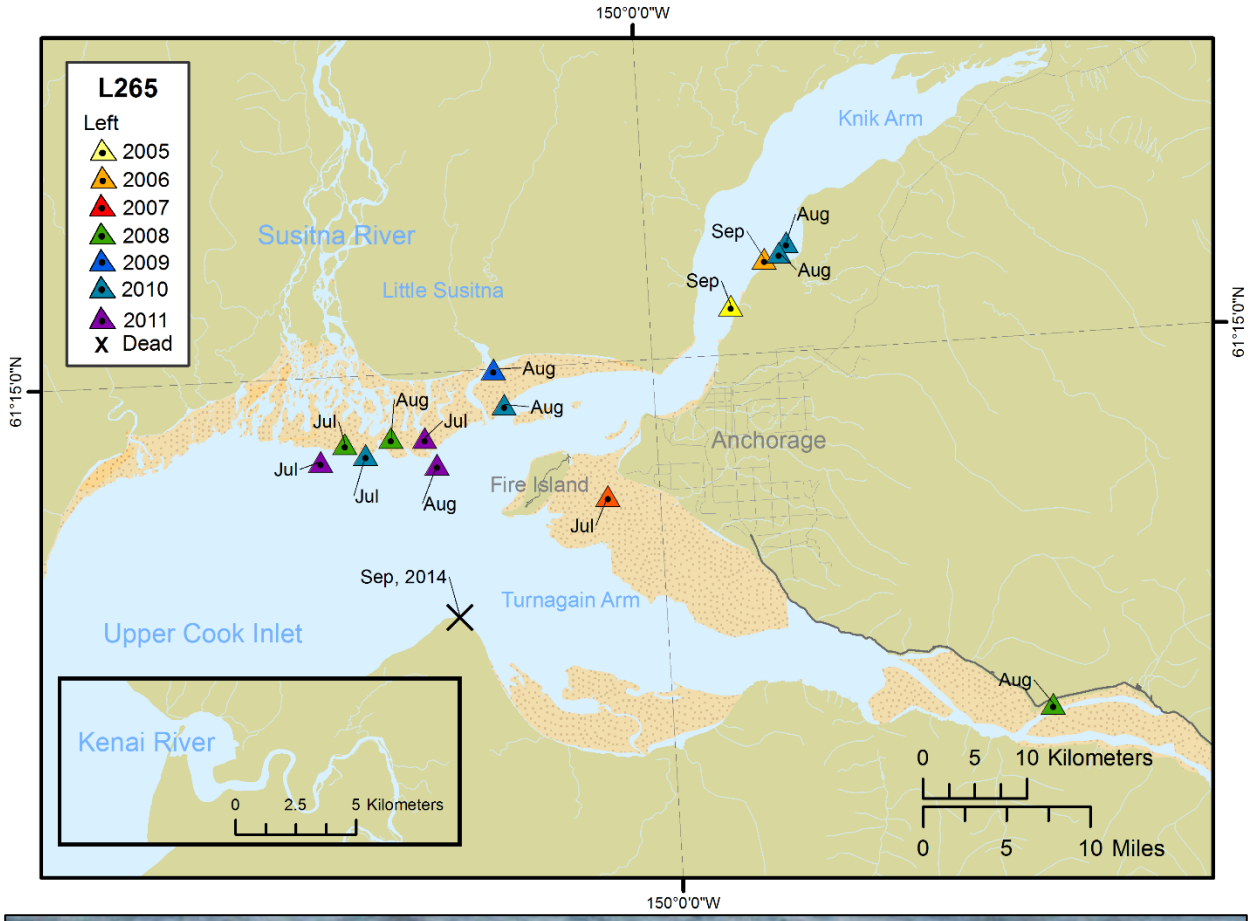
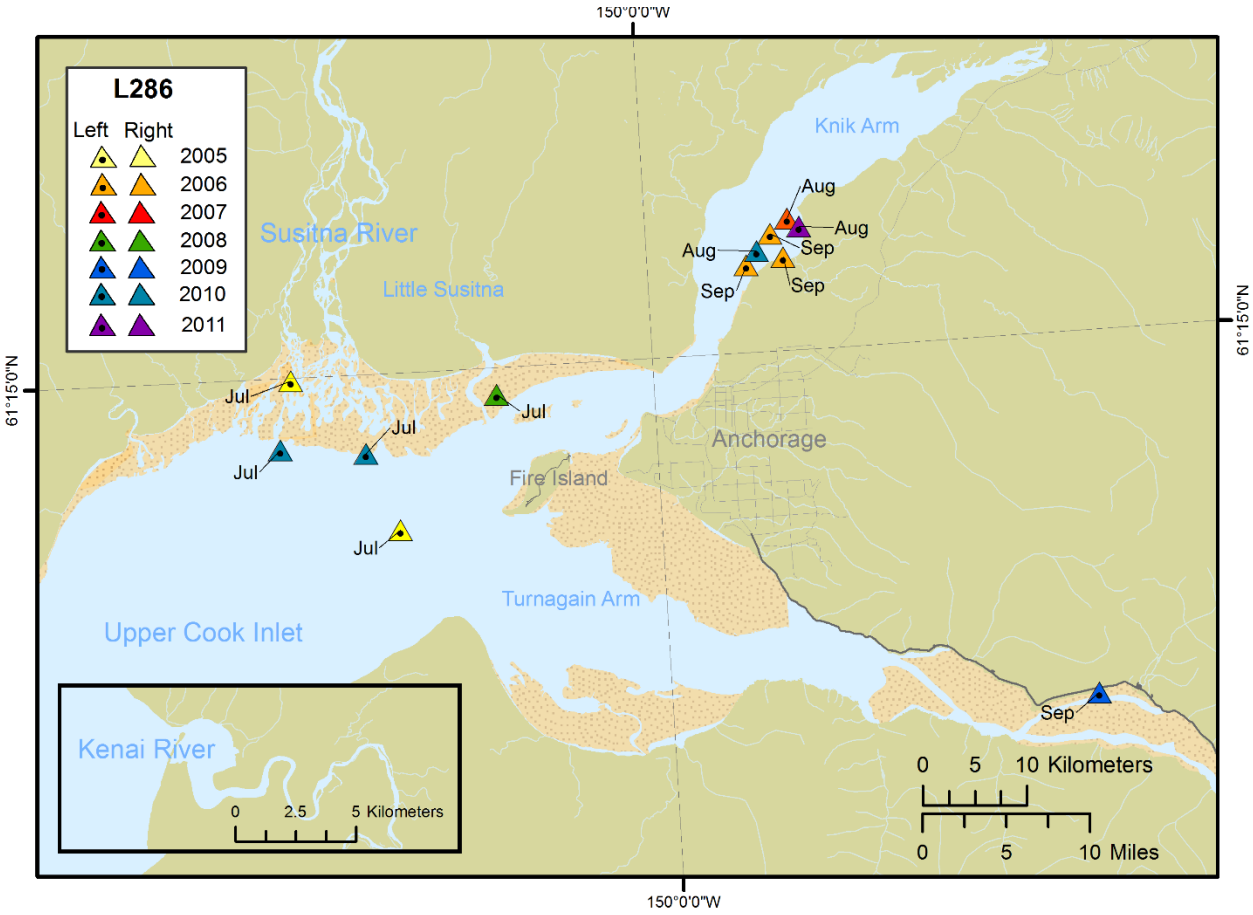


Figure 10. Sighting history and photograph of left-side beluga L265. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf. This whale was found dead near Pt. Possession in 2014 and was confirmed to be a female.



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535 **Figure 11. Sighting history (including sightings from both right- and left-side photographs) and photograph**
536 **of left-side beluga L286. This beluga was photographed every year from 2005-2011 and is a presumed**
537 **mother based on photographs with an accompanying calf.**

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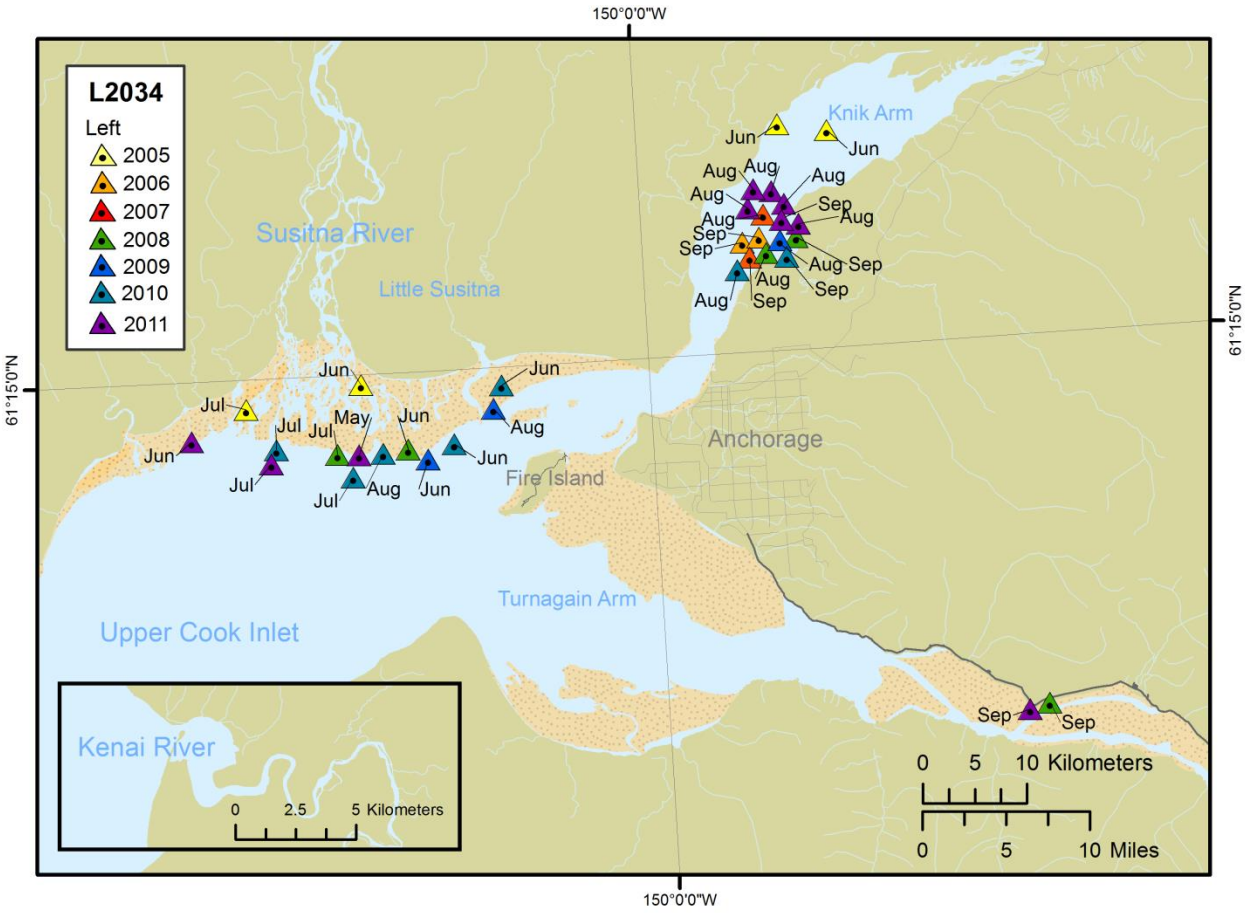


Figure 12. Sighting history and photograph of left-side beluga L2034. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

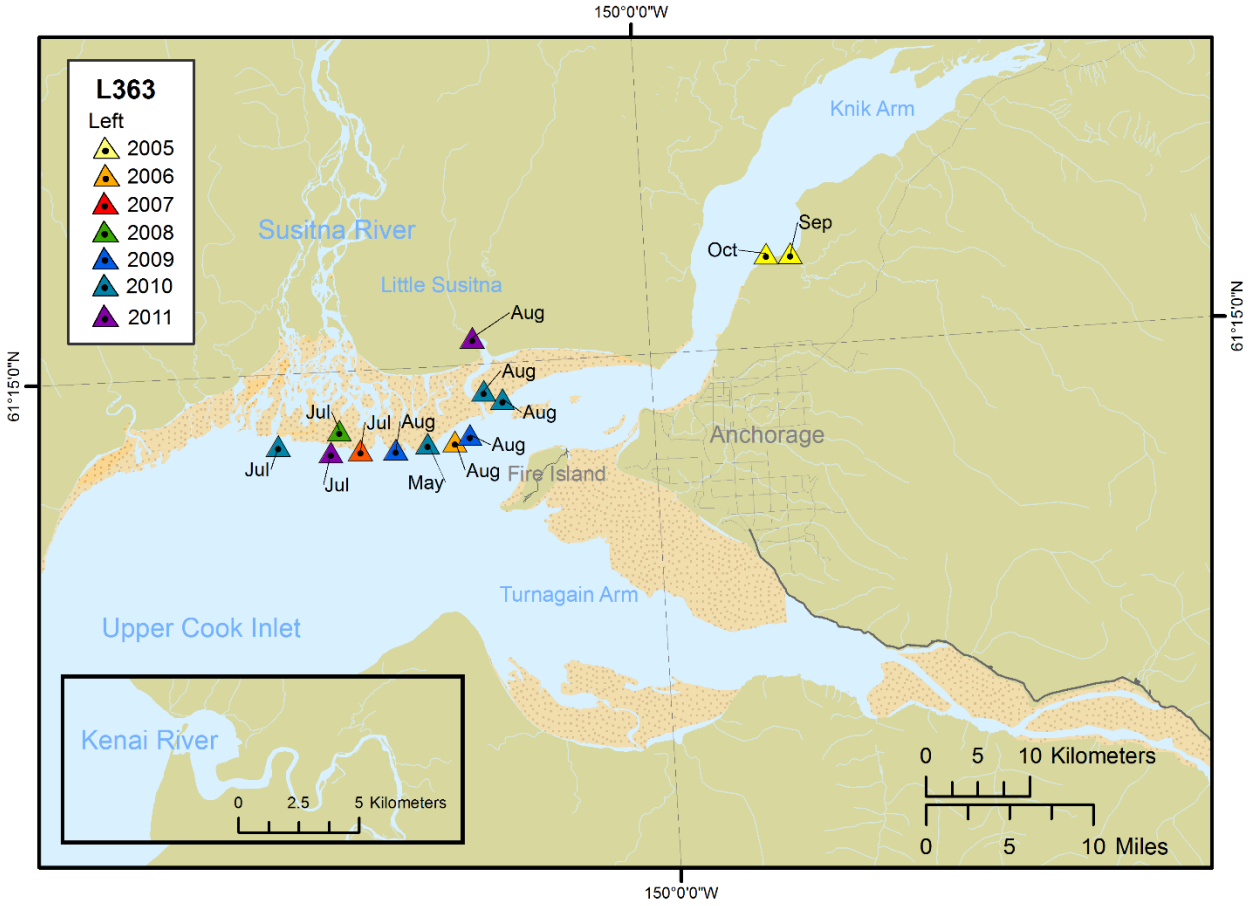


Figure 13. Sighting history and photograph of left-side beluga L363. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

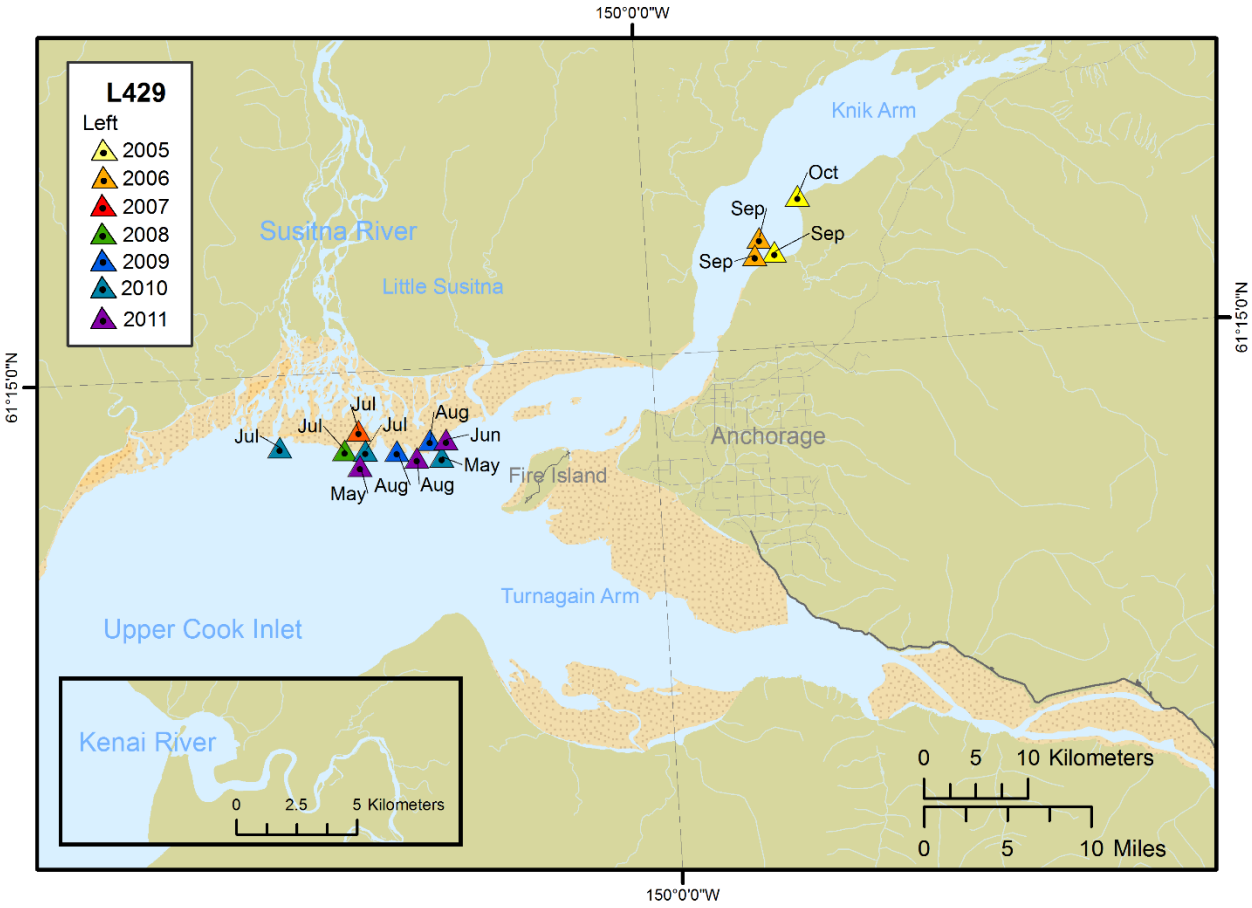


Figure 14. Sighting history and photograph of left-side beluga L429. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

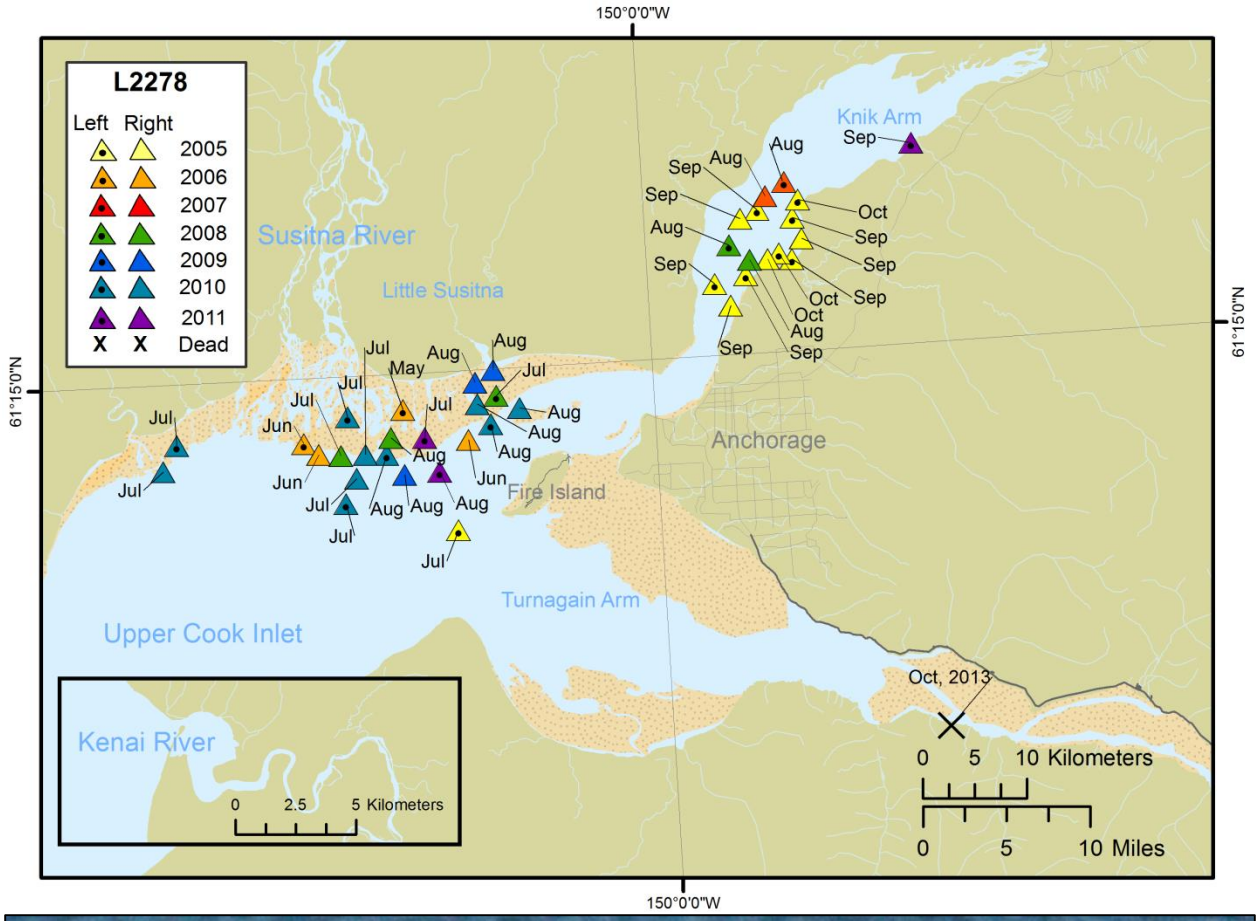
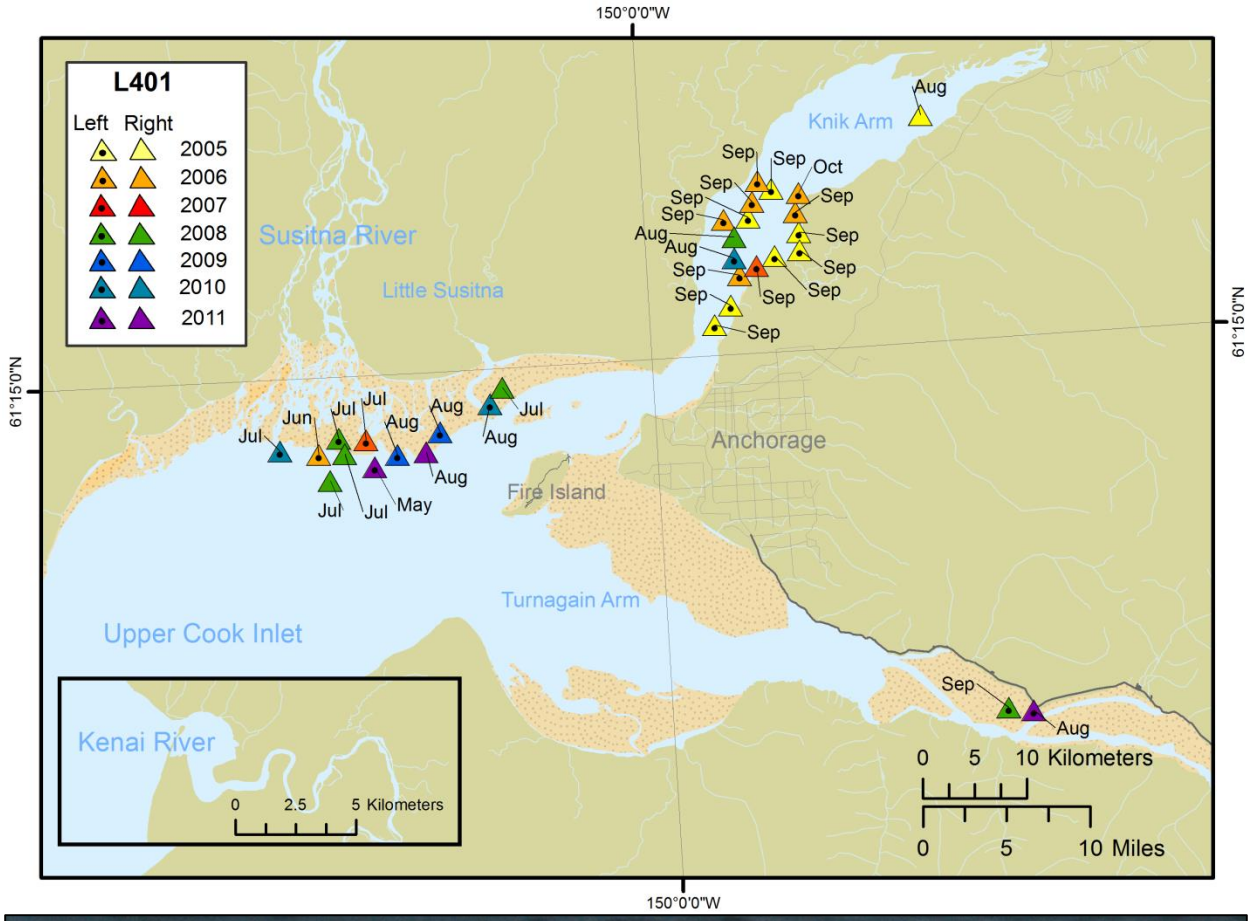


Figure 15. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L2278. This beluga was photographed every year from 2005-2011. It was found dead in 2013 near Hope and was confirmed to be a male.



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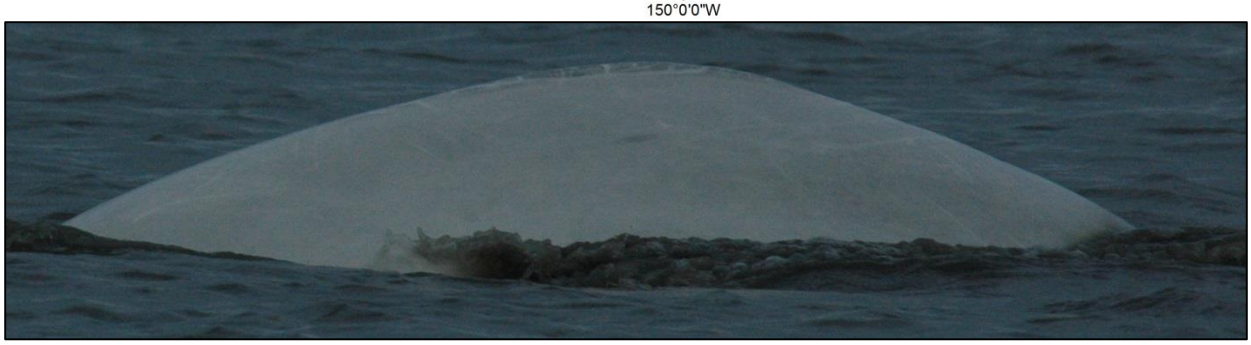

584

585 **Figure 16. Sighting history (including sightings from both right- and left-side photographs) and photograph**
586 **of left-side beluga L401. This beluga was photographed every year from 2005-2011 and is a presumed**
587 **mother based on photographs with an accompanying calf.**

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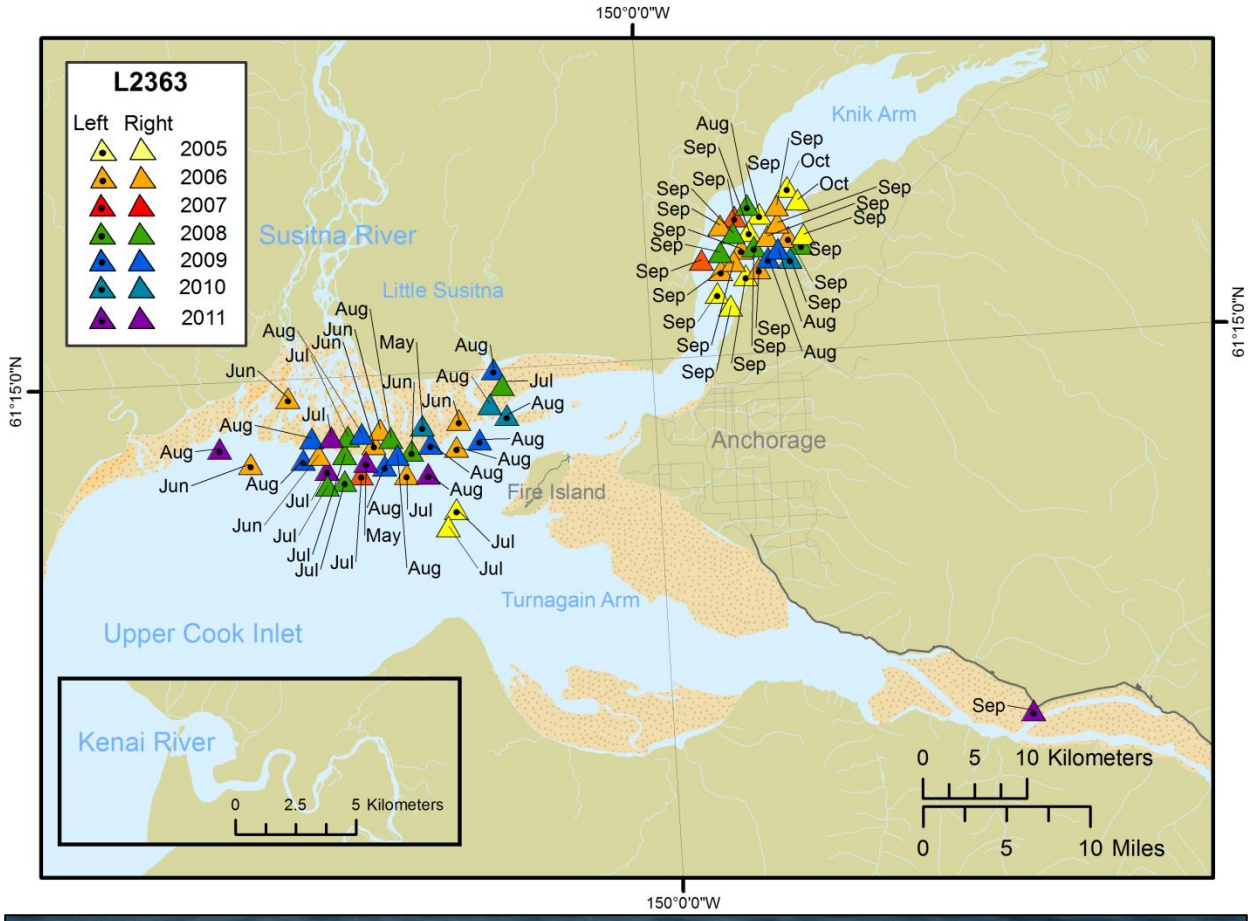


Figure 17. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L2363. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

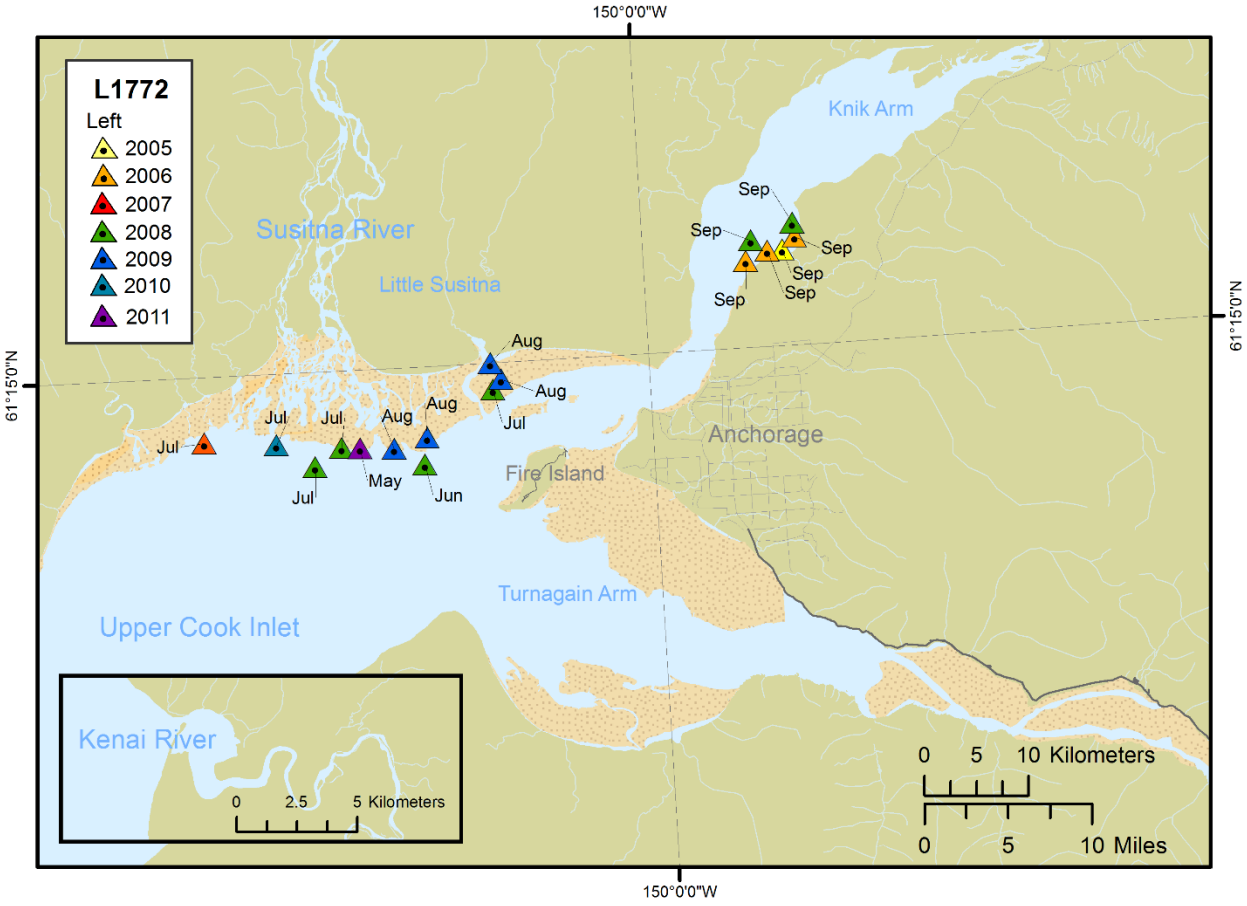


Figure 18. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L1772. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

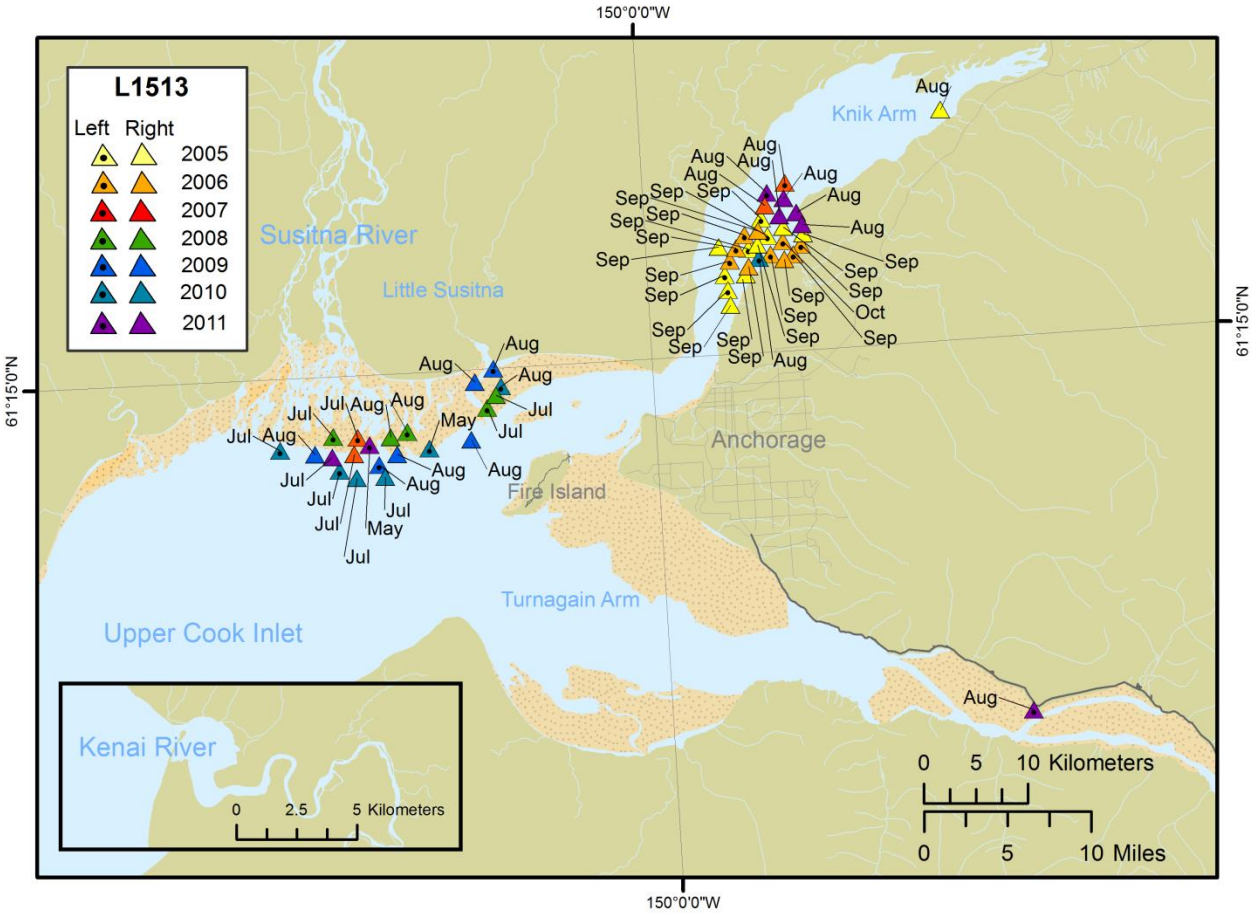


Figure 19. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L1513. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf.

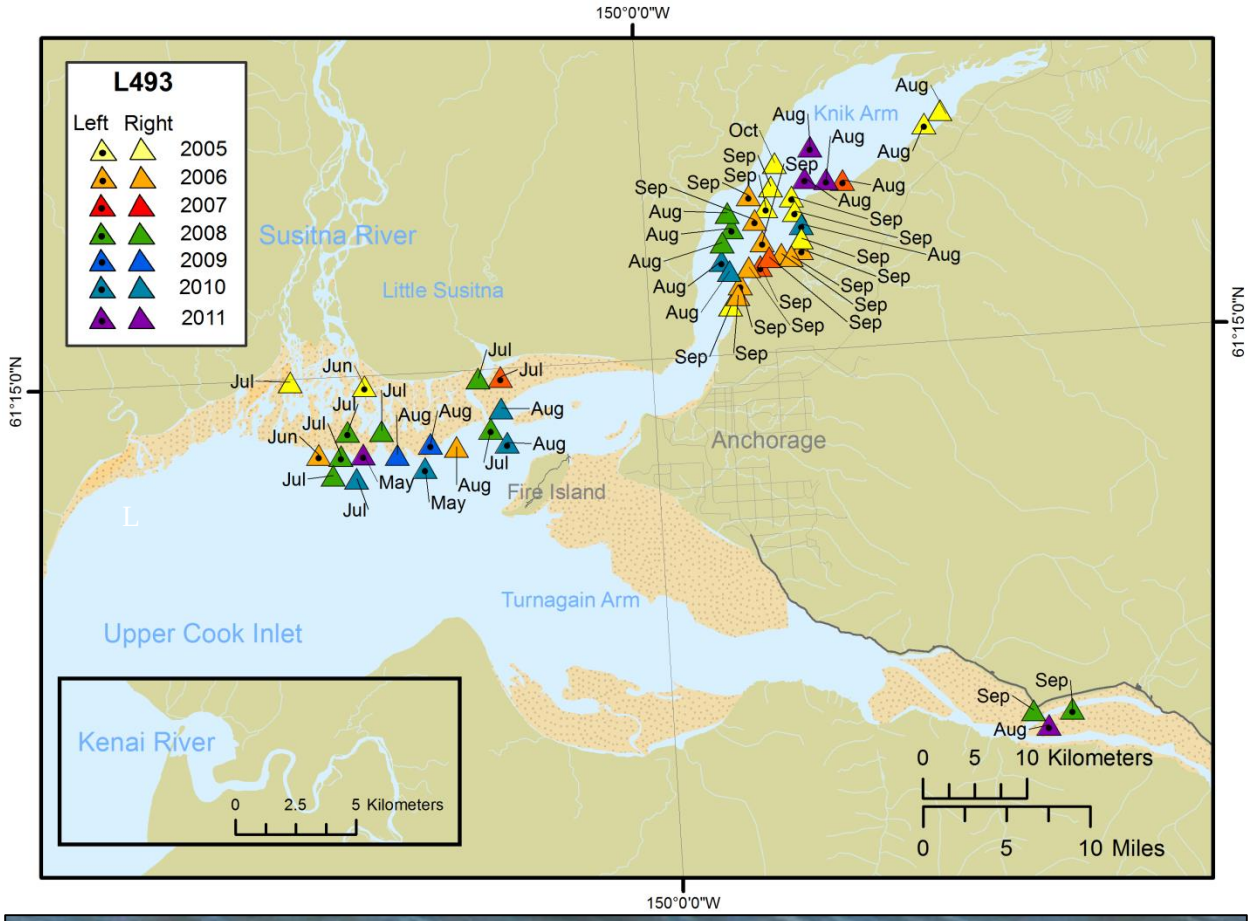


Figure 20. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L493. This beluga was photographed every year from 2005-2011 and is a presumed mother based on photographs with an accompanying calf. This beluga was tagged by NMFS sometime between 1999 and 2002.

Sighting histories of belugas identified by satellite tag scars

Eight belugas photo-identified by their left sides had unique scars from satellite tags affixed between 1999 and 2002 by NMFS (Table 6). These individuals were identified based on a combination of natural marks and the tag scars to avoid mistakenly matching similar scar patterns caused by the same tag type. Six of these previously tagged whales were also identified by marks on the right side of their bodies, and by marks that spanned the right and left sides of the body. Four previously tagged belugas were presumed to be mothers based on the close accompaniment of calves (Table 6). All of the previously tagged belugas were photographed in Knik Arm and the Susitna River Delta; 75% were also photographed in Turnagain Arm. None of the previously tagged belugas were photographed in Chickaloon Bay/Southeast Fire Island or the Kenai River Delta during the 2005-2011 surveys conducted in these areas. Individual sighting histories and photographs of previously tagged belugas are presented in Figures 21-28.

Table 6. Sighting records from 2005-2011 of eight individual belugas that were identified primarily by left-side scars from satellite tags applied by NMFS, 1999-2002, according to year and location (P=photographed).

	Susitna River Delta	**Knik Arm**	**Turnagain Arm**	**Chickaloon Bay/ SE Fire Island**	**Kenai River Delta**
	# of Surveys	# of Surveys	# of Surveys	# of Surveys	# of Surveys
Whale ID	90	99	71	7	4
L2327	P	P	P		
L493 [M]	P	P	P		
L1936 [M]	P	P			
L2204 [M]	P	P	P		
L2303	P	P	P		
L2467 [M]	P	P			
L7861	P	P	P		
L2579	P	P	P		

M=presumed mother

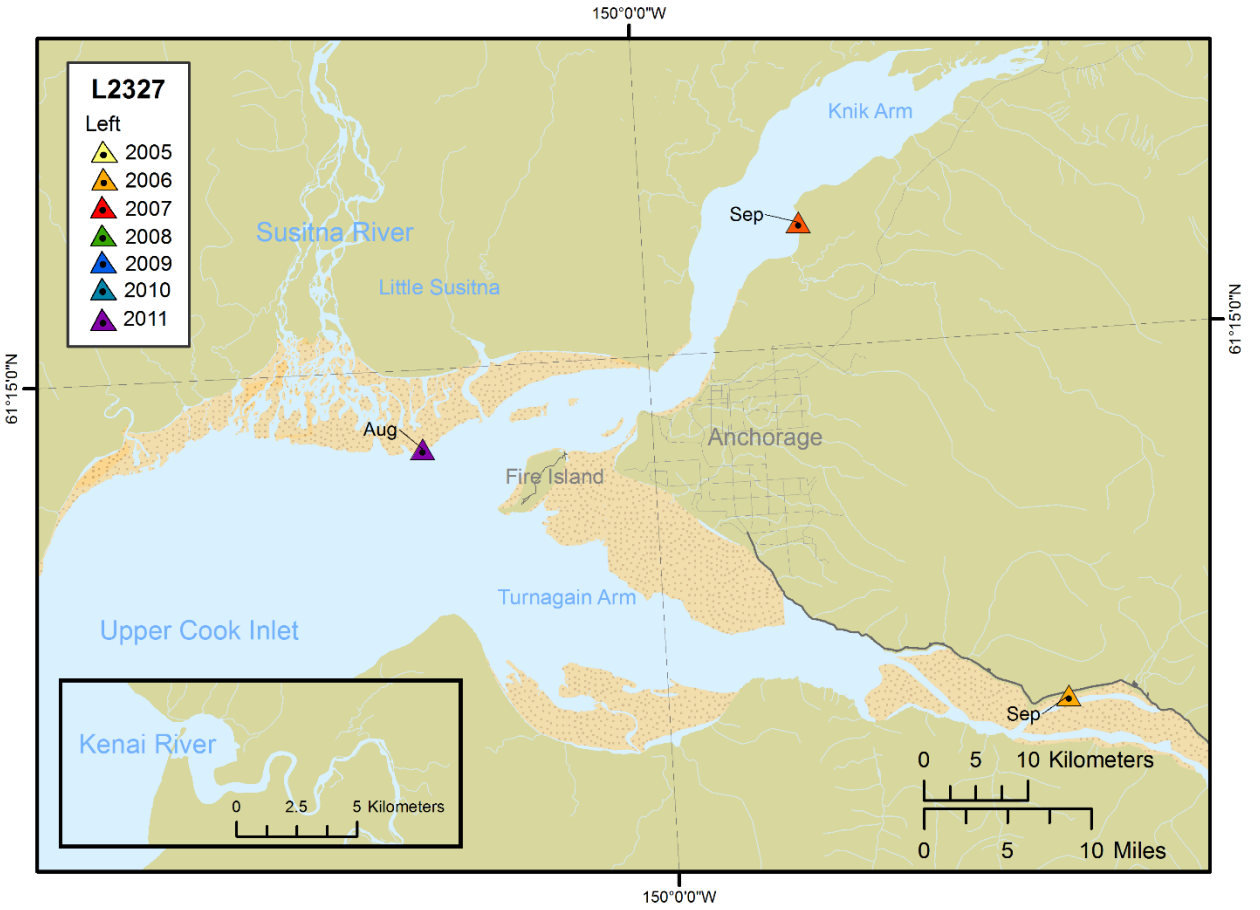


Figure 21. Sighting history and photograph of left-side beluga L2327. This beluga was tagged by NMFS sometime between 1999 and 2002.

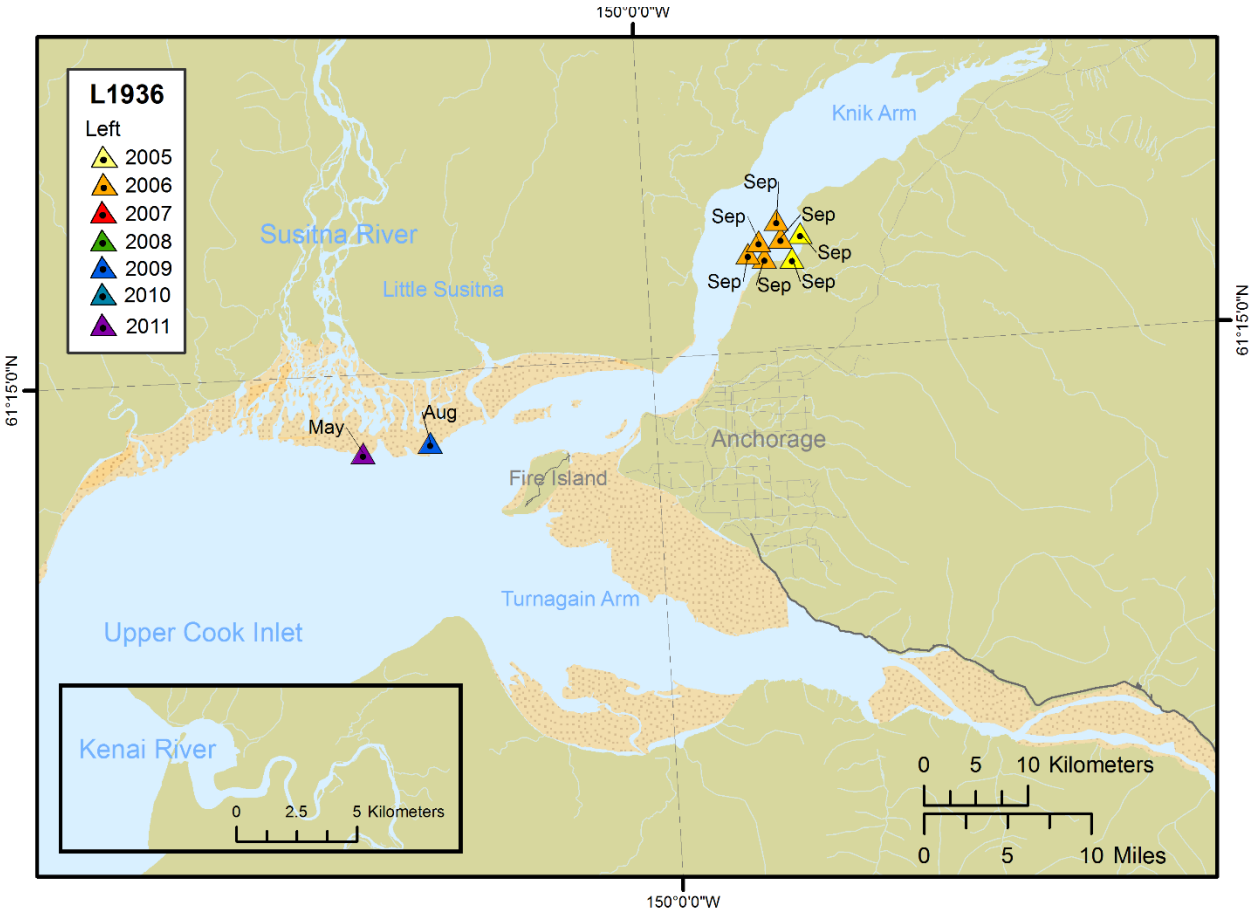


Figure 22. Sighting history and photograph of left-side beluga L1936. This whale is a presumed mother based on photographs with an accompanying calf. This beluga was tagged by NMFS sometime between 1999 and 2002.

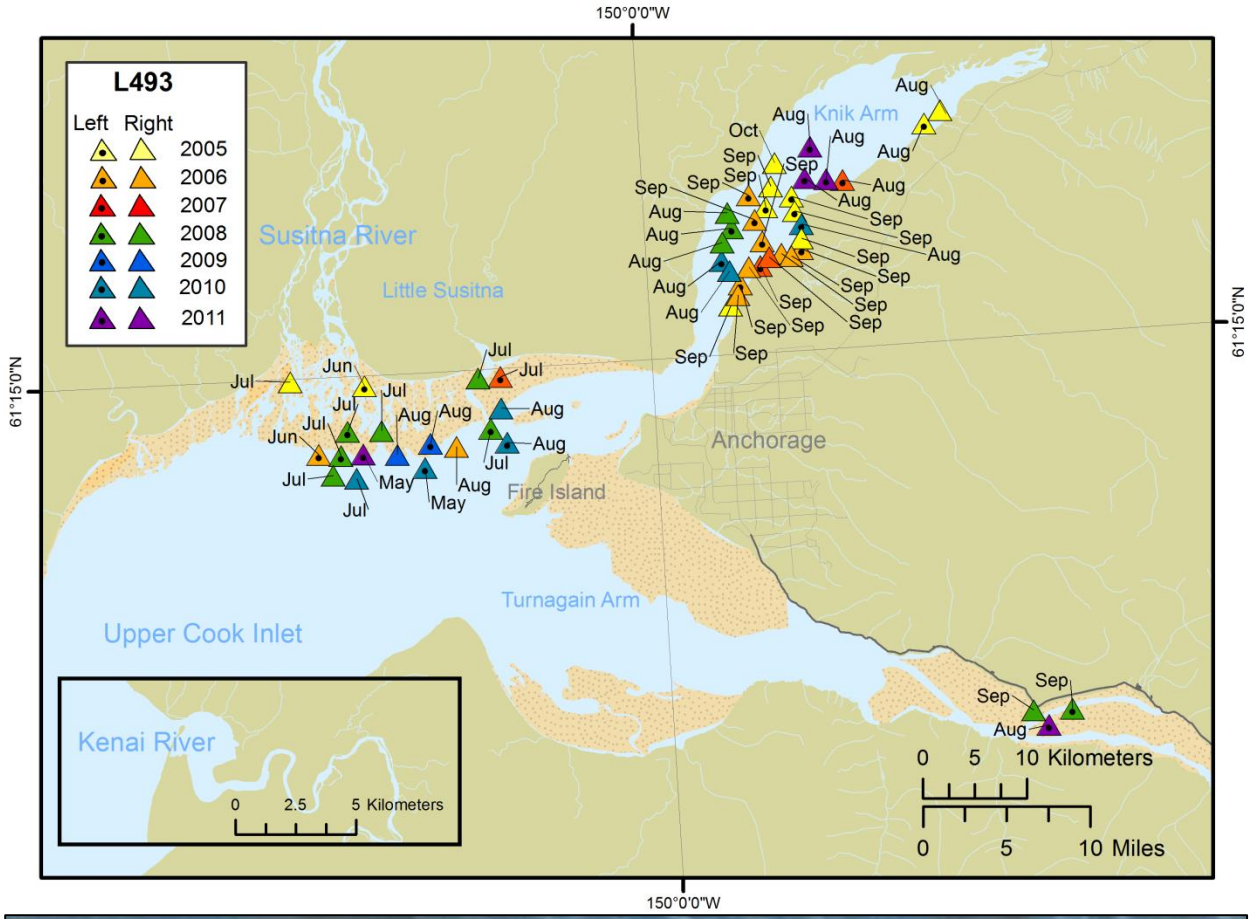


Figure 23. Sighting history (including sightings from both right- and left-side photographs) and photograph of the left-side beluga L493. This whale is a presumed mother based on photographs with an accompanying calf. This whale was tagged by NMFS sometime between 1999 and 2002.

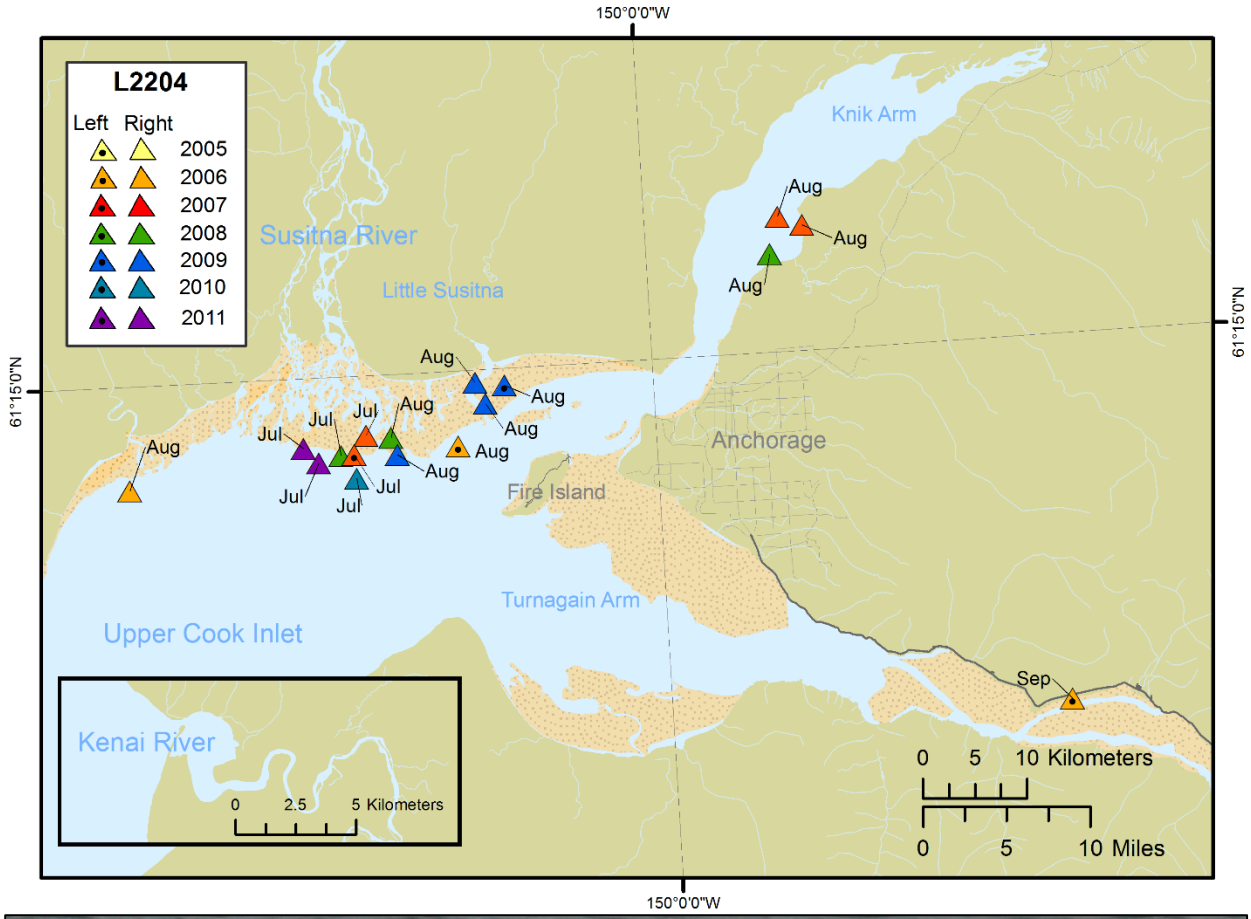
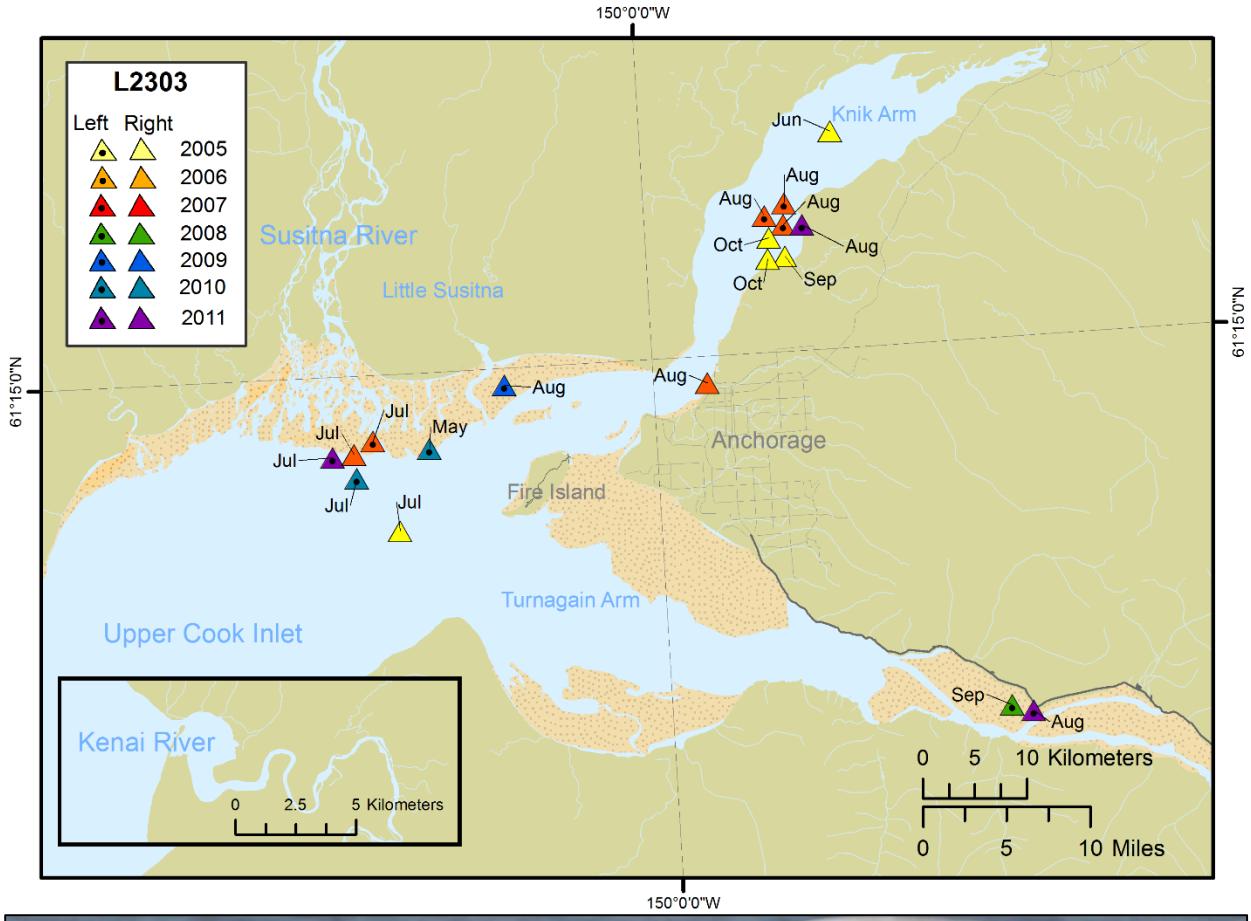


Figure 24. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L2204. This whale is a presumed mother based on photographs with and accompanying calf. This beluga was tagged by NMFS sometime between 1999 and 2002.



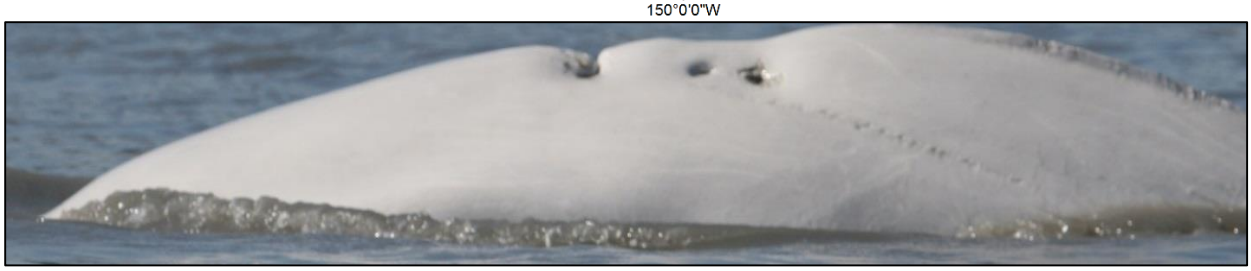
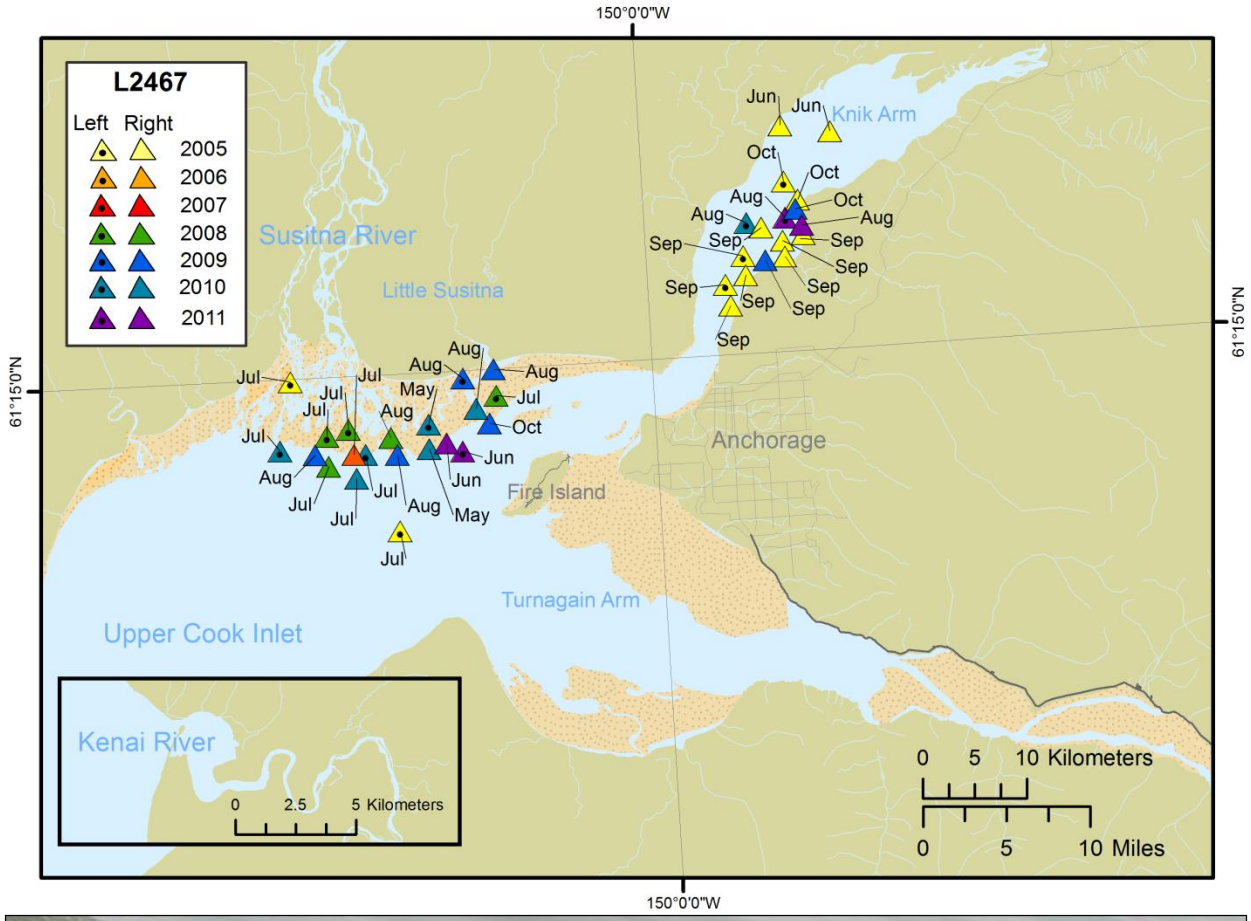


Figure 25. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L2303. This beluga was tagged by NMFS sometime between 1999 and 2002.



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694 **Figure 26. Sighting history (including sightings from both right- and left-side photographs) and photograph**
695 **of left-side beluga L2467. This whale is a presumed mother based on photographs with and accompanying**
696 **calf. This beluga was tagged by NMFS sometime between 1999 and 2002.**
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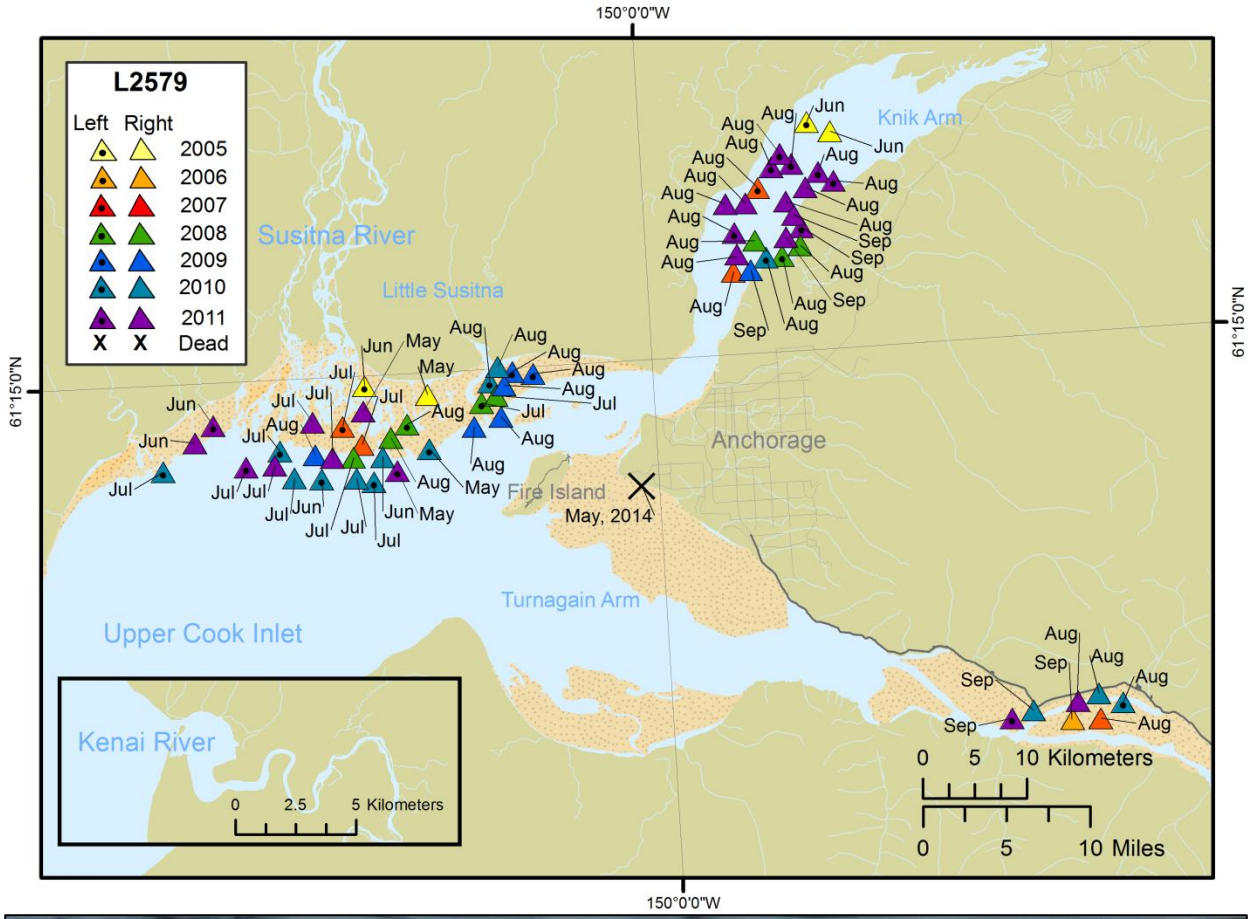


Figure 27. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L2579. This beluga was tagged by NMFS sometime between 1999 and 2002. This whale was found dead near Kincaid Park in Anchorage in 2014 and was confirmed to be a male.

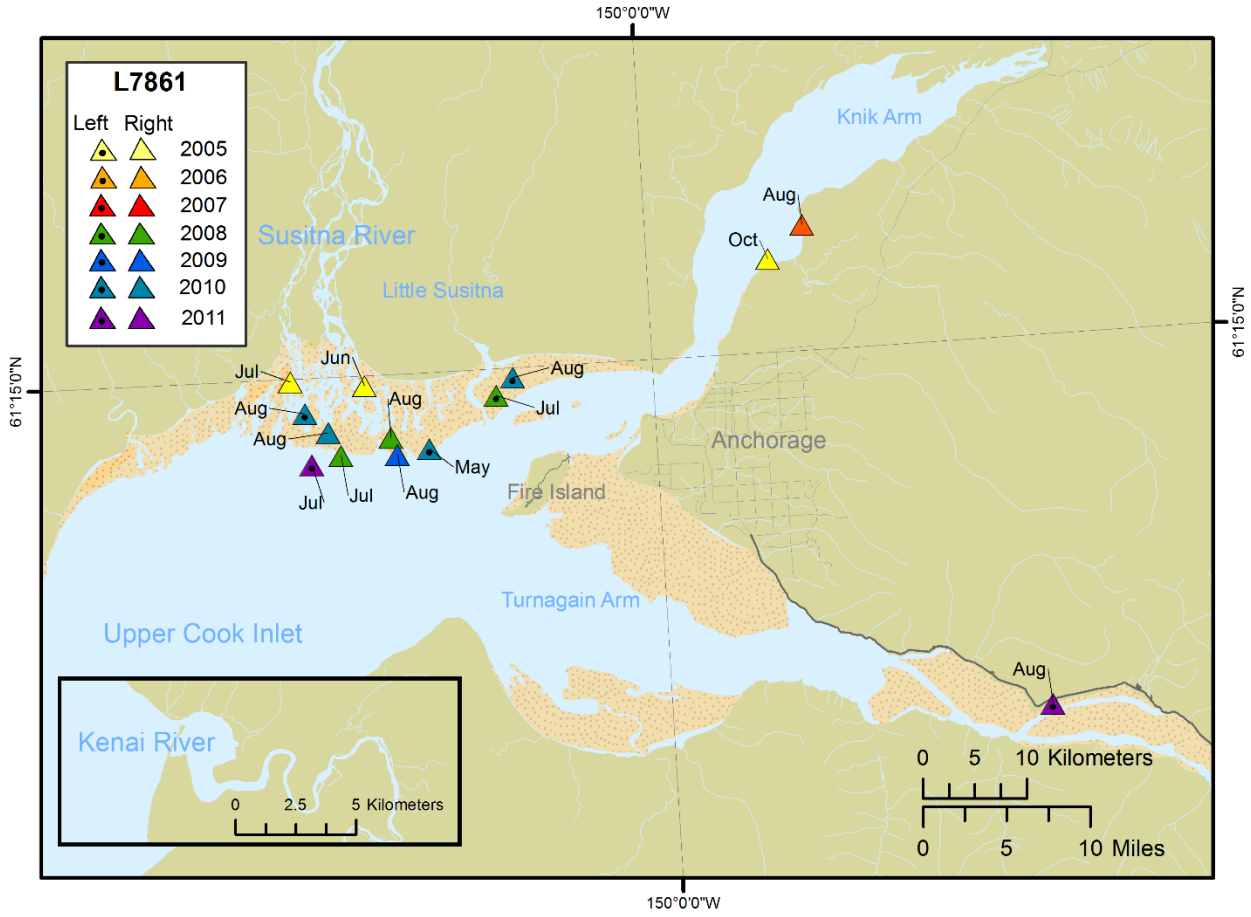


Figure 28. Sighting history (including sightings from both right- and left-side photographs) and photograph of left-side beluga L7861. This beluga was tagged by NMFS sometime between 1999 and 2002.

Sighting histories of mothers and their calves

A total of 117 identified belugas were presumed to be reproductive adult females; this presumption was based on left-side photographs taken of these females from 2005 to 2011 in which they were closely accompanied by calves (Table 7). In all, 39% of the 296 individuals in the left-side catalog have been classified as presumed mothers. The position of the calf relative to the presumed mother was either the "neonate position", in which the calf surfaced just above the mother's midline (Figure 29), or the "calf position" alongside the posterior half of the mother (Figure 30). Position descriptions are based on those described for bottlenose dolphins *Tursiops* sp. by Mann and Smuts (1999), and for belugas by Krasnova et al. (2009). Size rather than position descriptions were used to estimate the age of the calf.

Fifty-six identified belugas were photographed with calves in more than one year (Table 7) and five identified belugas were seen with a calf in four or more years. Of the presumed mothers seen with a calf in four or more years, all five were photographed with maturing calves (i.e., if a presumed mother was seen with a calf in multiple years, and the calf appeared larger every year, it was assumed to be the same calf maturing; Figure 31), and three of these were each first seen with a larger calf, then 1 or 2 years later, were seen with a much smaller calf (which were assumed to be a new calves).

The majority of calves seen during surveys could not be identified as individuals because they were either not marked or they were never photographed with enough of the body above water to allow marks to be seen. No neonate calves were identified as individuals. Twelve calves were individually identified between 2005 and 2011 (Figure 32 ; Table 8). Eleven of these calves were large (i.e., 2/3 the body length of an adult), one was medium-size (i.e., ½ the body length of an adult), and each was photographed with a larger, lighter-colored beluga assumed to be the mother.

Calves and neonates were seen in all areas of Cook Inlet where beluga groups were encountered during photo-id surveys 2005-2011 (Figure 33). Groups with calves and neonates were generally closer to shore than groups without. Details of group compositions of calves and neonates according to area and date are described in McGuire and Kaplan 2009 and McGuire et al. 2013a,b, 2014a,b.

Table 7. Yearly sighting records of five individual beluga whales presumed to be mothers based on the close accompaniment of a calf in photographs taken 2005-2011 (C=photographed with a calf, P=photographed without a calf, N=not photographed).

	2005	2006	2007	2008	2009	2010	2011		
# of Survey Days	49	38	23	32	32	35	42		
Whale ID								**# Years Seen with a Calf**	**Calf Age Information Inferred from Individuals seen with Calves in >3years (CBD=could not be determined)**
L461	C	C	N	P	C	C	C	5	maturing 2005-2006; smaller 2009; maturing 2010-2011
L1772	C	C	P	C	C	P	P	4	CBD 2005-2006; maturing 2008, CBD 2009
L2257	N	N	C	C	P	C	C	4	maturing 2007-2008; smaller 2010, maturing 2011
L339	N	P	C	N	C	C	C	4	maturing 2007, 2009, 2010; CBD 2011
L401	P	C	C	P	C	C	P	4	maturing 2006, 2007, 2009; smaller 2010
23 left-side whales								3	
28 left-side whales								2	
61 left-side whales								1	

Table 8. Yearly sighting records of 12 individual beluga whales assumed to be calves based on the proximity of a larger, whiter beluga at least once, 2005-2011 (N=calf not photographed, C=calf photographed).

	2005	2006	2007	2008	2009	2010	2011		
# of Survey Days	49	38	23	32	32	35	42		
Whale ID								# Years Calf Seen	Size Estimates
L2140	N	N	C	C	N	C	C	4	Large calf (=2/3 length associated adult)
L2379	C	N	N	C	N	C	C	4	Large calf (=2/3 length associated adult)
L270	C	N	N	N	N	C	C	3	Large calf (=2/3 length associated adult)
L259	C	C	N	N	N	N	N	2	Large calf (=2/3 length associated adult)
L10813	N	N	N	N	N	C	C	2	Large calf (=2/3 length associated adult)
L2299	N	N	C	N	N	N	N	1	Large calf (=2/3 length associated adult)
L8025	N	N	N	N	N	C	N	1	Large calf (=2/3 length associated adult)
L10367	N	N	N	N	N	N	C	1	Large calf (=2/3 length associated adult)
L10627	N	N	N	N	N	N	C	1	Large calf (=2/3 length associated adult)
L10799	N	N	N	N	N	N	C	1	Large calf (=2/3 length associated adult)
L10994	N	N	N	N	N	N	C	1	Medium calf (=1/2 length associated adult)
L8120	N	N	N	N	N	C	N	1	Large calf (=2/3 length associated adult)

Figure 29. Example of a calf swimming alongside the front half of the presumed mother, in the "neonate" position. Image is of the right side of both whales.

Figure 30. Example of a calf swimming alongside the rear half of the presumed mother, in the "calf position". Image is of the left side of both whales.

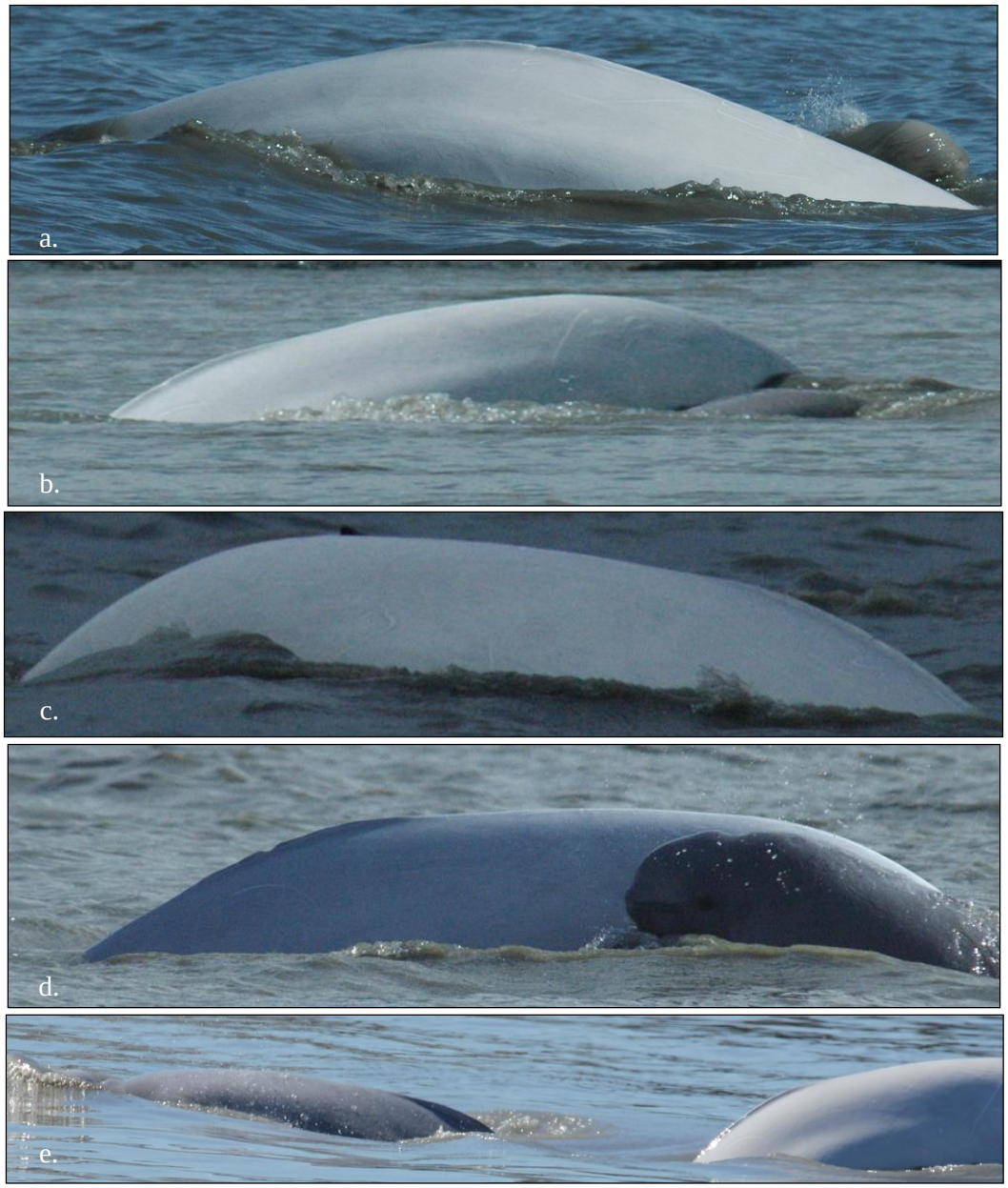


Figure 31. Adult beluga 'L492' accompanied by a calf in 2007 (a, b), 2008 (c, d), and 2011. Left-side images (b, d, e) indicate the calf is maturing (i.e., larger with each year); right side images (a, c) donot show enough of the calf to detect changes in size. (Photo "e" credit: Stacy DeRuiter.

Figure 32. Identified calf "L10994" accompanied by adult L2254 in 2011. Photo credit: Stacy DeRuiter.

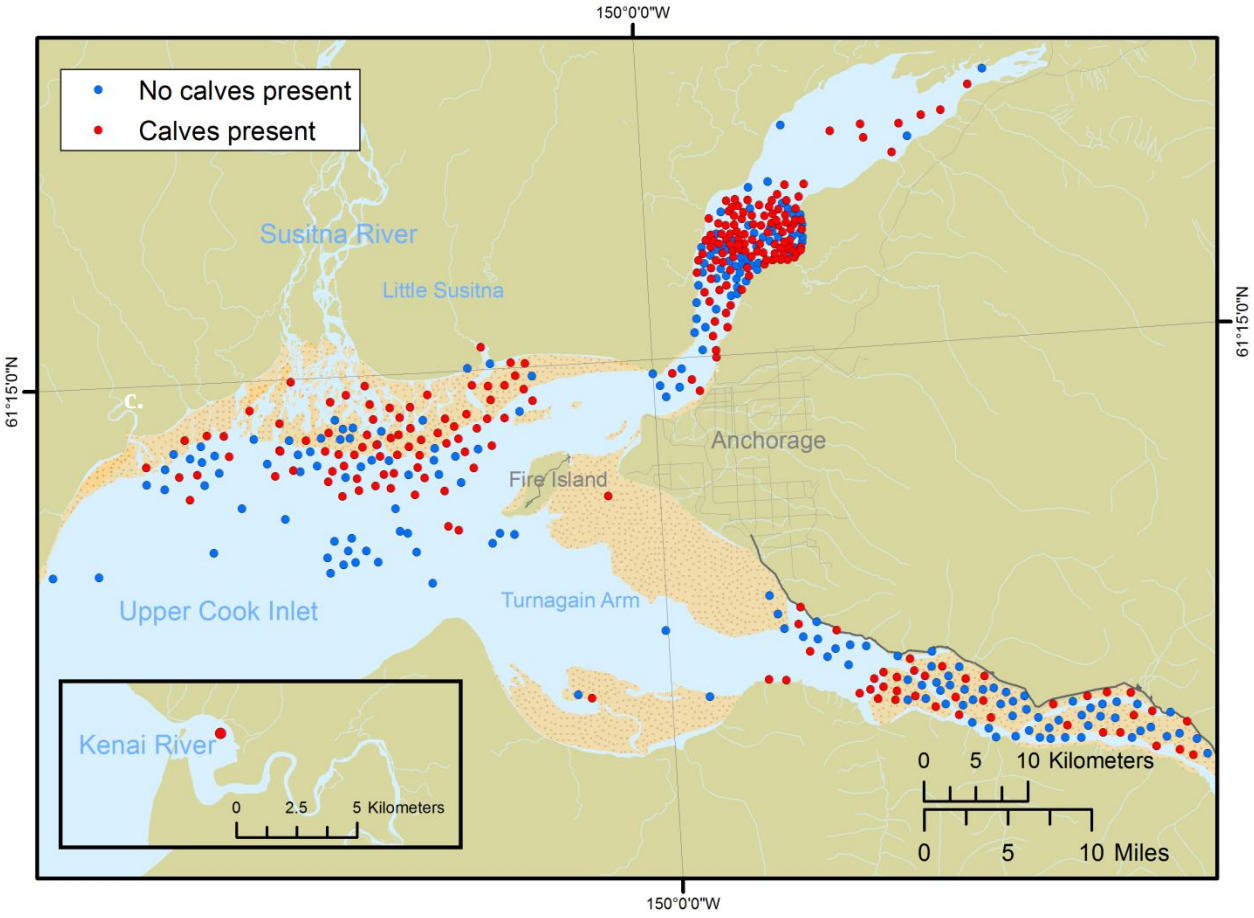


Figure 33. Locations of groups with and without calves (i.e., calves and neonates) encountered during boat- and land-based photo-id surveys of Upper Cook Inlet, Alaska, 2005-2011.

Sighting histories of belugas identified on both the right and left sides

Twenty-eight whales identified as individuals in the 2005-2011 left-side catalog were also identified as individuals in the 2005-2011 right-side catalog (McGuire et al. 2009, 2011a,b). Combining data from the right- and left-side catalogs for the 28 "dual" side whales provided additional information

about sighting histories, including sighting years, records of mothers and calves, and known ranges of individuals. Individual sighting histories and photographs of these dual-side whales are presented in Figures 34-61.

Several dual-side whales gained additional years of sighting records from the addition of left-side photographs. For example, beluga L401 had sighting records from 2005, 2008, and 2011 in the right-side catalog, but was photographed on the left side every year 2005-2011, which added 4 additional years (2006, 2007, 2009, 2010) to its sighting history (Figure 49).

Nineteen of the dual-side whales were presumed to be mothers, based on the close accompaniment by calves (Table 9). Five of these whales were identified as mothers from only right-side photos, and 13 were identified as mothers from both left and right-side photos. One dual-side whale (L395) was identified as a mother because of the addition of left-side photographs to its sighting history (Table 9).

Dual-side whales had areas added to their known range with addition of left-side photographs to their sighting histories. For example, right-side records for beluga L492 indicated a range of the Susitna River Delta and Knik Arm; the addition of left-side photographed expanded the range to include Turnagain Arm (Figure 61). Within some areas, there were differences between right-and left-side sightings (Figure 62). Within Knik Arm, left-side images were most likely to be taken in Eagle Bay than elsewhere within the Arm, while right-side images were taken the length of Knik Arm. Dual-side whales were identified from left-side images more often than by right-side images in Turnagain Arm.

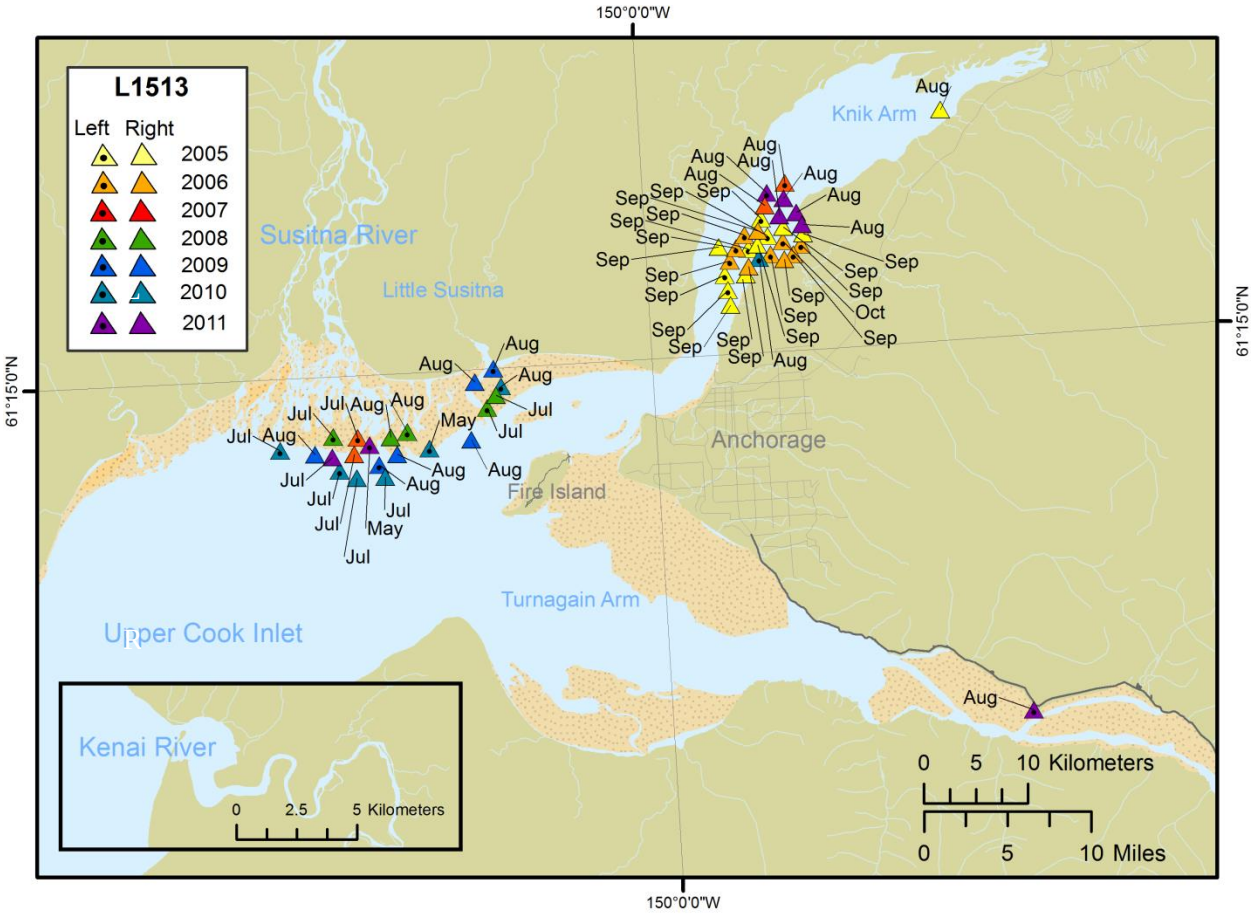
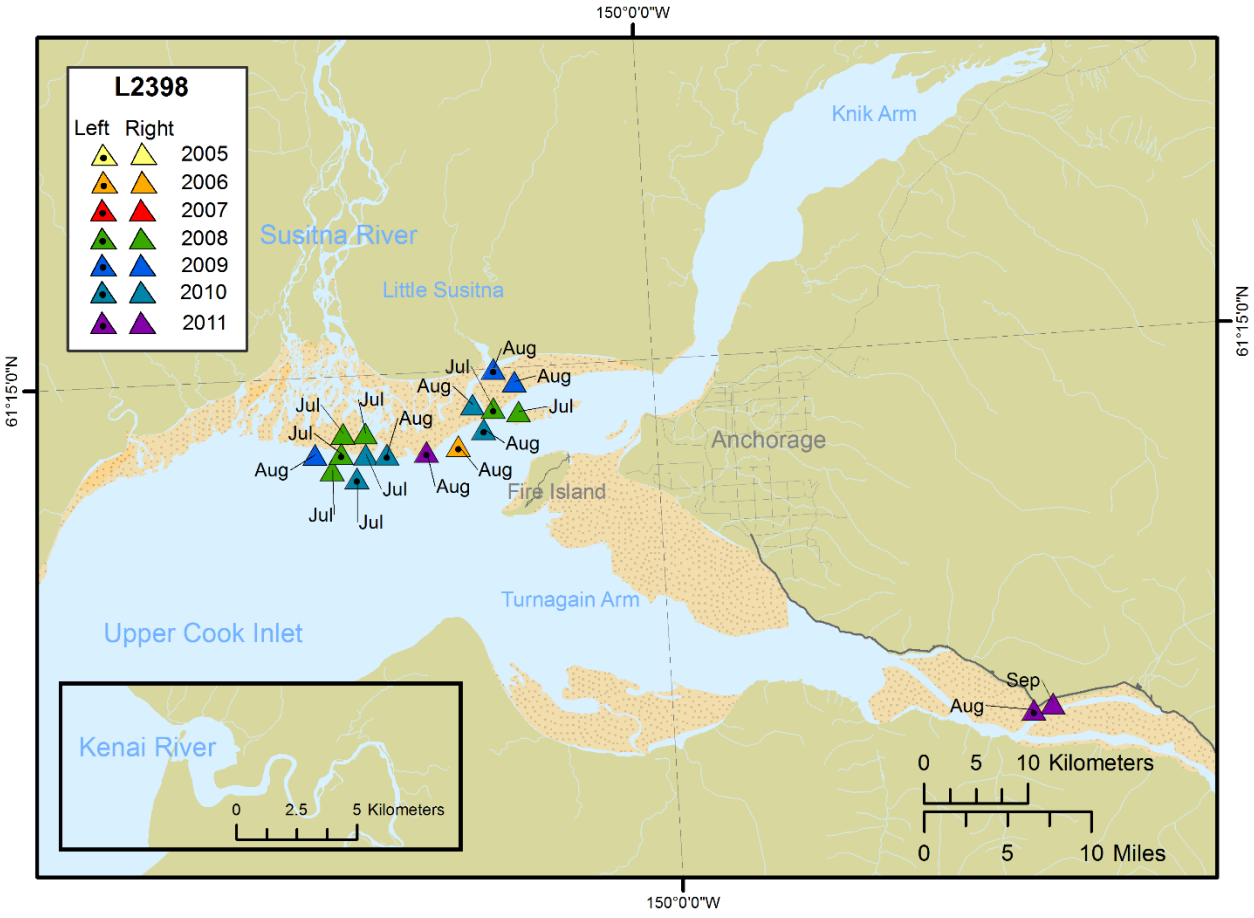


Figure 34. Sighting history and photographs of the left-side and right-side view for beluga L1513. This whale is a presumed mother based on photographs with an accompanying calf.



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822 **Figure 35. Sighting history and photographs of the left-side and right-side view for beluga L2398. This whale**
823 **is a presumed mother based on photographs with an accompanying calf.**

824

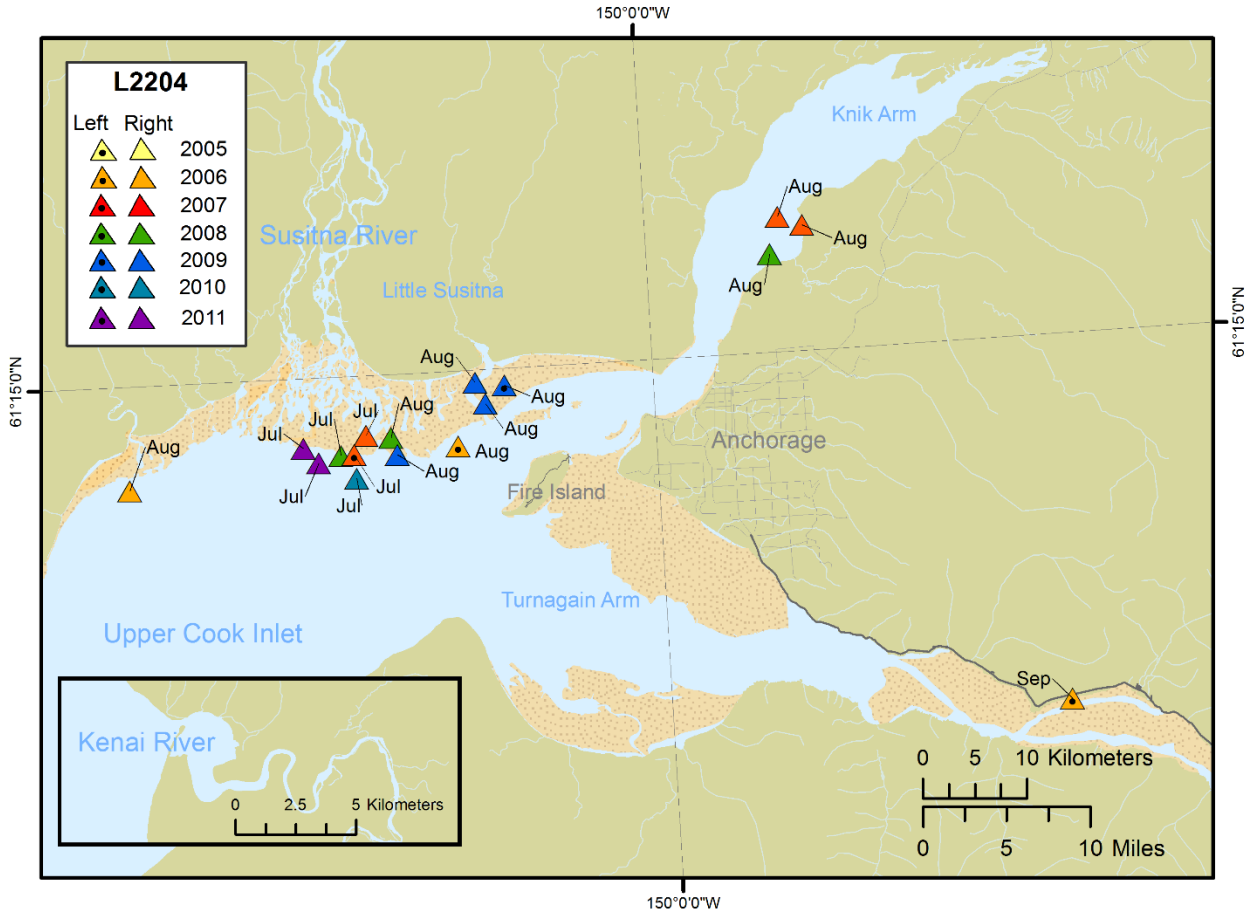
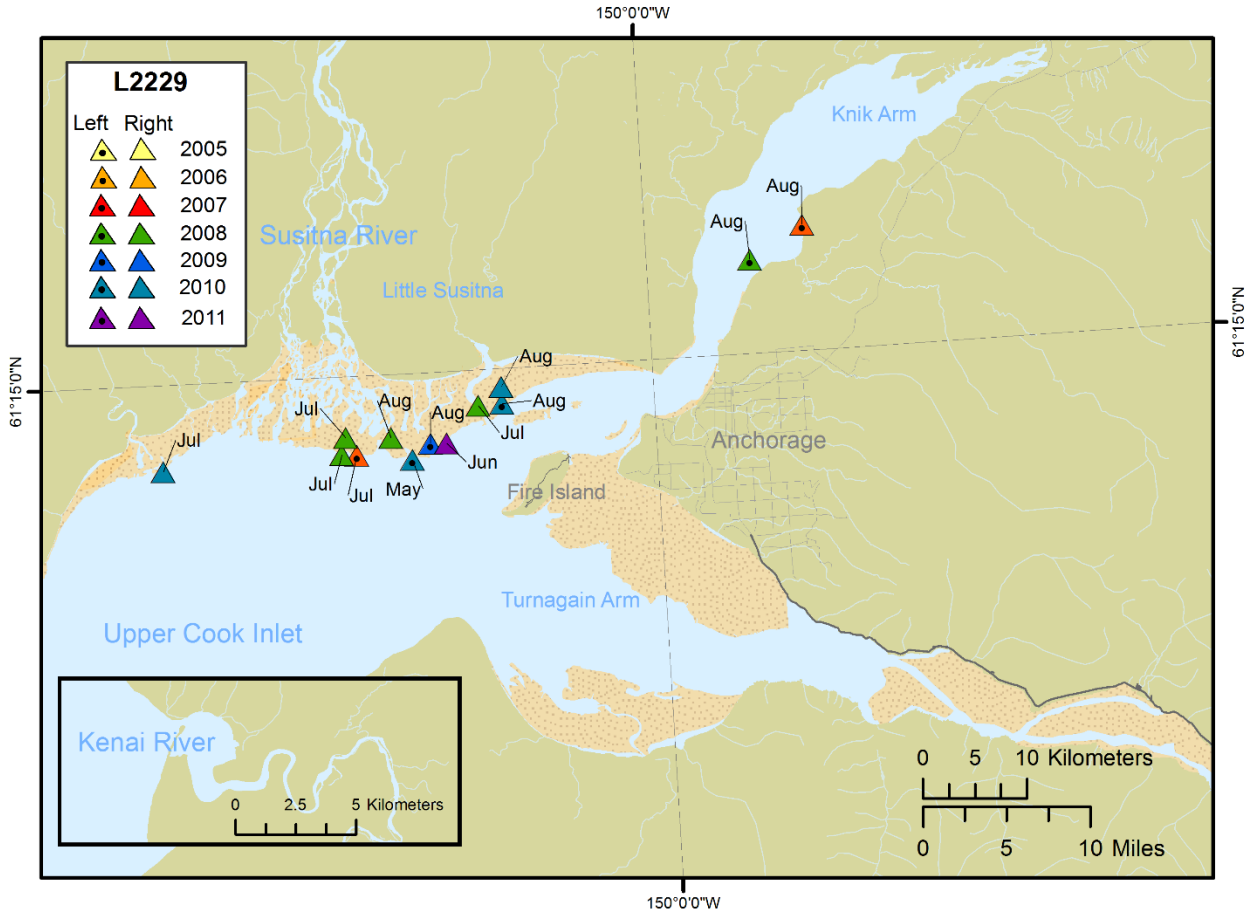


Figure 36. Sighting history and photographs of the left-side and right-side view for beluga L2204. This whale is a presumed mother based on photographs with an accompanying calf. This beluga was tagged by NMFS sometime between 1999 and 2002.



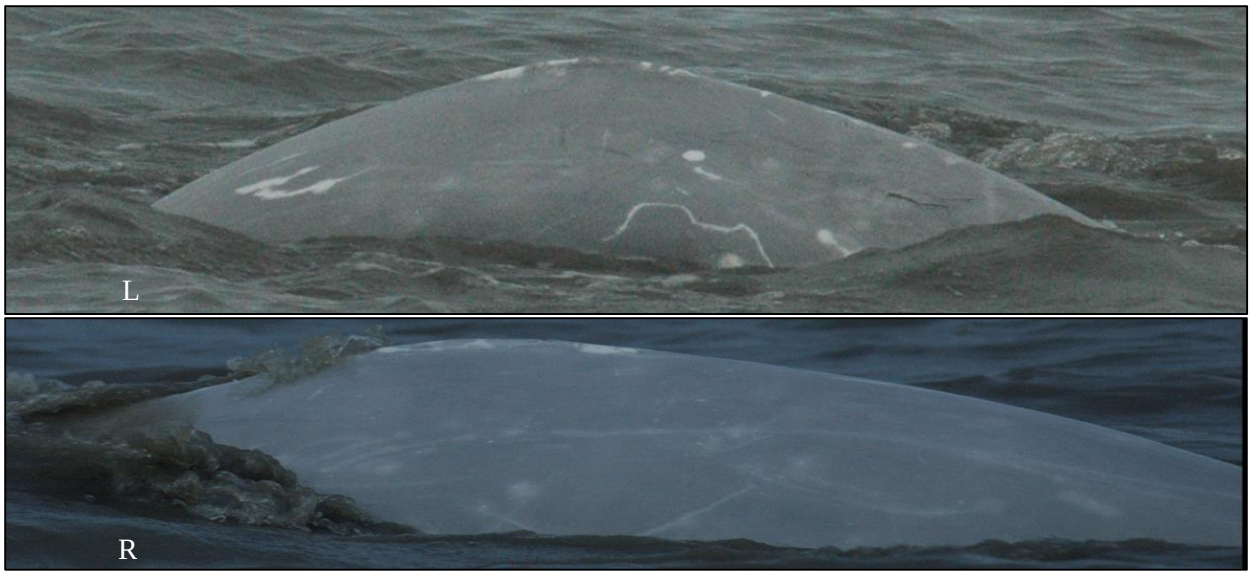
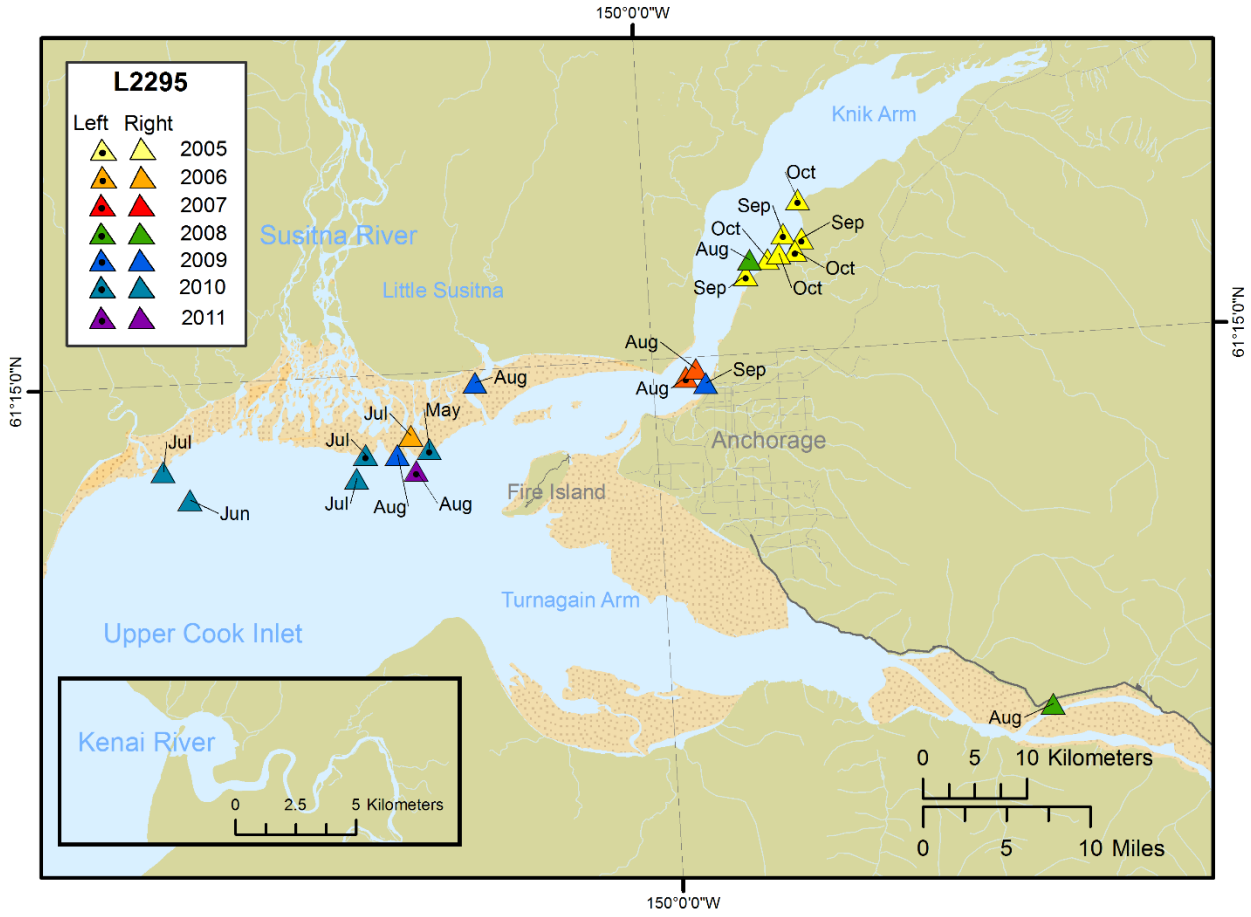


Figure 37. Sighting history and photographs of the left-side and right-side view for beluga L2229.



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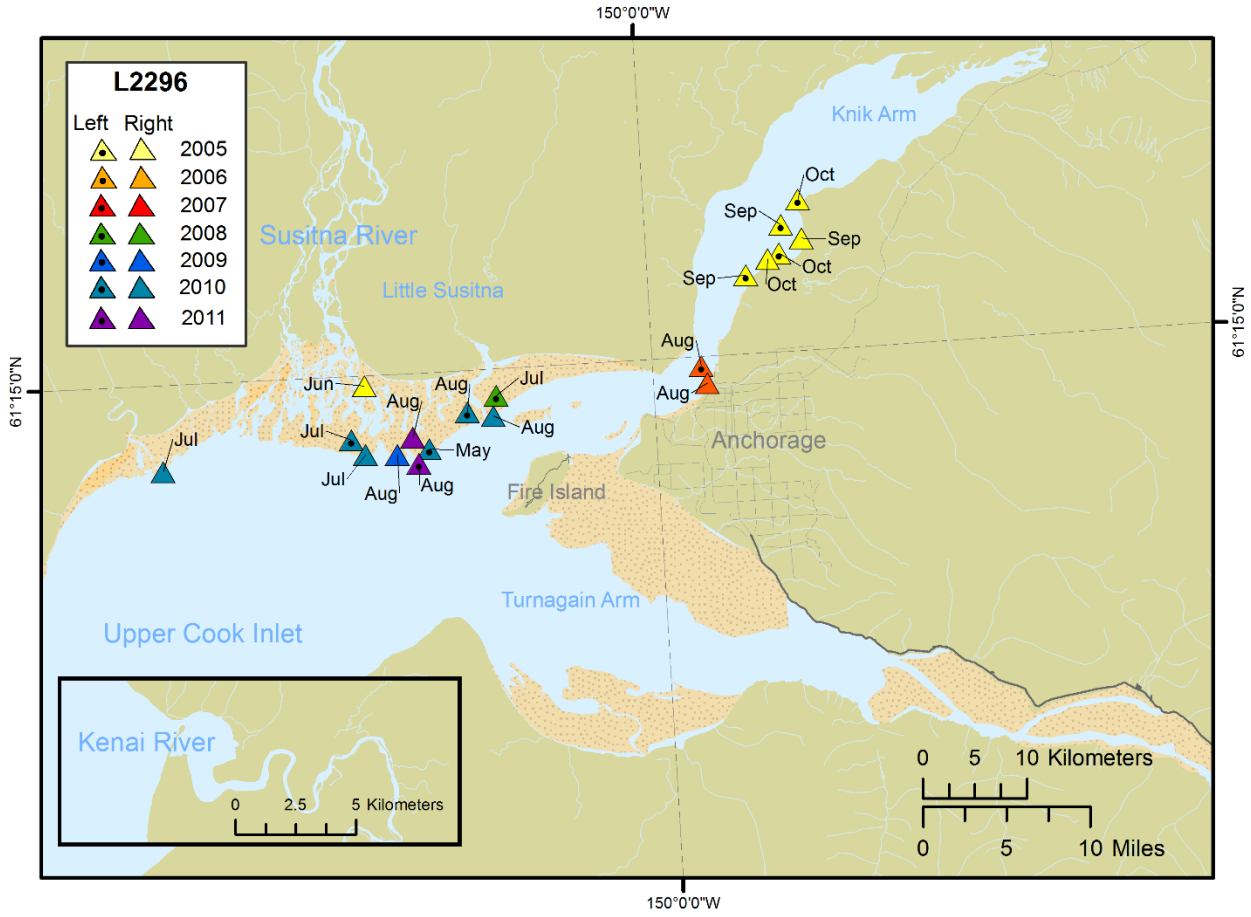
840 **Figure 38. Sighting history and photographs of the left-side and right-side view for beluga L2295. This whale**
841 **is a presumed mother based on photographs with an accompanying calf.**



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843

844 **Figure 39. Sighting history and photographs of the left-side and right-side view for beluga L2296. This whale**
845 **is a presumed mother based on photographs with an accompanying calf.**

846

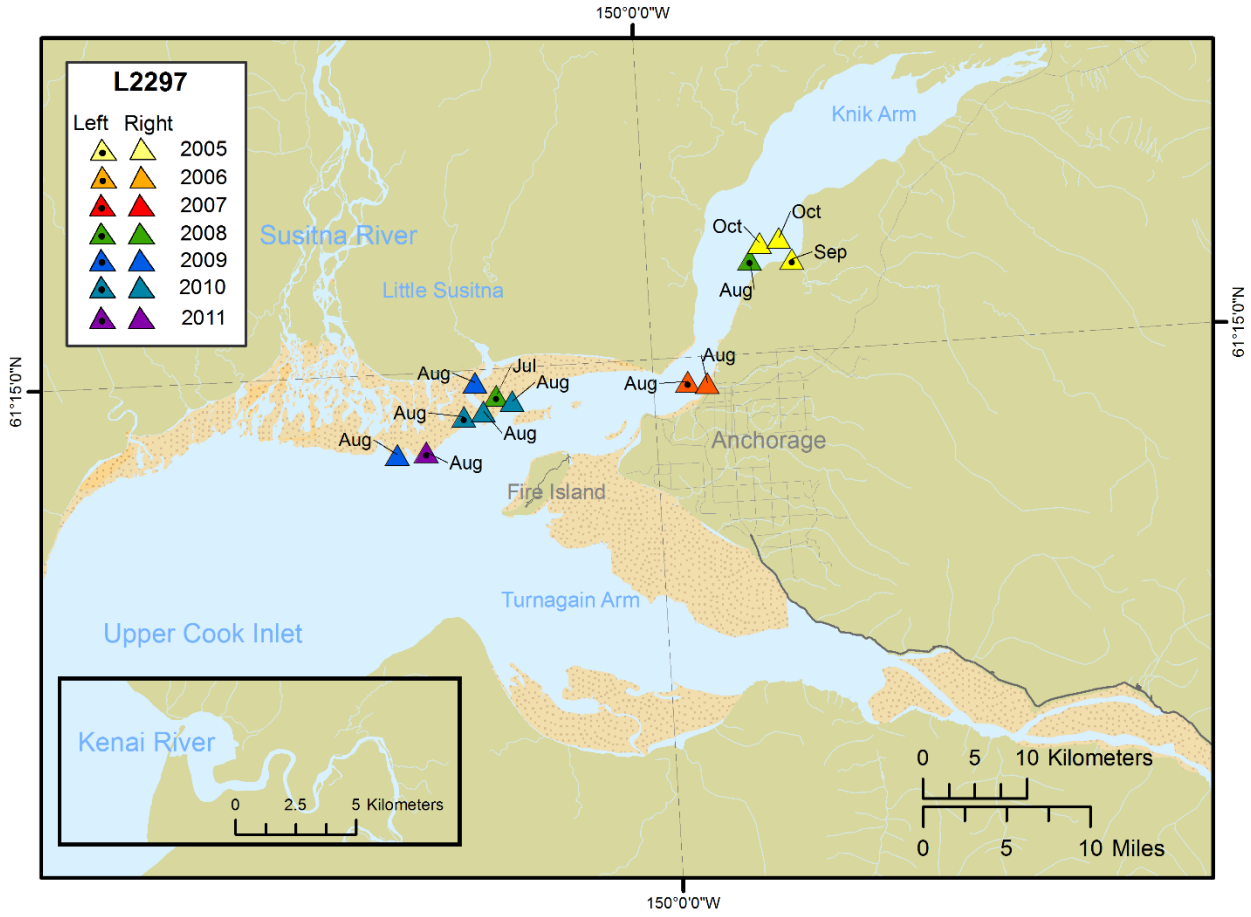
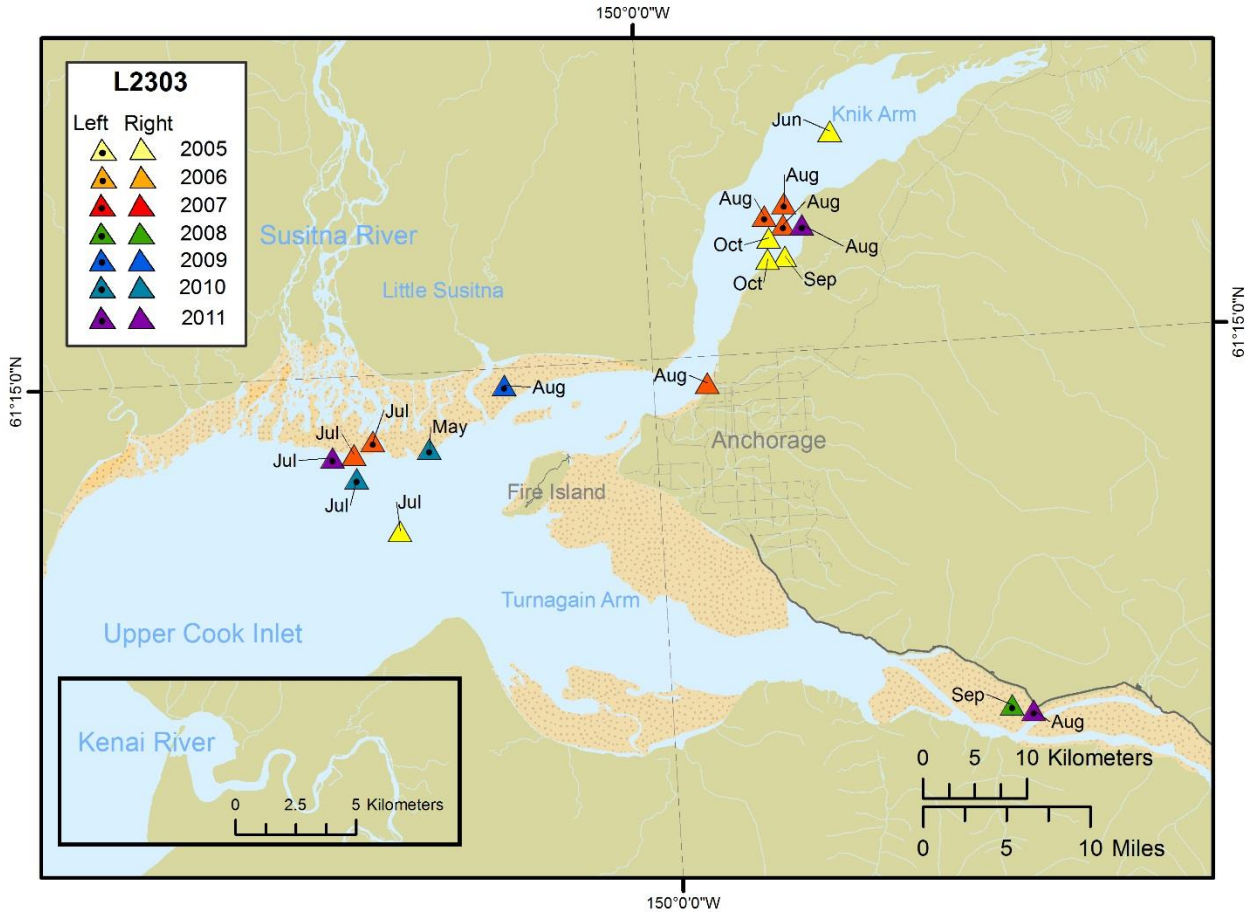


Figure 40. Sighting history and photographs of the left-side and right-side view for beluga L2297.



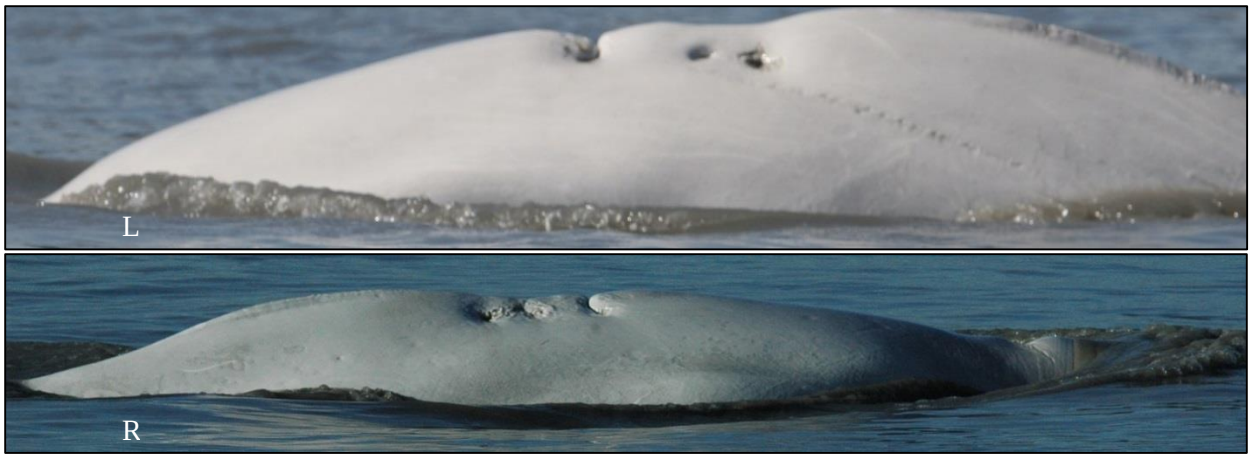
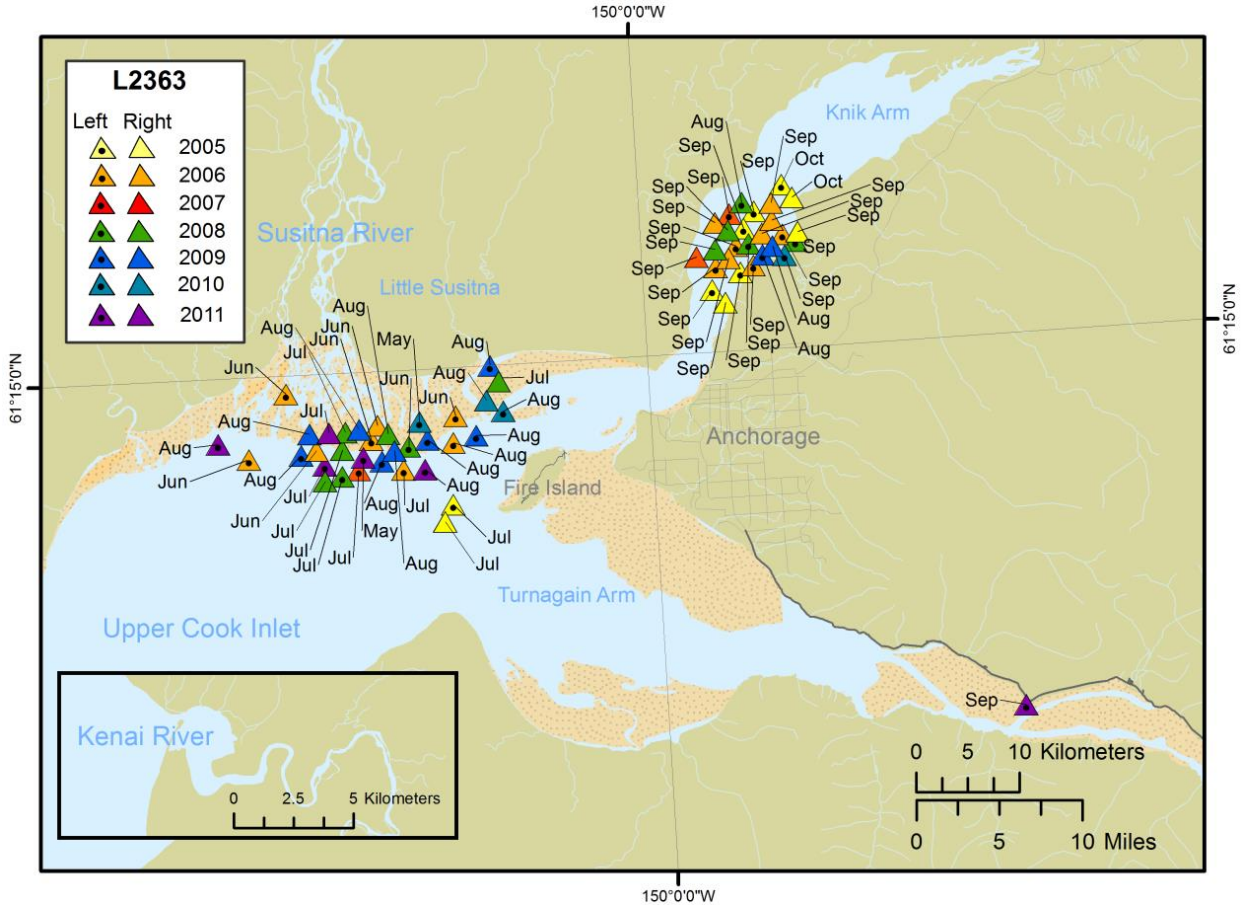


Figure 41. Sighting history and photographs of the left-side and right-side view for beluga L2303. This beluga was tagged by NMFS sometime between 1999 and 2002.



861

862 **Figure 42. Sighting history and photographs of the left-side and right-side view for beluga L2363. This whale**
863 **is a presumed mother based on photographs with an accompanying calf.**

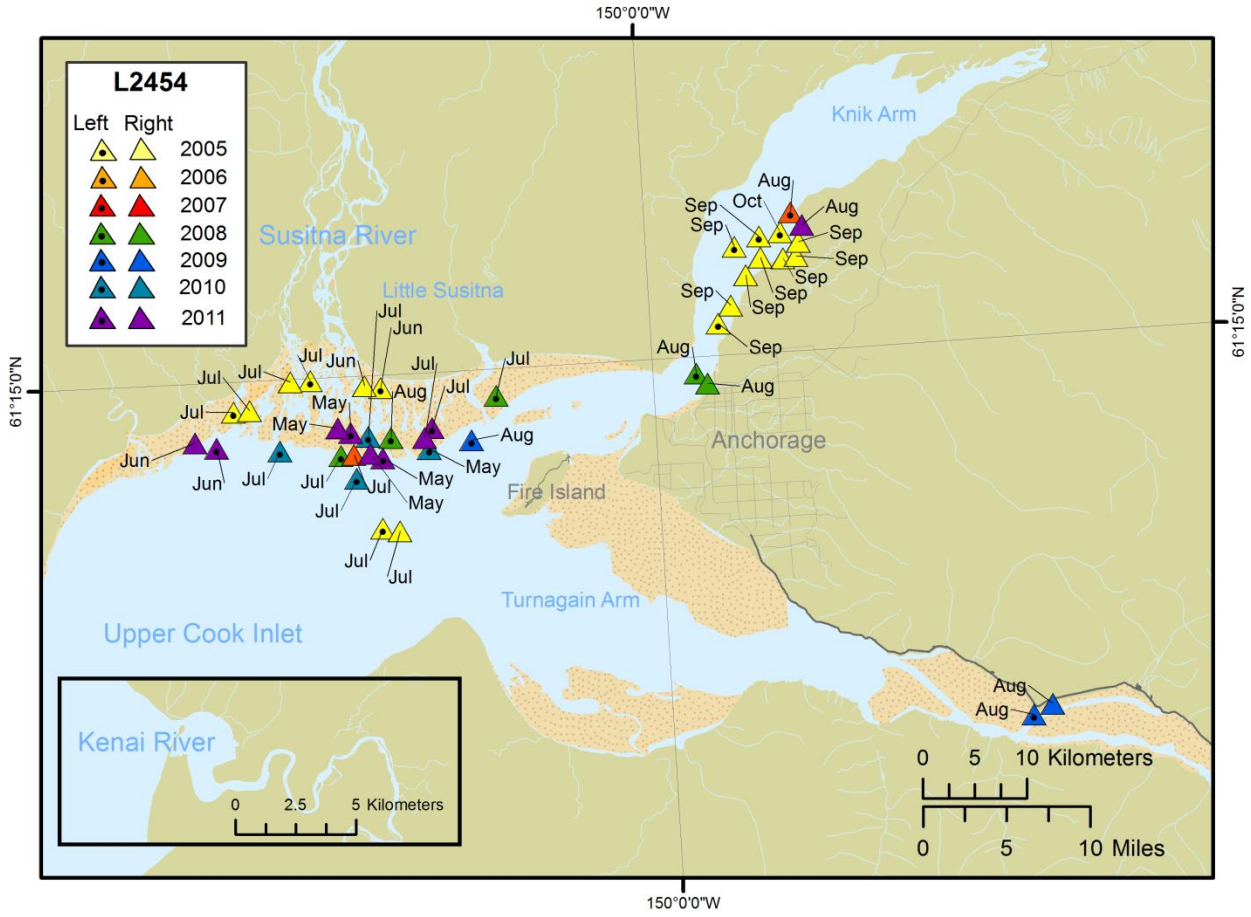
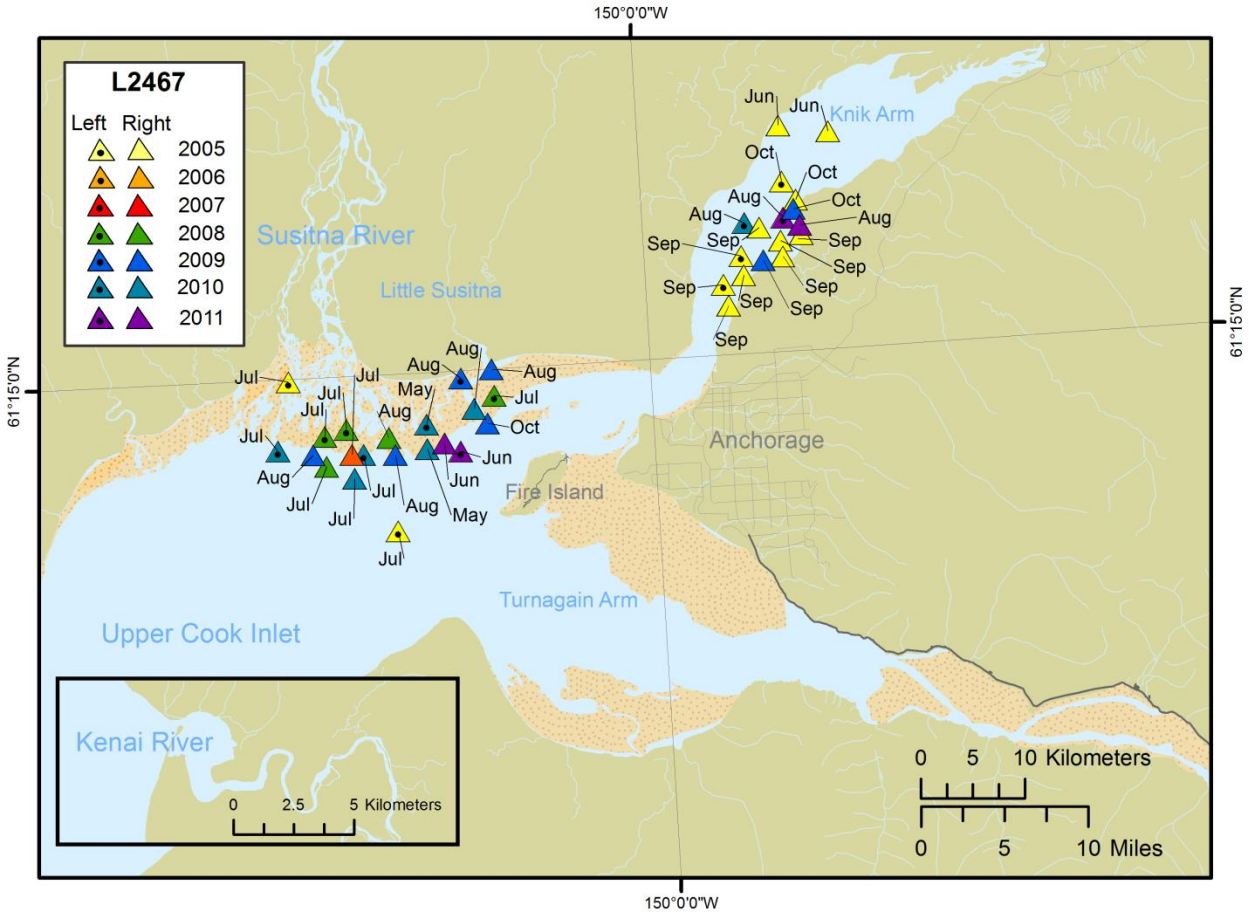


Figure 43. Sighting history and photographs of the left-side and right-side view for beluga L2454. This whale is a presumed mother based on photographs with an accompanying calf.



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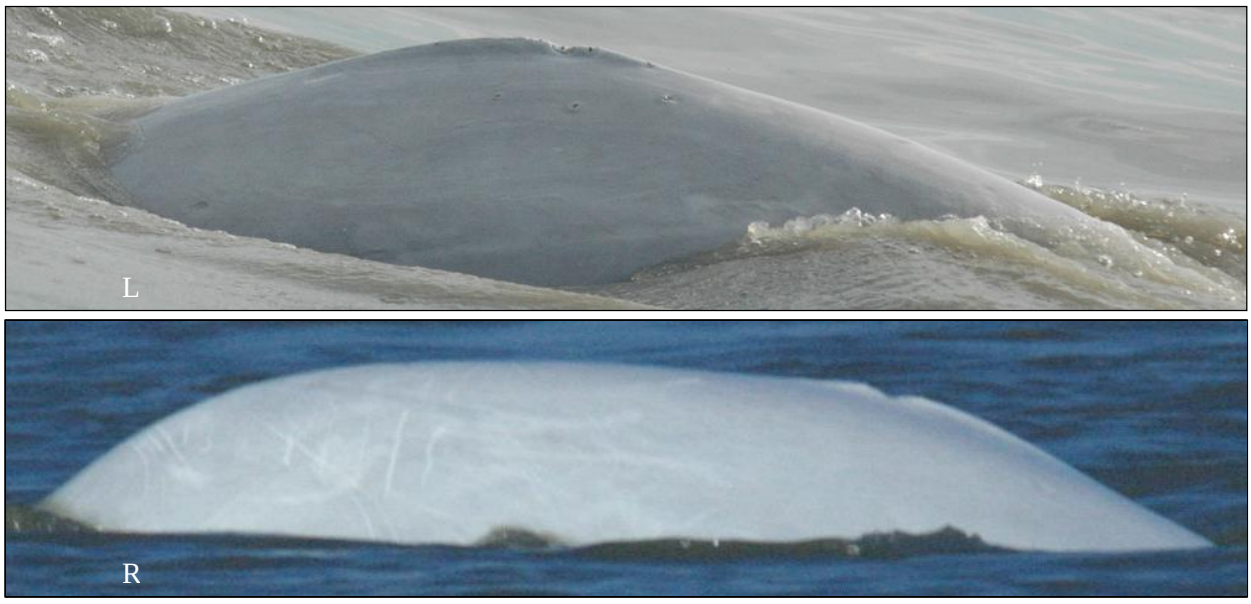
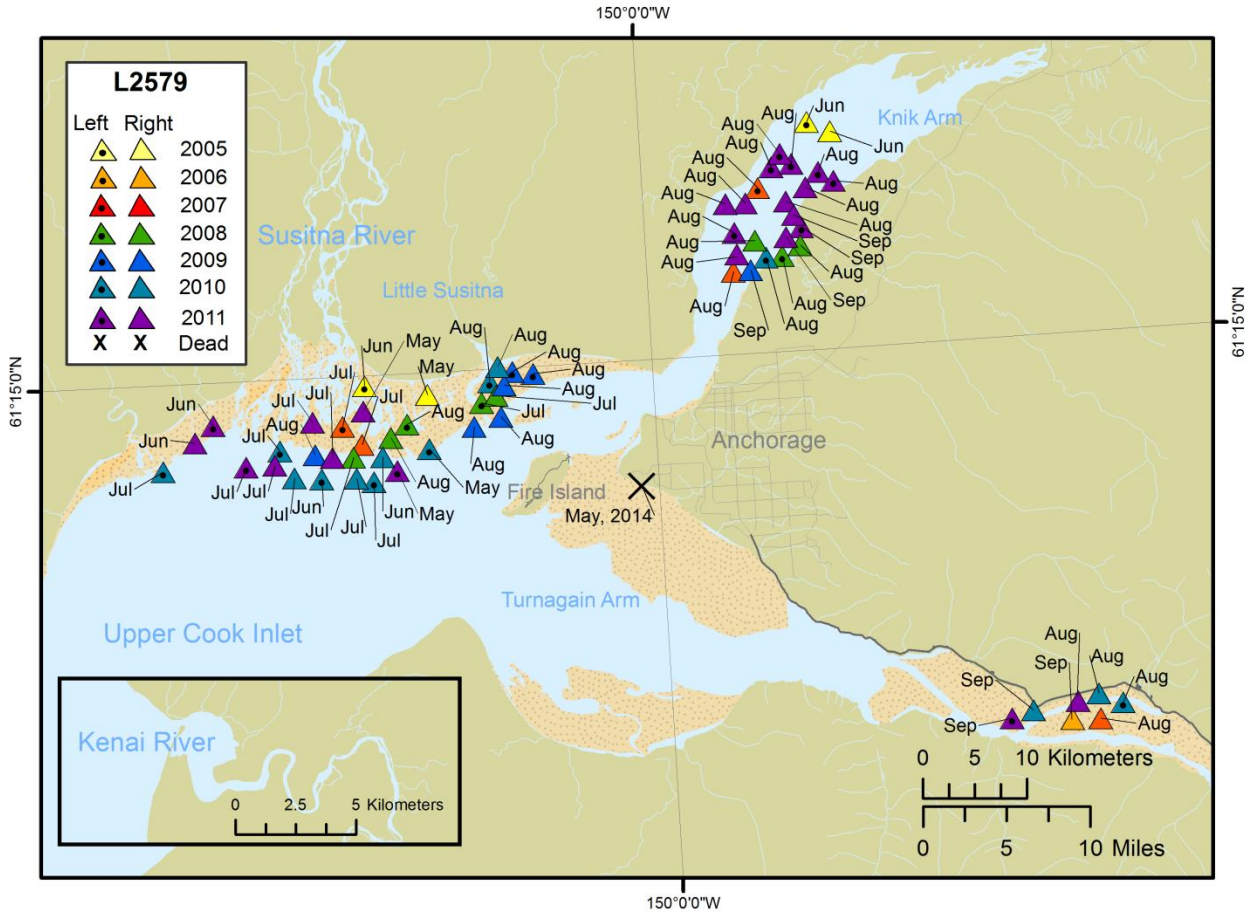


870
871 **Figure 44. Sighting history and photographs of the left-side and right-side view for beluga L2467. This whale**
872 **is a presumed mother based on photographs with an accompanying calf. This beluga was tagged by NMFS**
873 **sometime between 1999 and 2002.**
874

875



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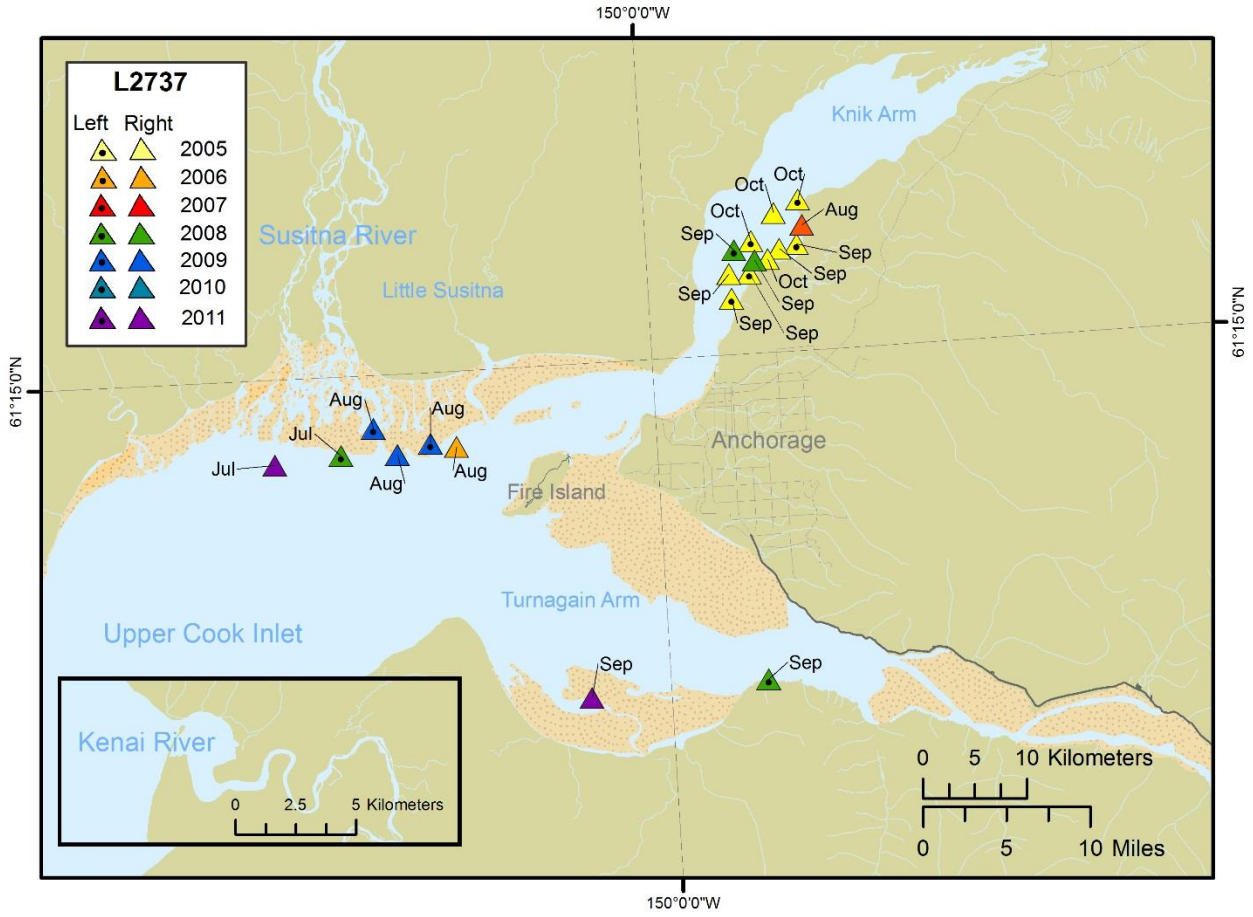
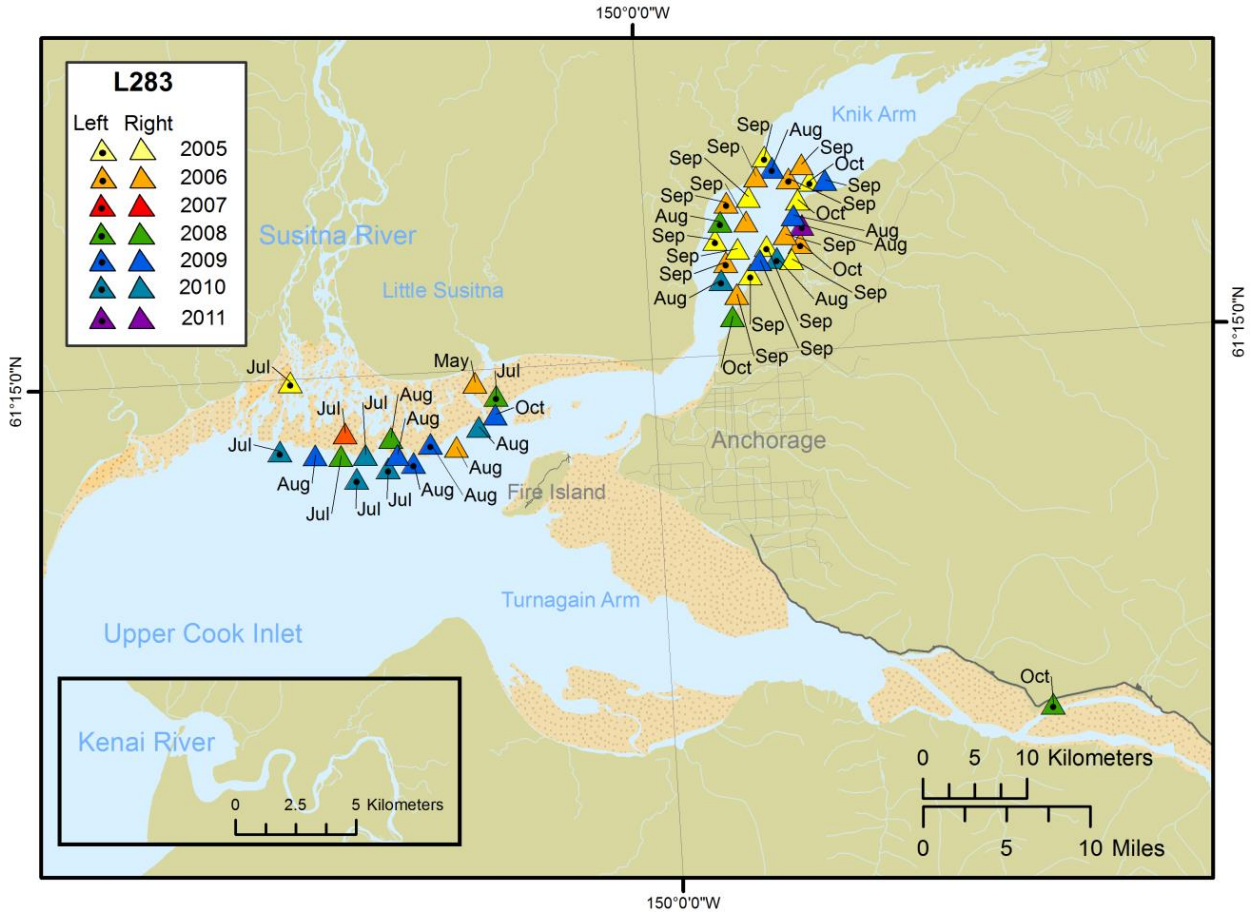
879 **Figure 45. Sighting history and photographs of the left-side and right-side view for beluga L2579. This**
880 **beluga was tagged by NMFS sometime between 1999 and 2002. This adult male was found dead in 2014 near**
881 **Kincaid Park in Anchorage.**



882

883 **Figure 46. Sighting history and photographs of the left-side and right-side view for beluga L2737. This whale**
884 **is a presumed mother based on photographs with an accompanying calf.**



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888 **Figure 47. Sighting history and photographs of the left-side and right-side view for beluga L283. This whale**
889 **is a presumed mother based on photographs with an accompanying calf.**

890

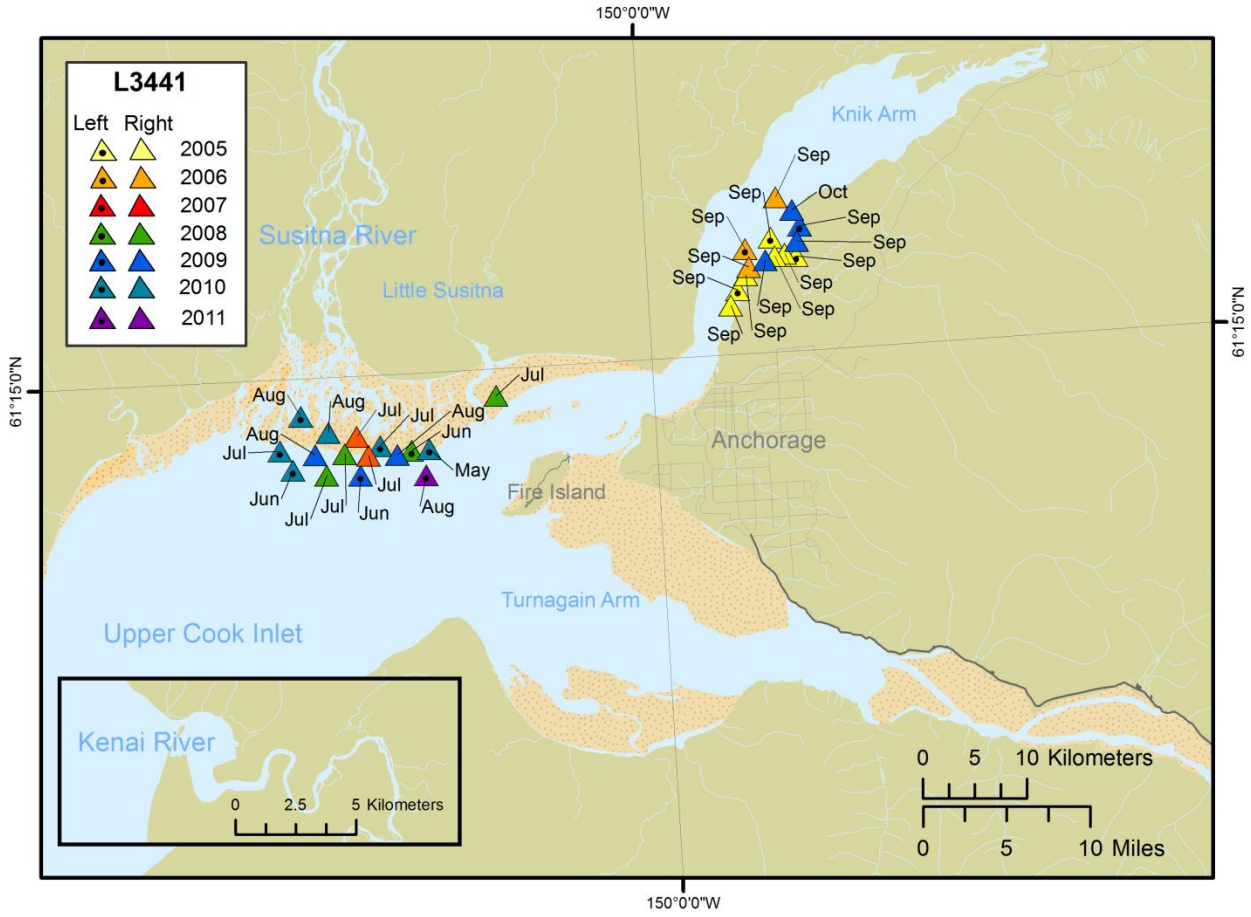
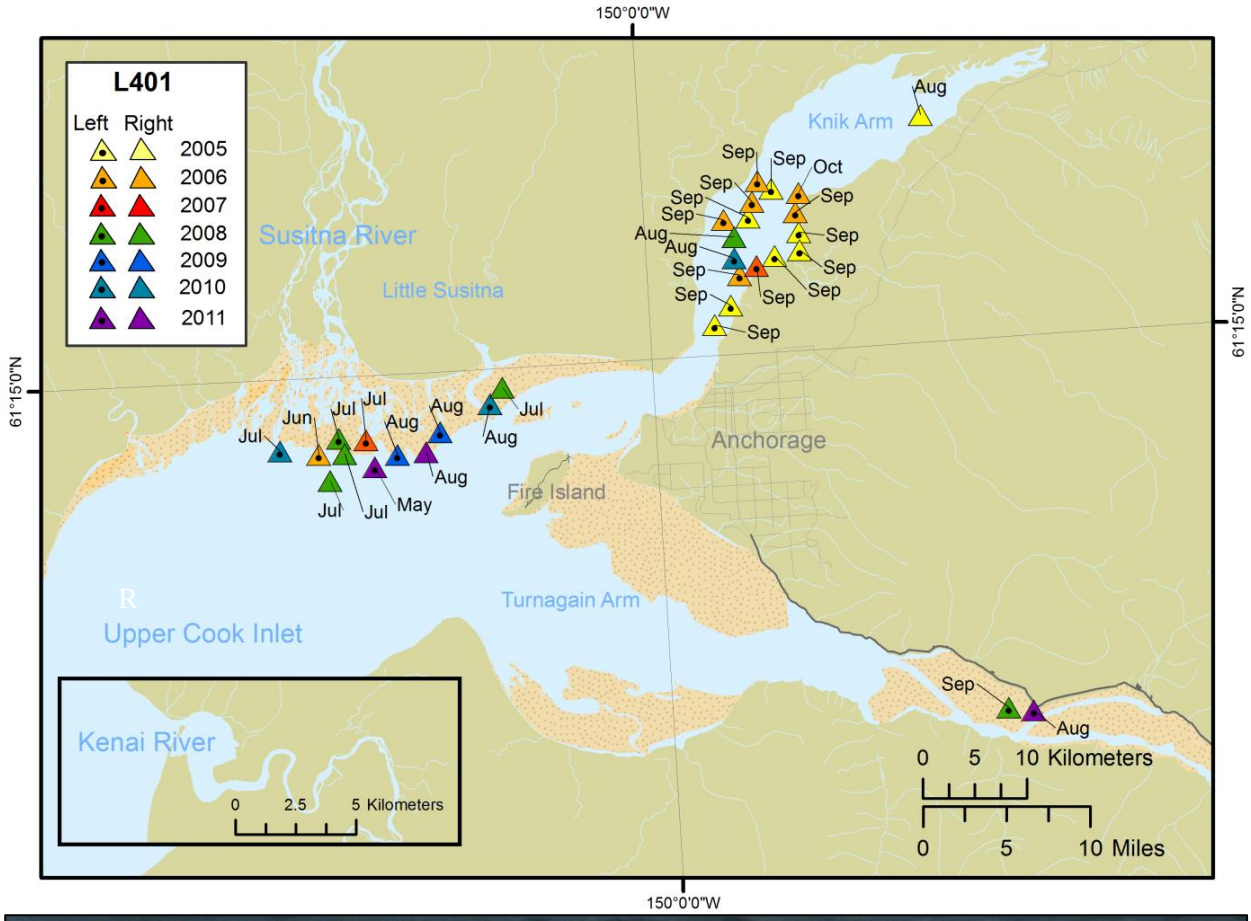


Figure 48. Sighting history and photographs of the left-side and right-side view for beluga L3441. This whale is a presumed mother based on photographs with an accompanying calf.



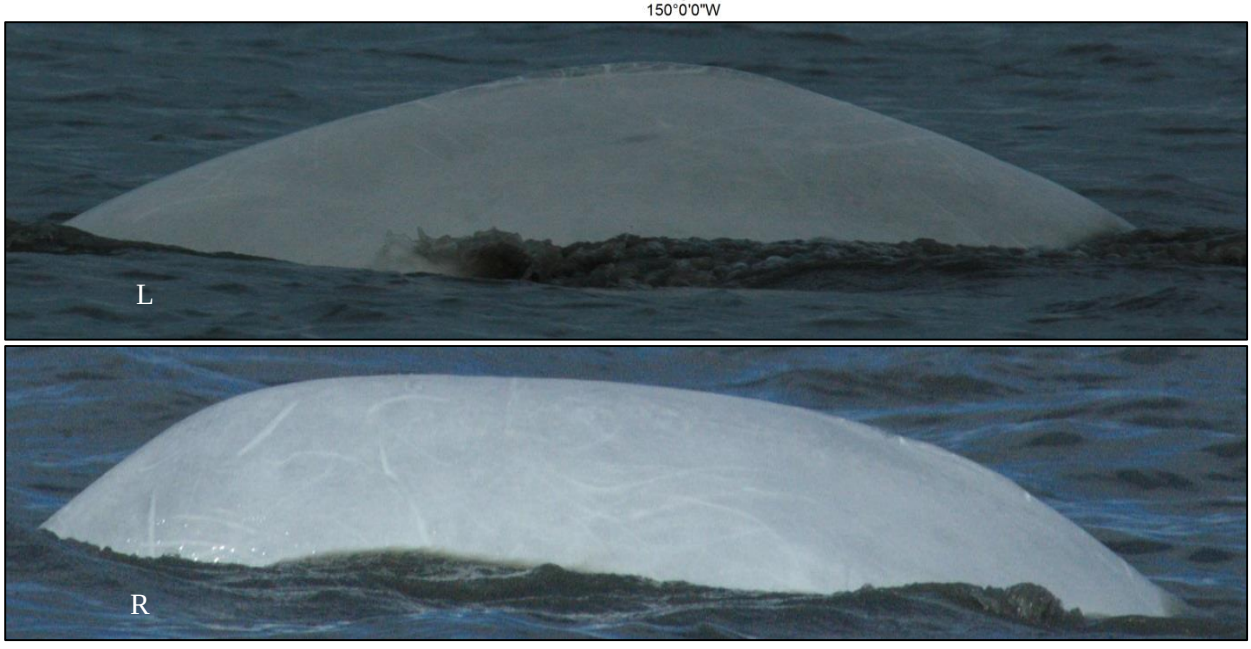
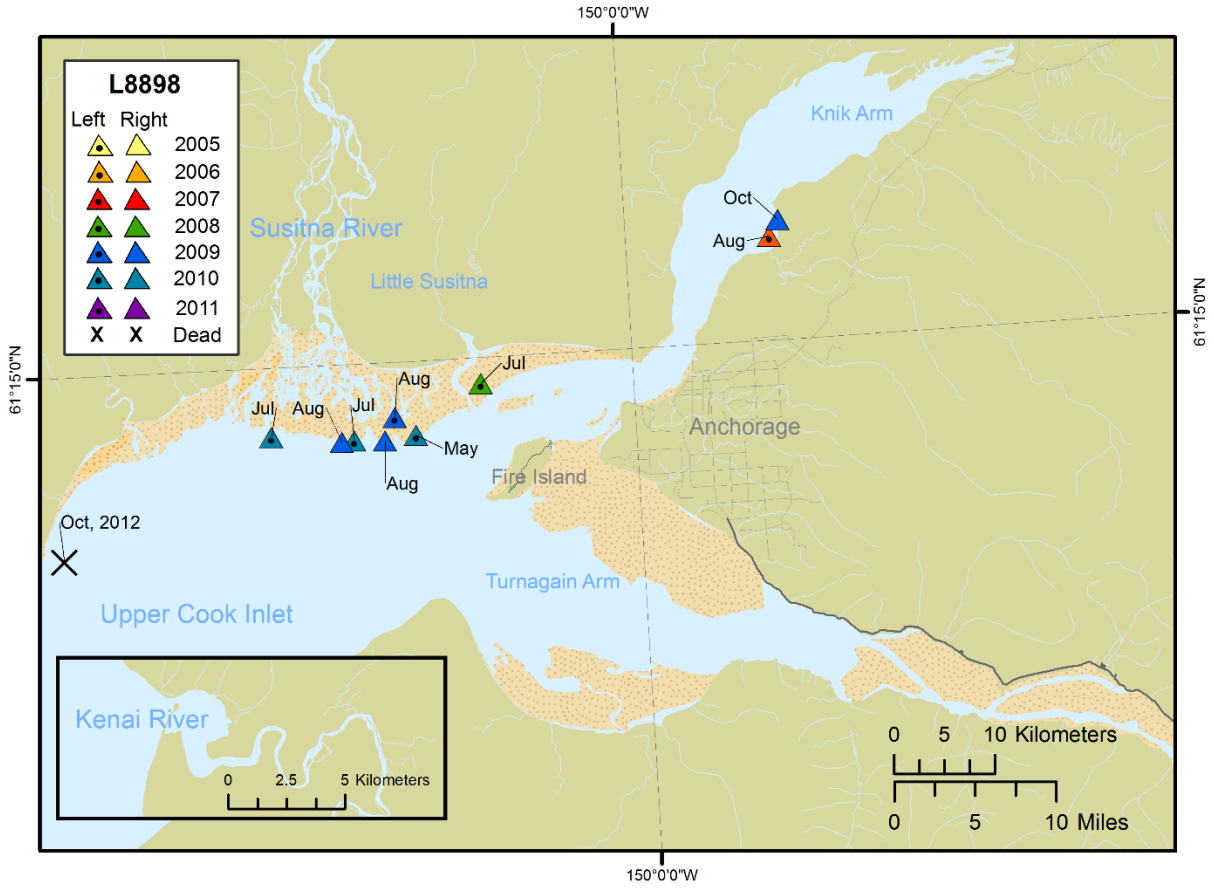


Figure 49. Sighting history and photographs of the left-side and right-side view for beluga L401. This whale is a presumed mother based on photographs with an accompanying calf.



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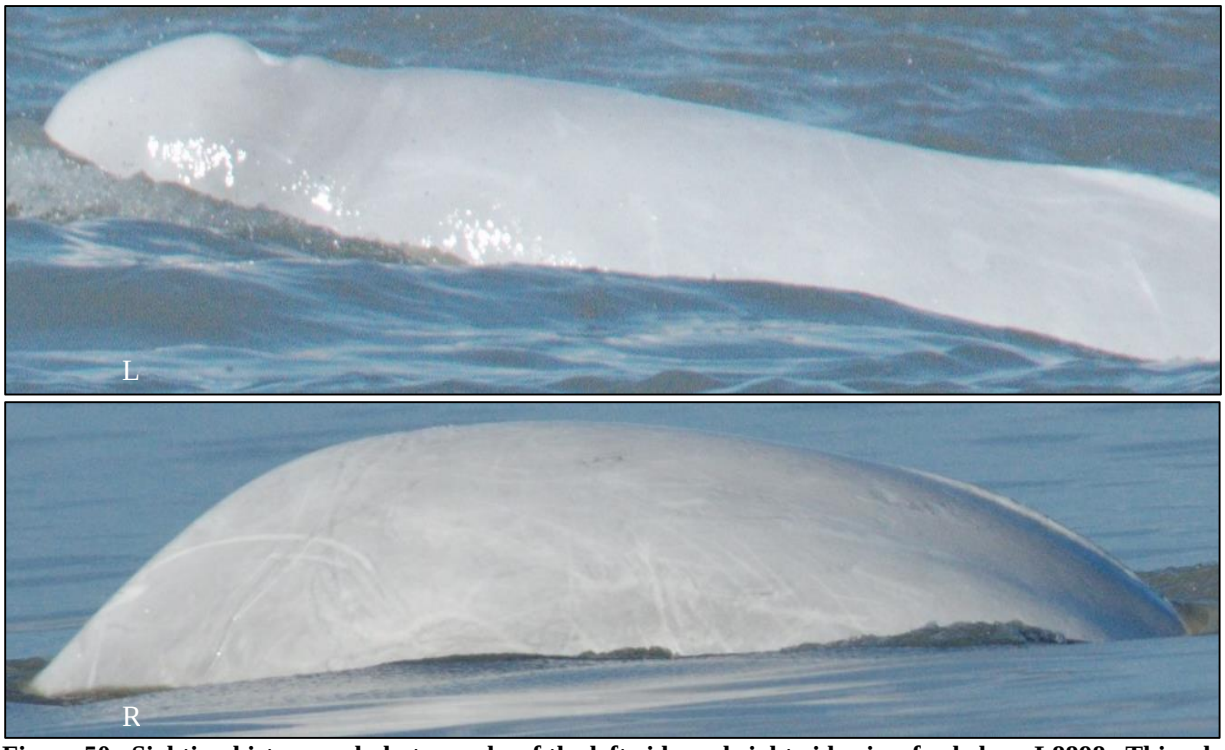
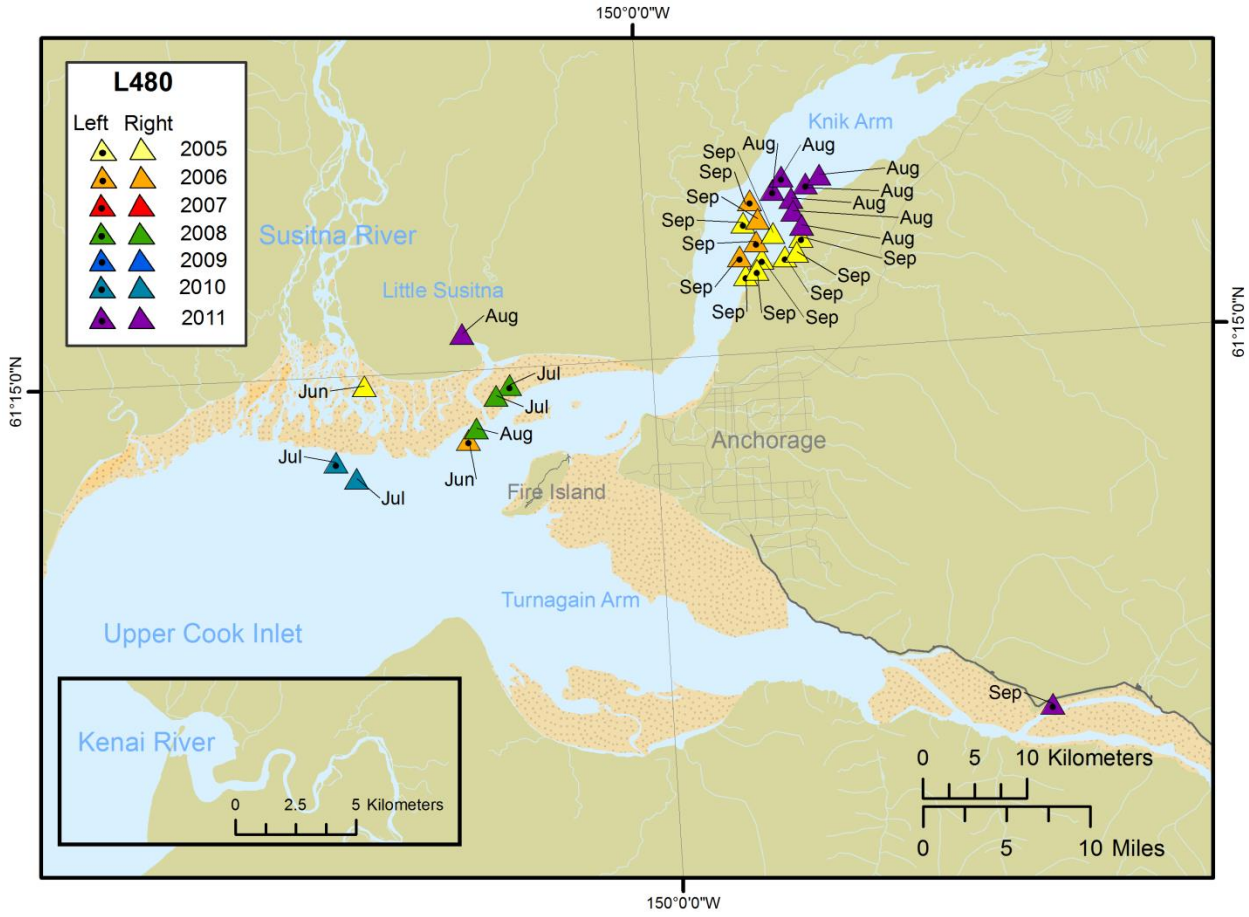


906

907

908 **Figure 50. Sighting history and photographs of the left-side and right-side view for beluga L8898. This adult**
909 **male was found dead in 2012 near Tyonek and necropsied in Nikiski.**



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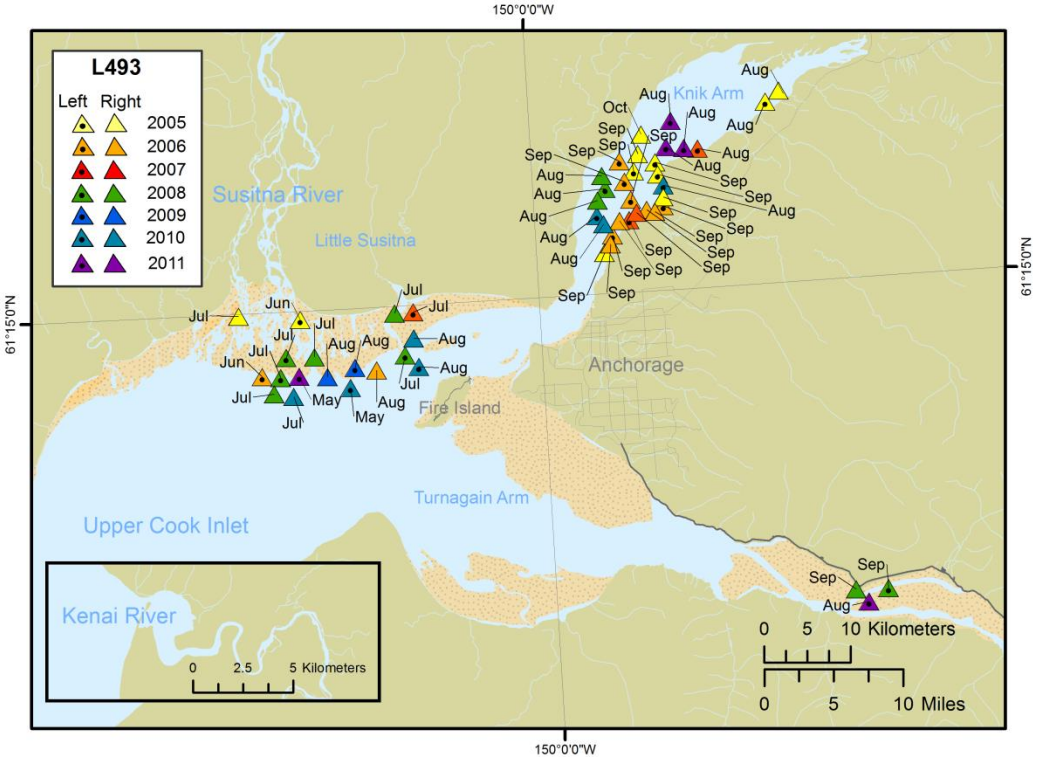
912

913 **Figure 51. Sighting history and photographs of the left-side and right-side view for beluga L480. This whale**
914 **is a presumed mother based on photographs with an accompanying calf.**

915



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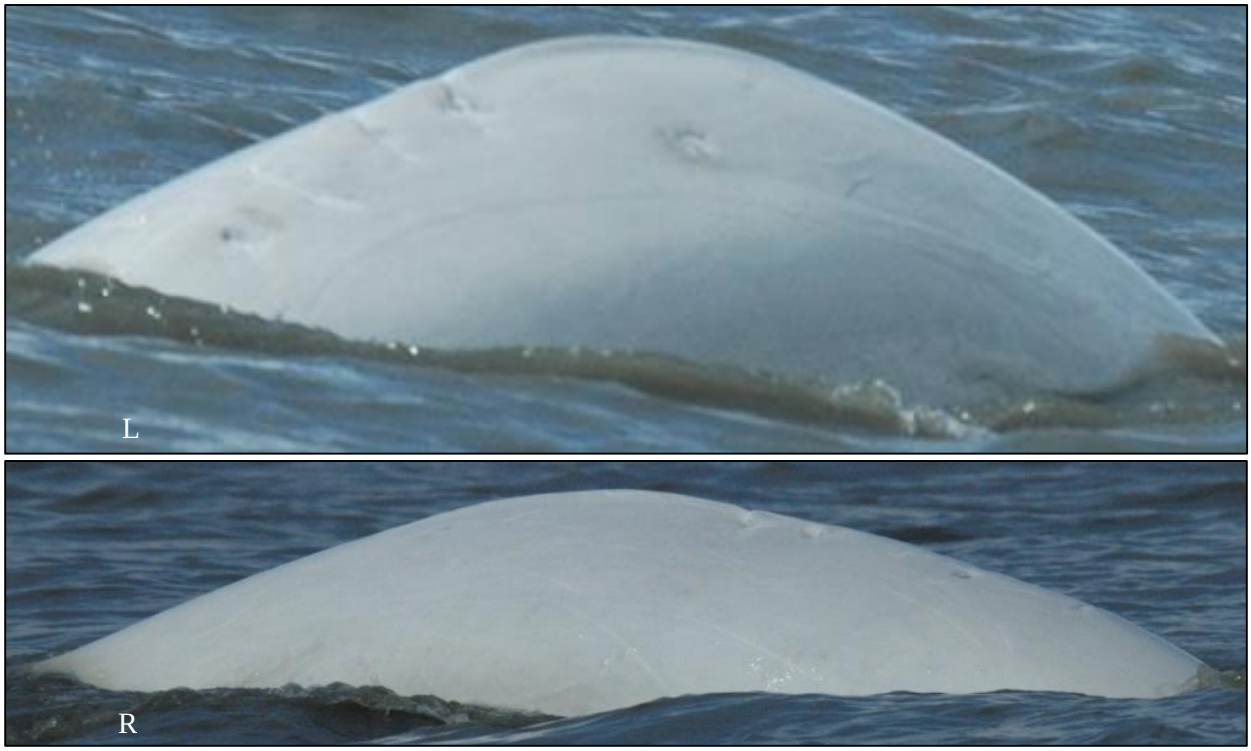

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918

919 **Figure 52. Sighting history and photographs of the left-side and right-side view for beluga L493. This whale**
920 **is a presumed mother based on photographs with an accompanying calf. This whale was tagged by NMFS**
921 **sometime between 1999 and 2002.**

922

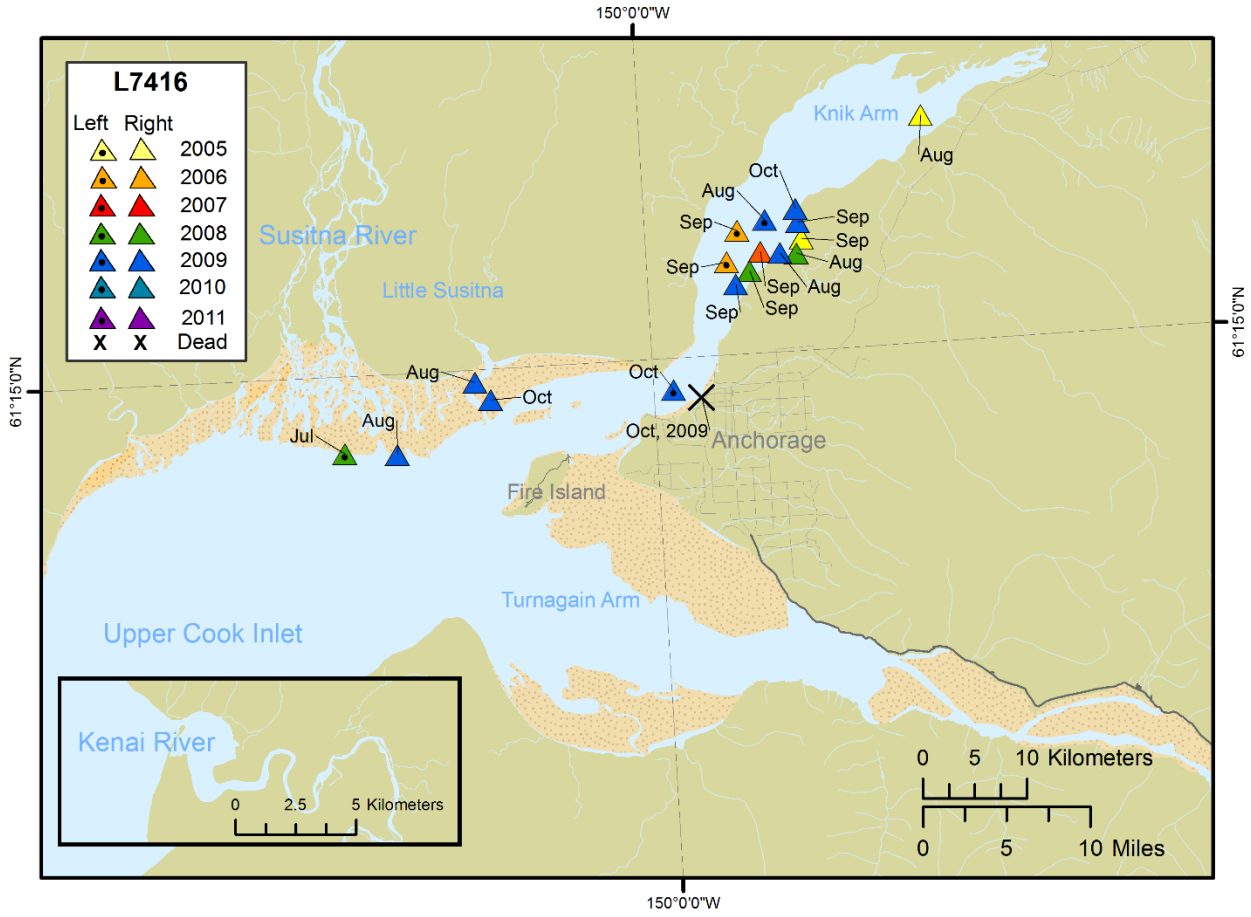
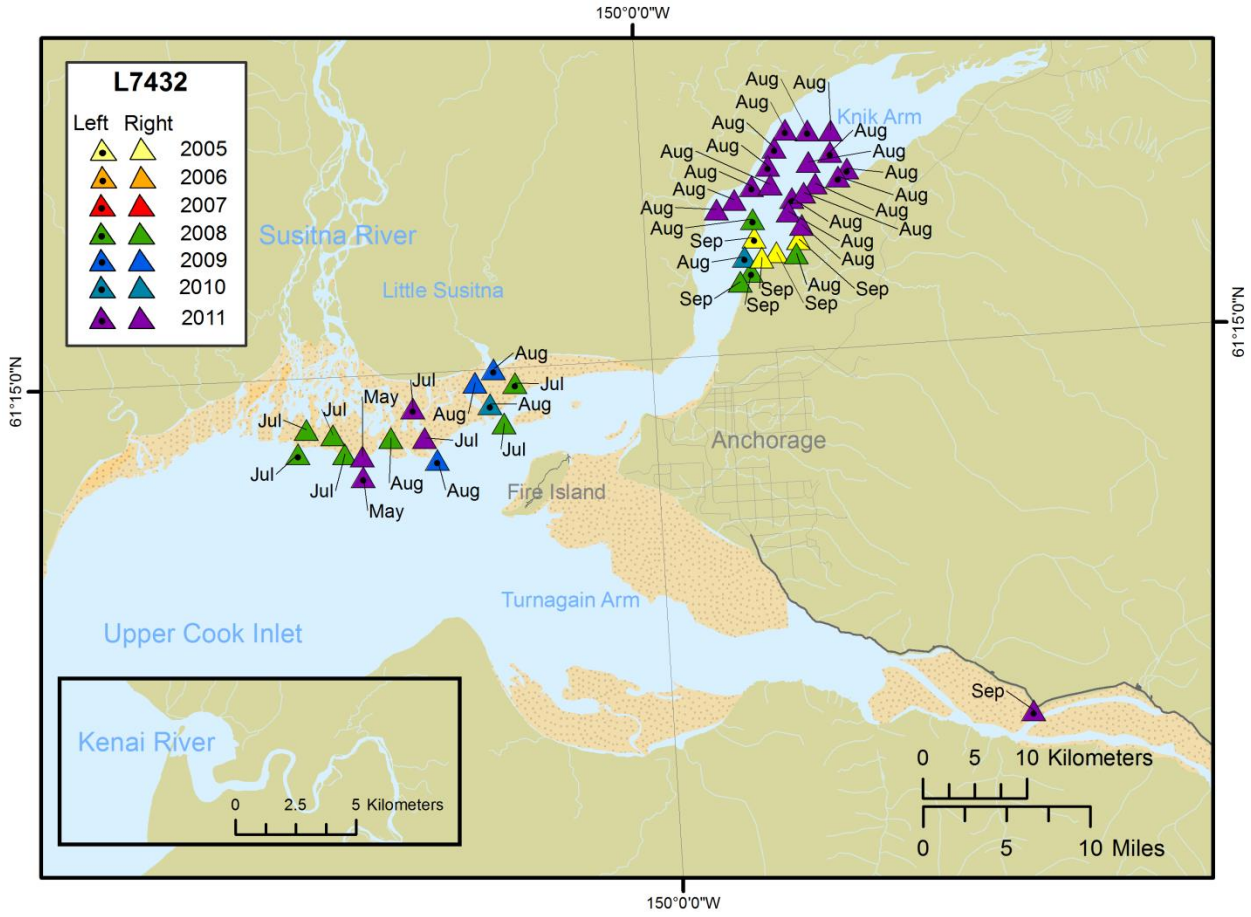


Figure 53. Sighting history and photographs of the left-side and right-side view for beluga L7416. This whale was presumed to be a mother based on photographs with an accompanying calf. This whale was found dead in 2009 near Ship Creek in Anchorage, and was confirmed to be a female.



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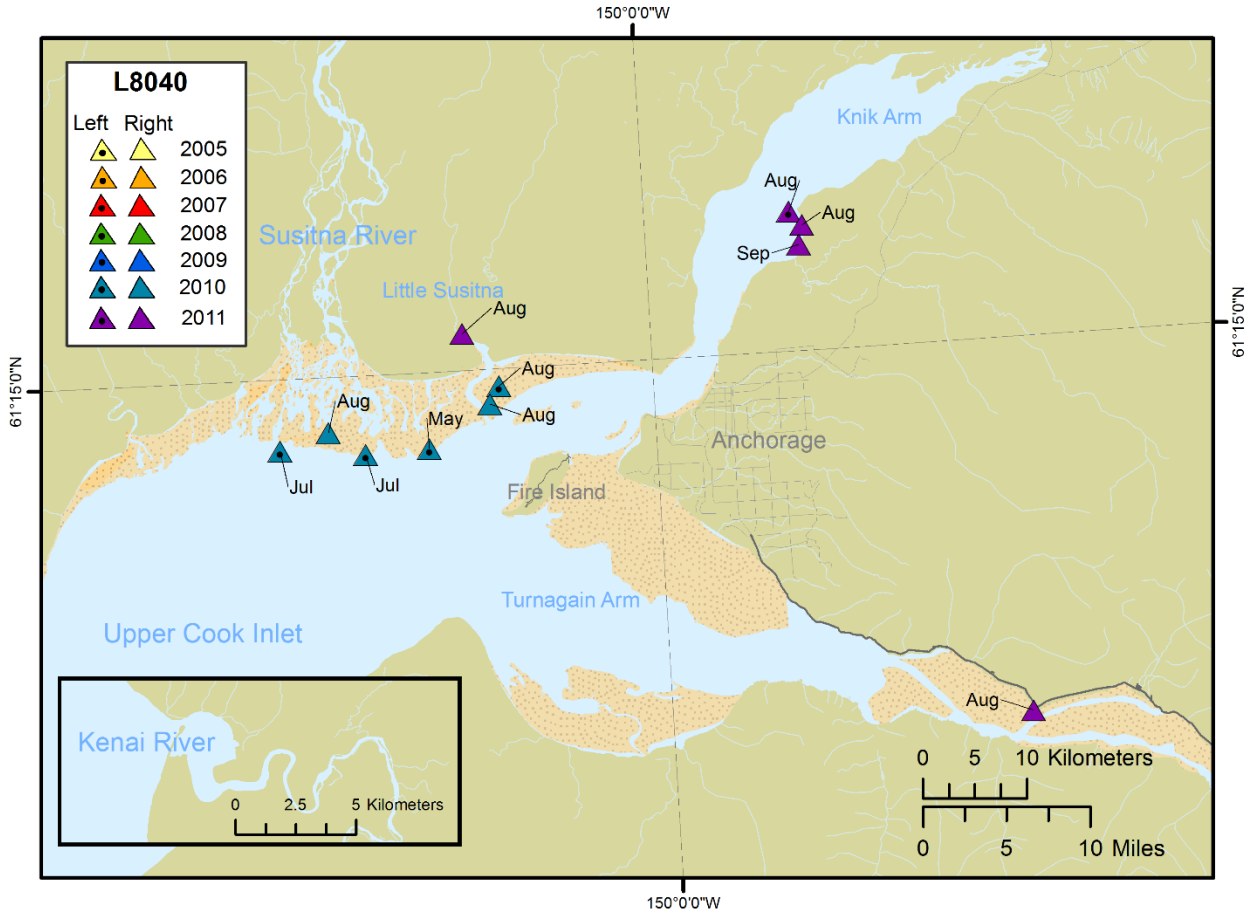
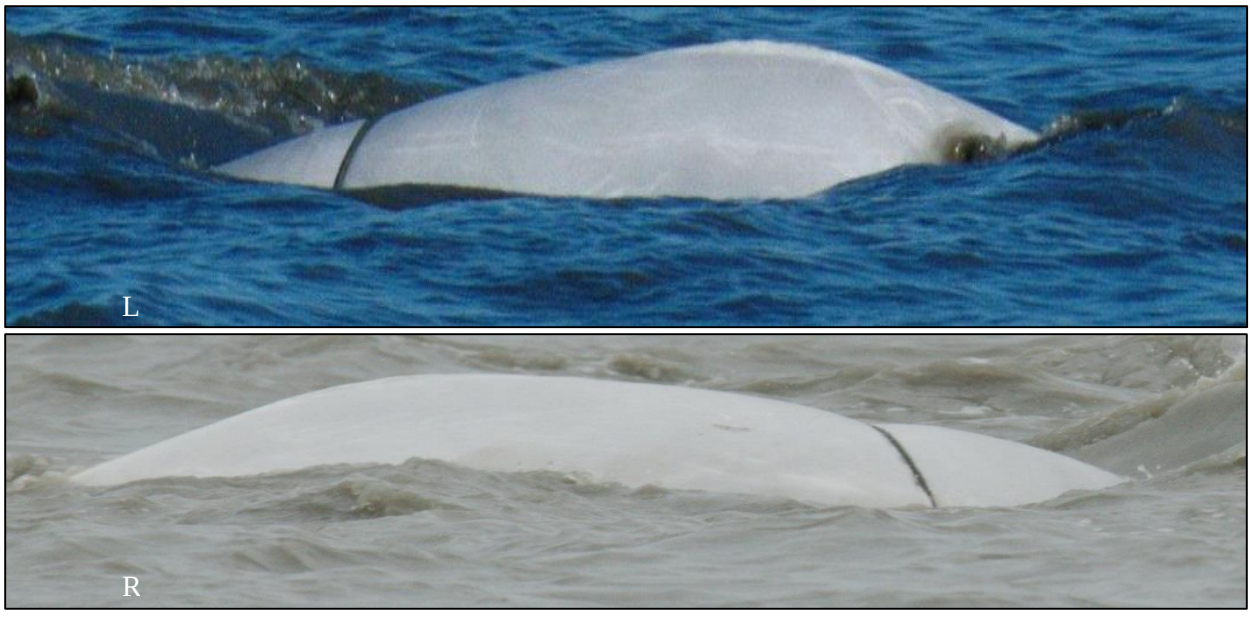
934 **Figure 54. Sighting history and photographs of the left-side and right-side view for beluga L7432. This whale**
935 **is a presumed mother based on photographs with an accompanying calf.**
936



937



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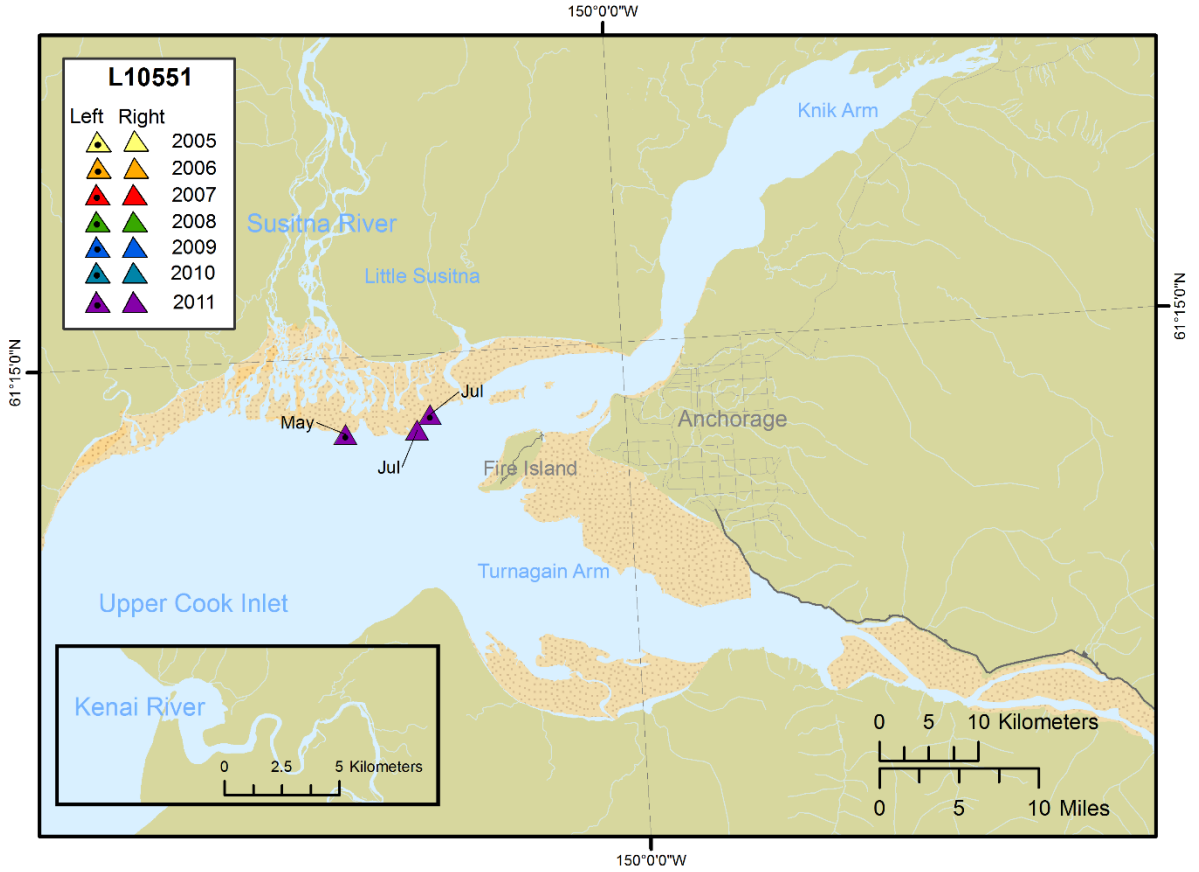
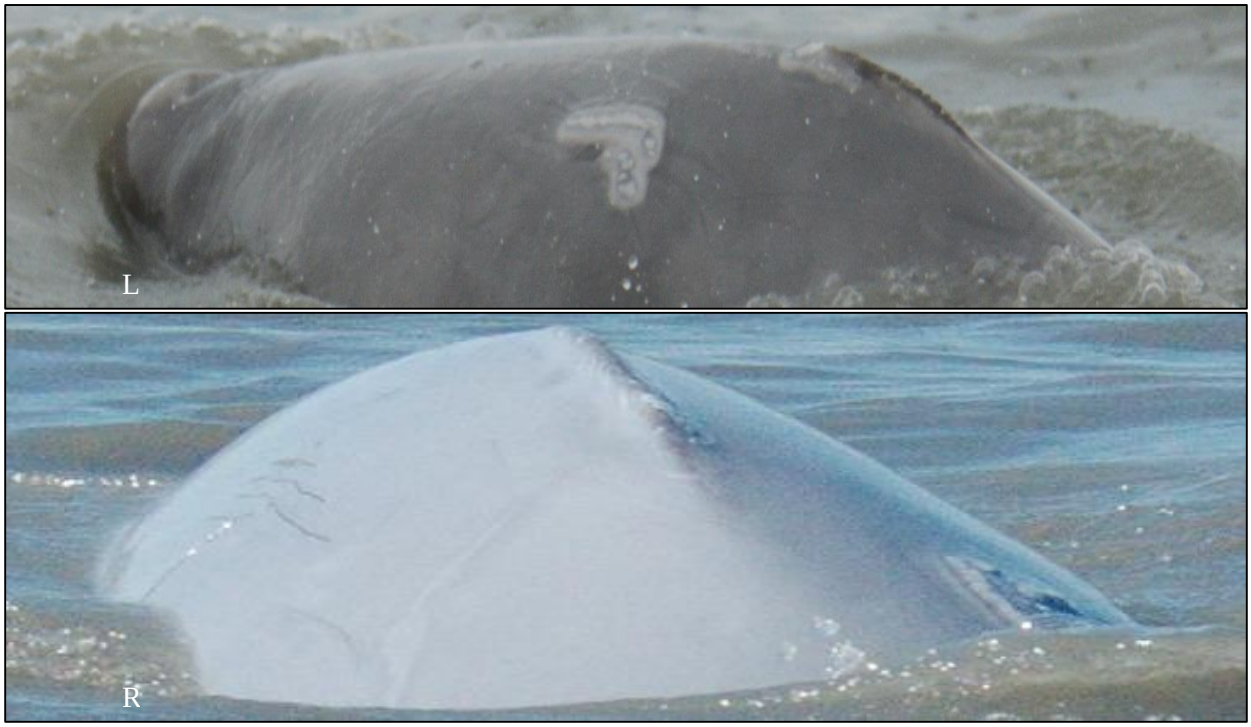
940 **Figure 55. Sighting history and photographs of the left-side and right-side view for an entangled beluga**
941 **L8040. This whale was not seen before 2010.**

942



943



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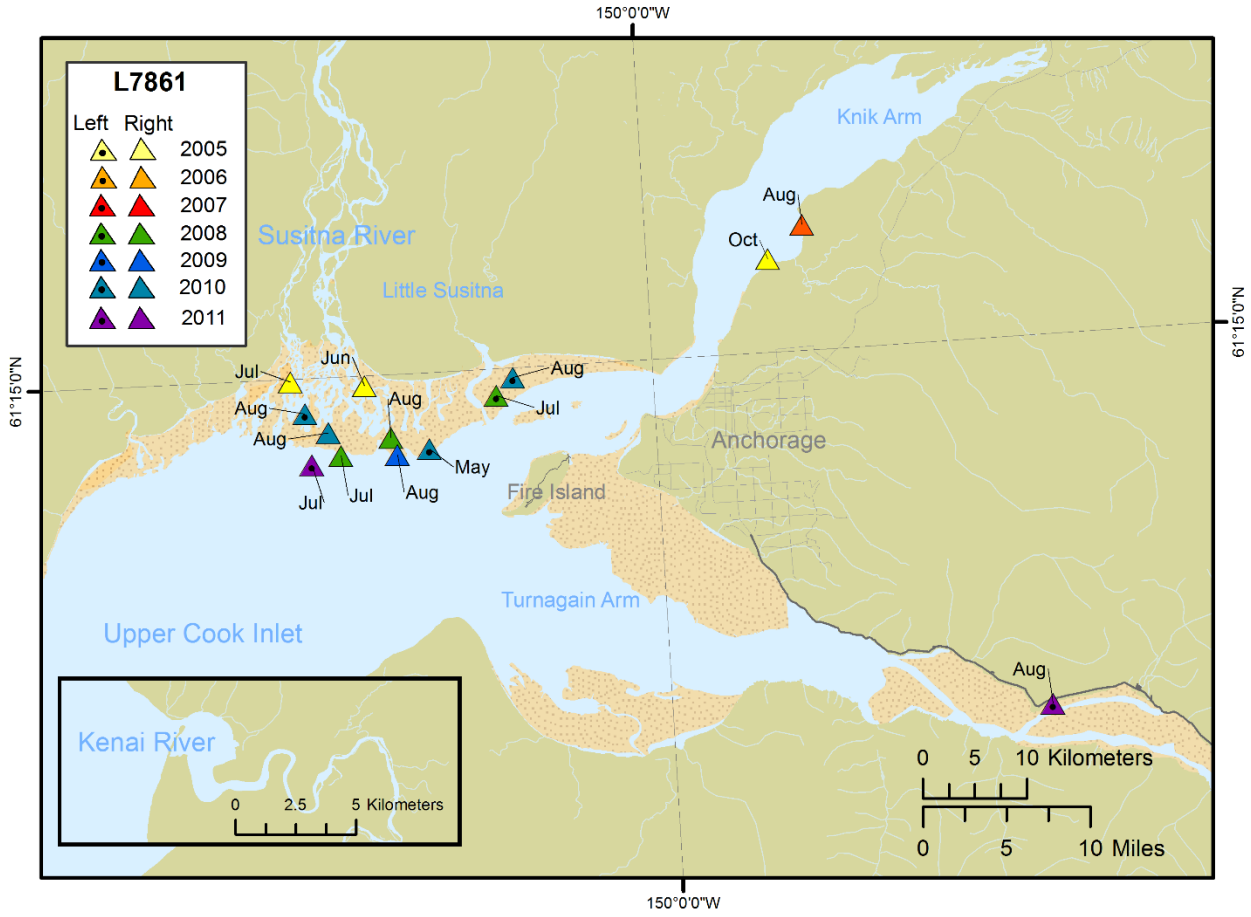
945

946 **Figure 56. Sighting history and photographs of the left-side and right-side view for beluga L10551.**



947

948 **Figure 57. Sighting history and photographs of the left-side and right-side view for beluga L7861. This**
949 **beluga was tagged by NMFS sometime between 1999 and 2002.**
950

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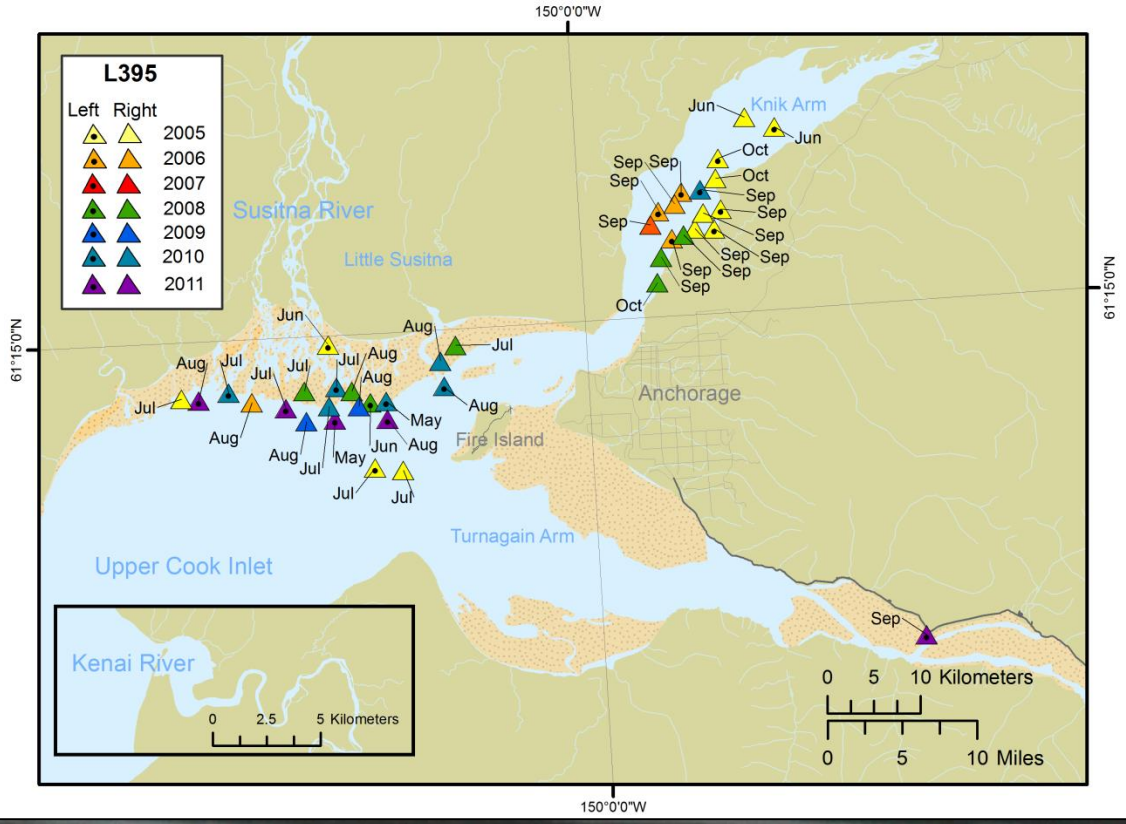
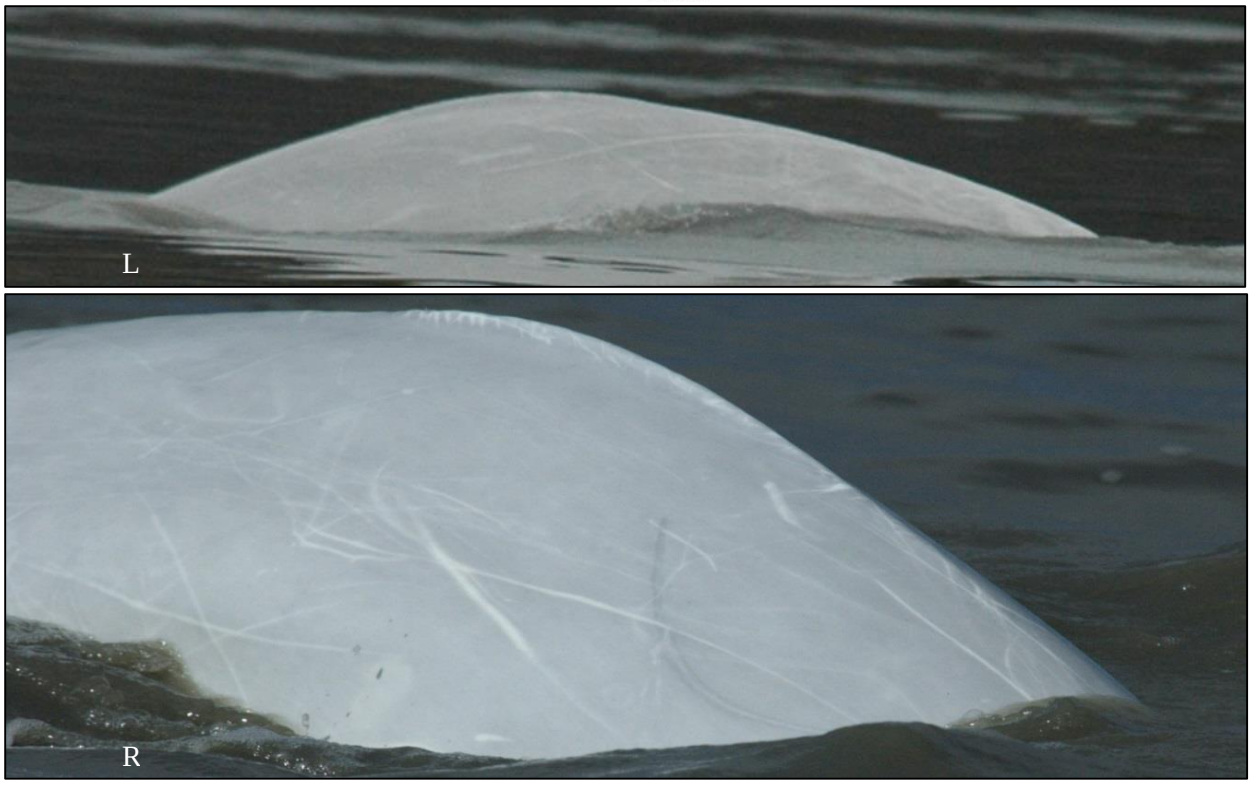


952



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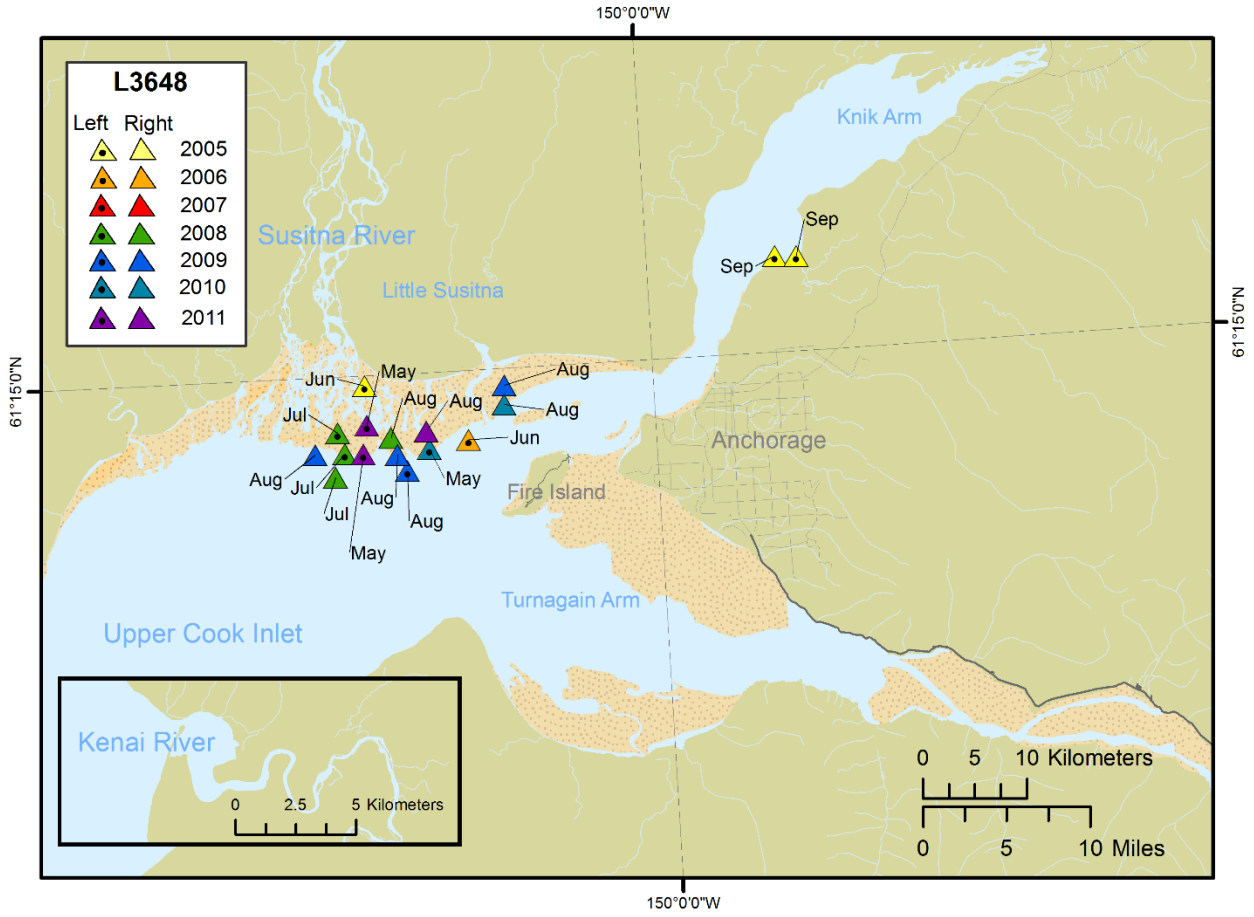
954

955 **Figure 58. Sighting history and photographs of the left-side and right-side view for beluga L395. This beluga**
956 **is a presumed mother based on photographs with an accompanying calf.**



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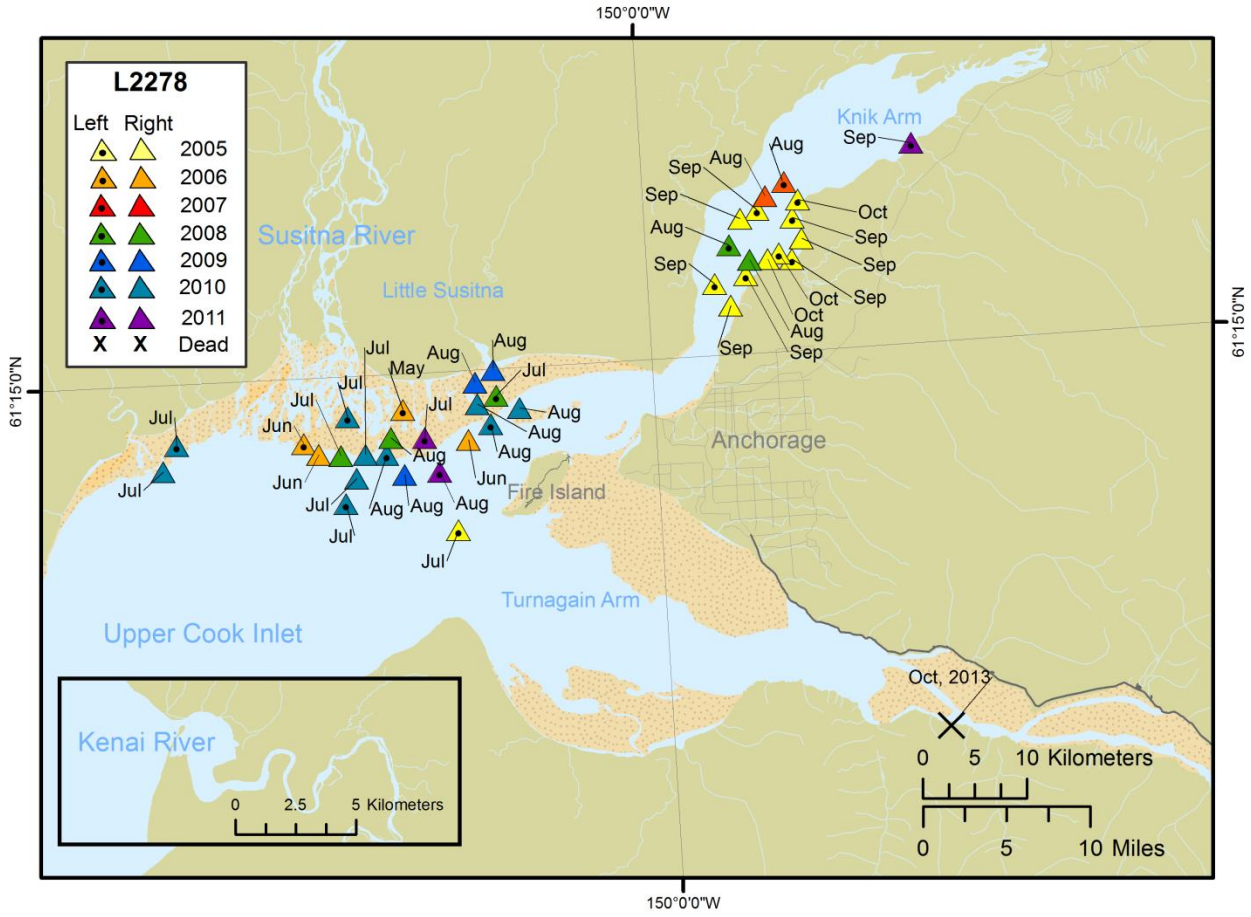
960 **Figure 59. Sighting history and photographs of the left-side and right-side view for beluga L3648. This**
961 **beluga is a presumed mother based on photographs with an accompanying calf.**

962



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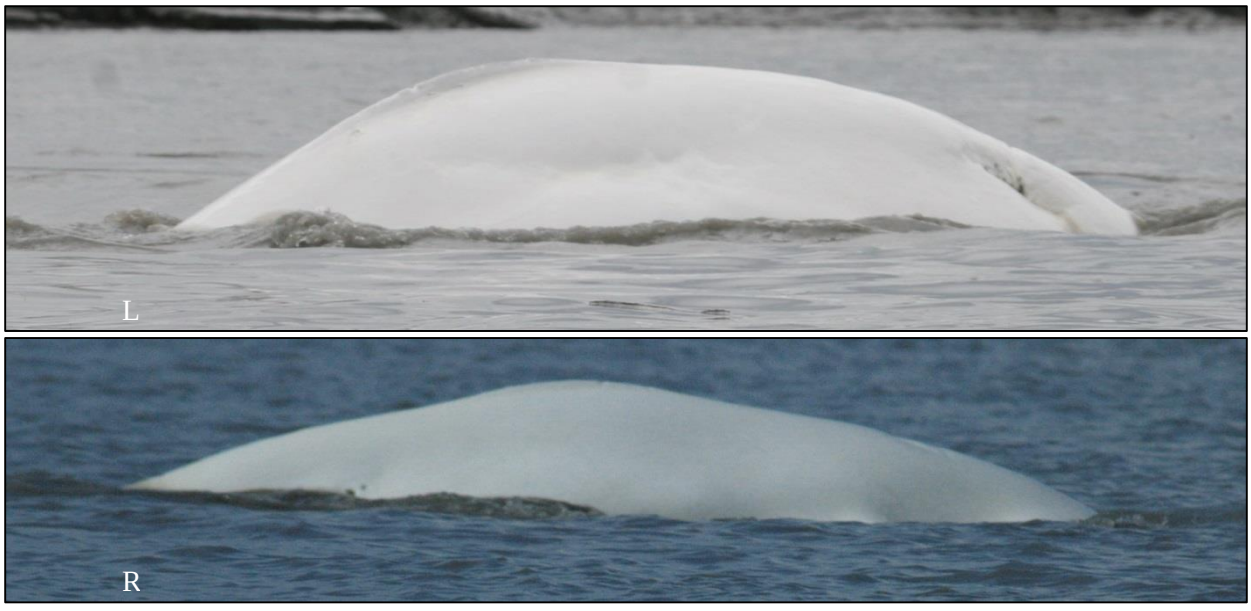

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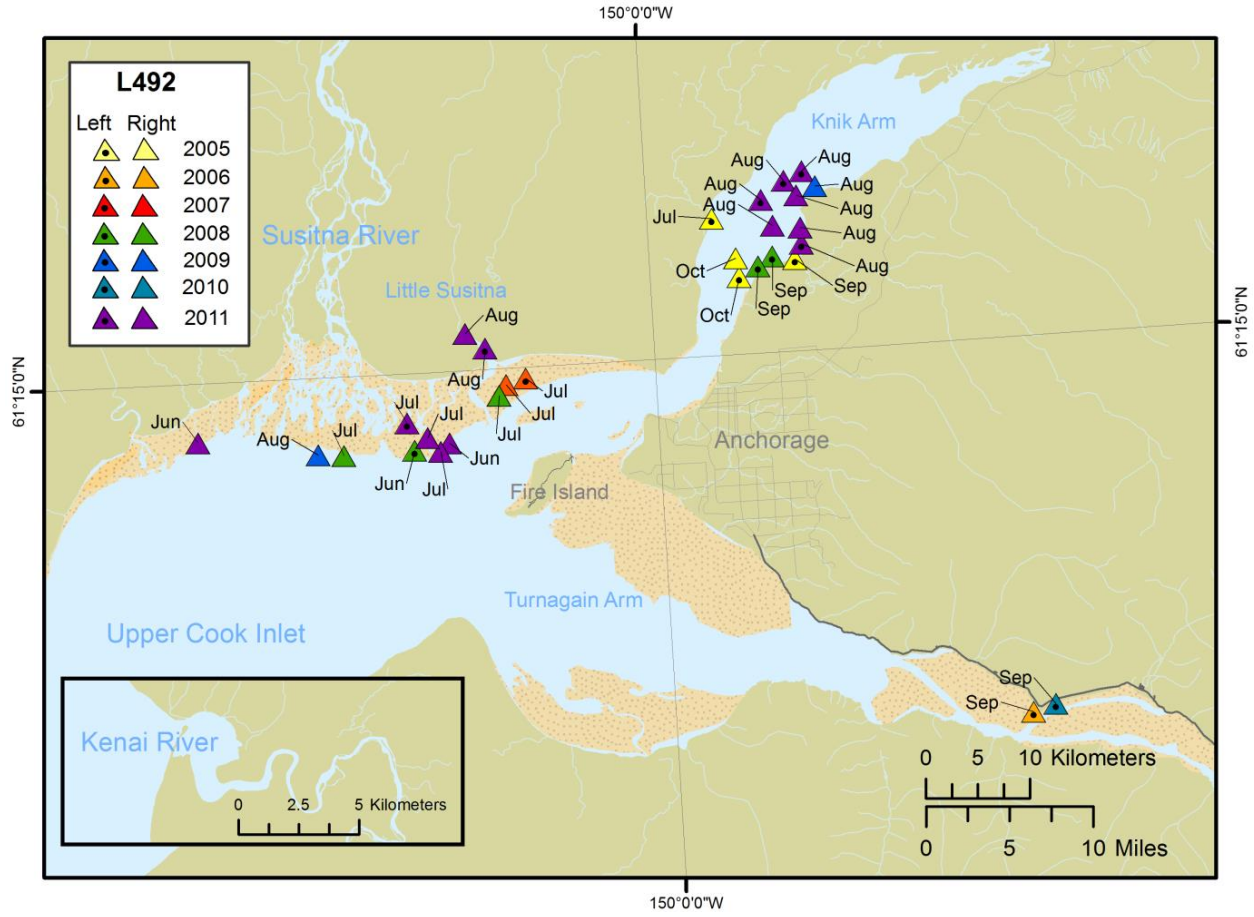
965

966 **Figure 60. Sighting history and photographs of the left-side and right-side view for beluga L2278. This adult**
967 **male was found dead in 2013 near Hope.**

968



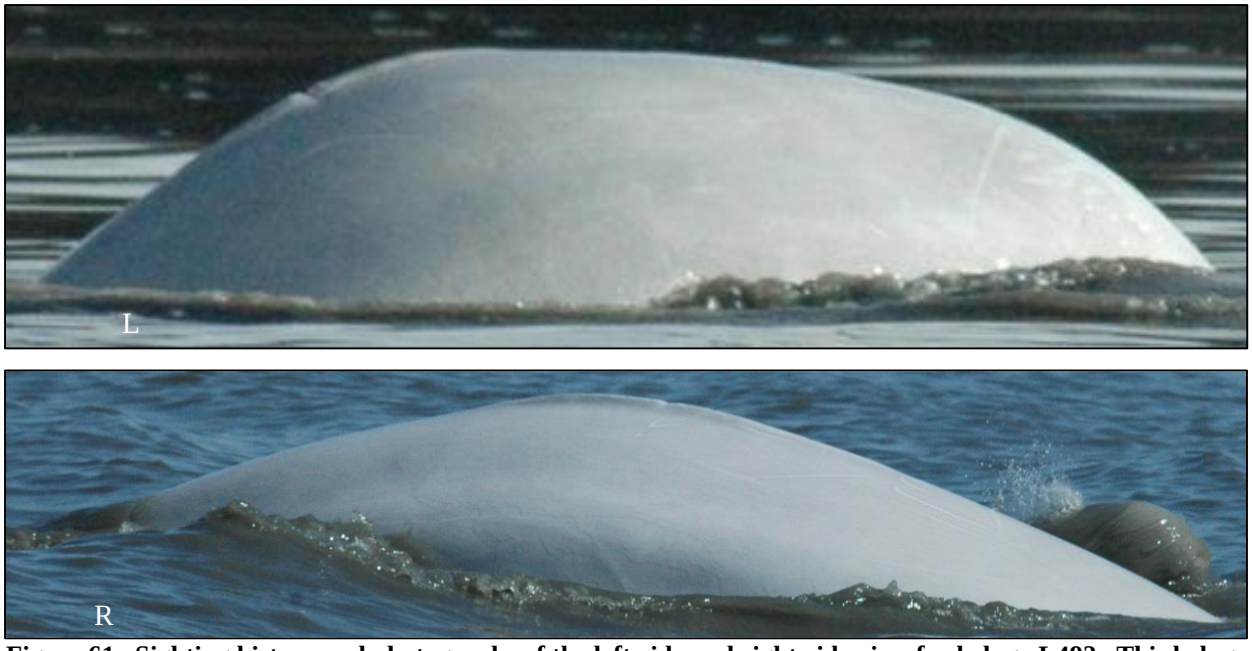


Figure 61. Sighting history and photographs of the left-side and right-side view for beluga L492. This beluga is a presumed mother based on photographs with an accompanying calf.

Table 9. Yearly sighting records of 19 "dual-side" individual beluga whales presumed to be mothers based on the close accompaniment of a calf at least once, 2008-2011 (L=left-side identification, C=photographed with a calf, P=photographed without a calf, N=not photographed).

Whale ID	2005	2006	2007	2008	2009	2010	2011	# Years Seen with a Calf	Side Identified as a Mother
L395	P	P	N	P	N	C	P	1	Left
right side	P	P	P	P	P	P	N		
L3441	P	P	N	C	P	P	P	5	Both
right side	C	C	C	C	C	P	N		
L492	P	P	C	C	N	P	C	3	Both
right side	P	N	C	C	P	N	C		
L1513	C	P	P	P	P	P	P	4	Both
right side	P	P	P	C	C	P	C		
L2454	P	N	P	C	P	C	P	3	Both
right side	P	N	P	P	P	P	C		
L2467	P	N	N	C	P	P	P	2	Both
right side	P	N	P	P	C	P	P		
L2737	C	N	N	P	P	N	N	2	Both
right side	C	P	P	P	P	N	C		
L283	P	C	N	P	C	C	P	4	Both
right side	C	C	P	P	C	C	N		
L3648	C	P	N	C	P	P	C	4	Both
right side	N	N	N	C	C	P	P		
L401	P	C	C	P	C	C	P	6	Both
right side	P	N	N	C	N	N	C		
L480	P	P	N	P	N	P	C	2	Both
right side	P	P	N	C	N	P	C		
L493	P	P	P	P	P	C	C	4	Both
right side	P	P	C	C	P	C	P		
L7432	P	N	N	C	P	C	C	4	Both
right side	P	N	N	C	C	N	C		
L2295	P	P	P	P	P	P	P	1	Right
right side	P	P	P	C	P	P	N		
L2363	P	P	P	P	P	P	P	4	Right
right side	C	C	P	C	C	P	P		
L2204	N	P	P	N	P	N	N	3	Right
right side	N	P	P	C	P	C	C		
L2296	P	N	P	P	P	P	P	1	Right
right side	P	N	P	N	P	C	P		
L7416	N	P	N	P	P	N	N	3	Right
right side	C	N	P	C	C	N	N		
L2398	N	P	N	C	P	C	P	3	Both
right side	N	N	N	C	C	P	P		

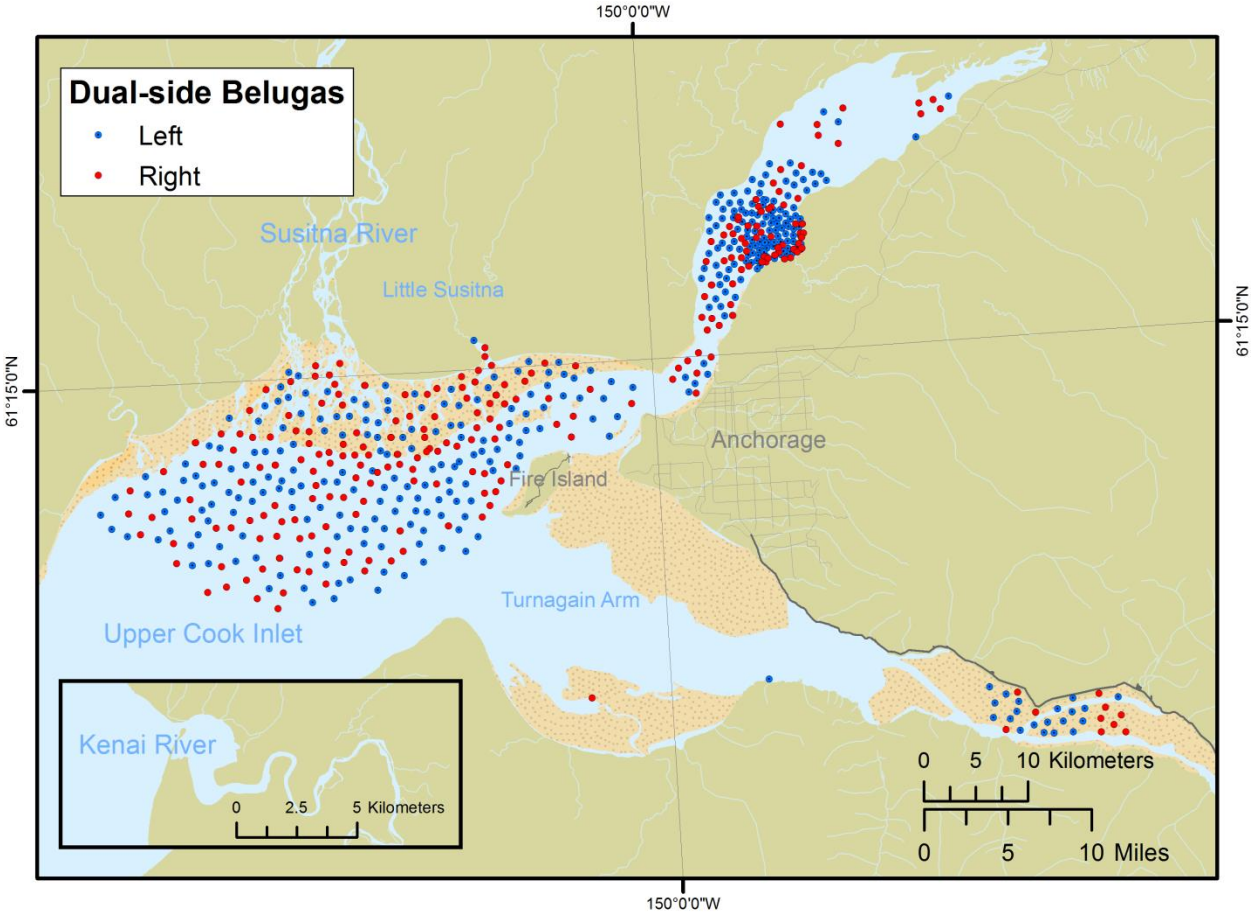


Figure 62. Locations of 28 belugas identified from both their right and left sides during photo-id surveys in Upper Cook Inlet, Alaska, 2005-2011.

Dead belugas

Between 2008 and 2014, nine dead beluga whales were identified as individuals from the left-side catalog (Table 10). All dead belugas encountered by the CIBW Photo-ID Project were reported to NMFS. Details of necropsy results can be requested from the NMFS Alaska Region.

On October 9, 2009, biologists with the CIBW Photo-ID Project secured and photographed a dead stranded beluga near Ship Creek in Anchorage. This pregnant adult female was identified as L7416, first photographed in 2005 in Knik Arm and photographed in subsequent years in Knik Arm and the Susitna River Delta (Figure 63). A necropsy was performed by Dr. Kathy Burek-Huntington.

On October 5, 2012, biologists with the CIBW Photo-ID Project assisted the Alaska Marine Mammal Stranding Network with a response to a dead beluga first reported a day earlier to NMFS after it was found dead in the water near Tyonek. Marks on the dead beluga were at initially matched to records of an identified beluga in the photo-id catalog, R7244 (McGuire et al. 2014a). Upon further examination

of the photographs, it has now been re-identified as beluga L8898. This adult male had been photographed in Knik Arm and the Susitna River Delta since 2007 (Figure 64). A necropsy was conducted by Dr. Kathy Burek-Huntington.

On September 4, 2013, a pilot with the Army Air National Guard reported a dead beluga in Turnagain Arm near Taylor Creek. The pilot landed by the whale and provided photographs to NMFS, who in turn shared the photos with the CIBW Photo-ID Project. This whale was identified as beluga L2634, previously sighted August 2008 at the Port of Anchorage and in the Susitna River Delta in 2010 (Figure 65). This whale had been a presumed mother as she had been photographed with a newborn calf when she was alive. It could not be determined from photographs if this adult female was pregnant in 2013 or if it was simply bloated from decomposition. The whale was not necropsied or otherwise examined by NMFS or the Alaska Marine Mammal Stranding Network, and cause of death is unknown.

On October 7, 2013 a pilot reported a stranded beluga to NMFS near Hope. A necropsy was performed by Dr. Kathy Burek-Huntington who provided photos to the CIBW Photo-ID Project. The cause of death was diagnosed as asphyxiation due to obstruction of pharynx with a flat fish. This adult male, L2278, had been photographed in all consecutive years 2004-2013, and has been photographed in Knik Arm, and the Susitna River Delta (Figure 66).

On May 26, 2014 two dead beluga whales were reported off of Kincaid Park in Anchorage. The CIBW Photo-ID Project assisted with the stranding response and photographed the whales. One of the whales was an adult male identified as L2579. This whale had been photographed every year of the photo-id project and had been seen in Turnagain Arm, Knik Arm, and the Susitna River Delta (Figure 67). This whale also had scars from a satellite tag affixed by NMFS sometime between 1999 and 2002. A necropsy was performed by Dr. Carrie Goertz. The pregnant female beluga has not yet been identified.

On August 1, 2014 a dead male beluga was reported in Tyonek and photographs were provided to the CIBW Photo-ID Project. The markings on this whale were matched to known catalog whale L2294. This whale was photographed in Knik Arm in 2005 and 2007, and the Susitna River Delta in 2010 and 2011 (Figure 68). A necropsy was performed by Dr. Carrie Goertz.

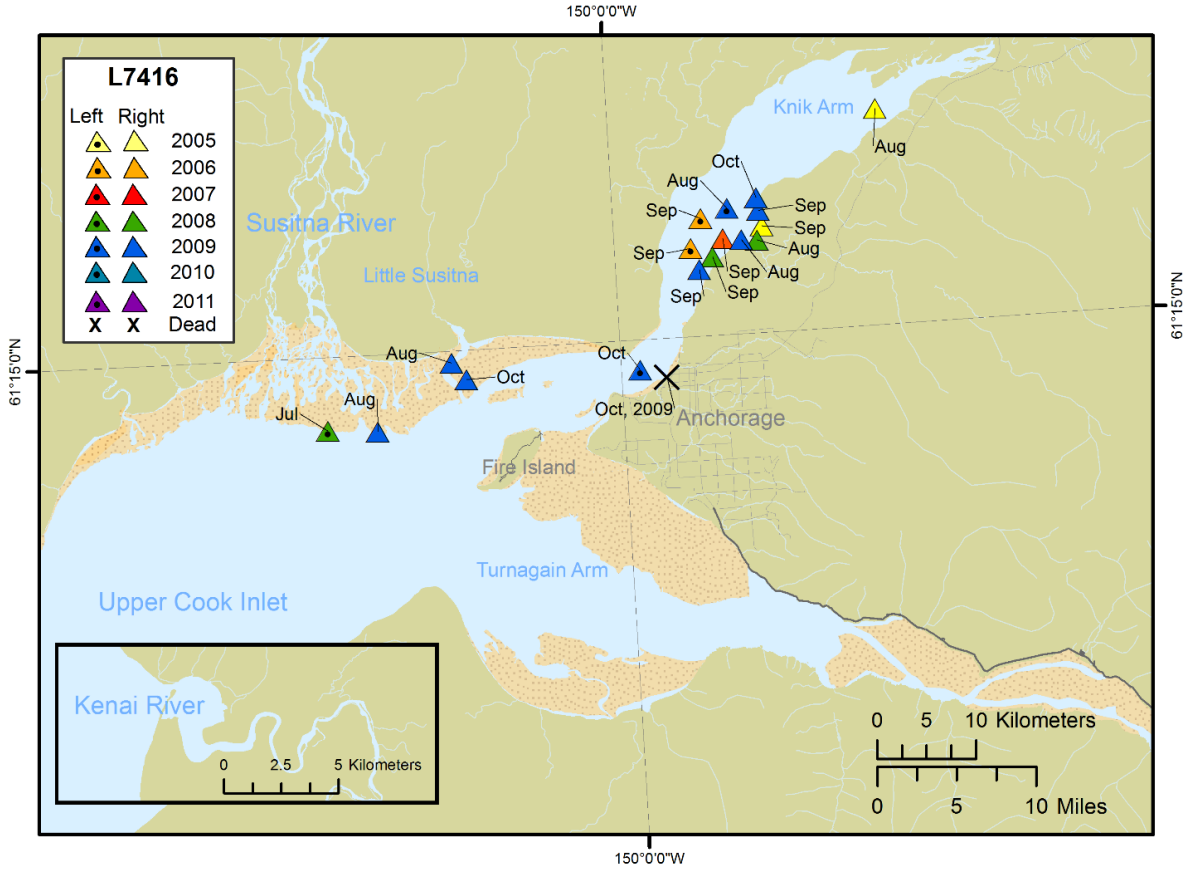
On September 2, 2014 a dead beluga was reported near the mouth of the Chuitna River. A necropsy was performed by Dr. Pam Tuomi. Photographs of this adult female were provided to the CIBW Photo-ID Project and the whale was matched to a known catalog whale L1849. This whale was a presumed mother as it was photographed with a calf in 2006 in Knik Arm. This whale was also photographed in the Susitna River Delta in 2011 (Figure 69).

On September 8, 2014 NMFS informed the CIBW Photo-ID Project about a stranded beluga in Turnagain Arm near Indian. Marks on the dead beluga were matched to beluga L496. This adult male was seen in Knik Arm in 2005 and in the Susitna River Delta in 2010 (Figure 70). This whale was examined by Dr. Carrie Goertz and Dr. Kathy Burek-Huntington.

On September 27, 2014 a dead stranded beluga near Pt. Possession was reported to NMFS, who relayed photos to the CIBW Photo-ID Project. This whale was identified as beluga L265, an adult female presumed to be a mother because she was photographed in 2010 and 2011 with a calf. This whale was photographed in Knik Arm, Turnagain Arm, the Susitna River Delta and Chickaloon Bay 2005-2011 (Figure 71). The whale was not necropsied or otherwise examined by NMFS or the Alaska Marine Mammal Stranding Network, and cause of death is unknown.

Table 10. Summary of 16 Cook Inlet beluga whales that died, 2009-2014, with left-side photographs provided to the CIBW Photo-ID Project.

Date	Location of Dead Beluga	Necropsy Performed?	Age class/sex	Whale matched to known catalog whale?
October 9, 2009	Ship Creek, Anchorage	yes	pregnant female	yes
May 7, 2012	Kenai River	yes	male calf	no
October 5, 2012	Tyonek	yes	adult male	yes
September 4, 2013	Taylor Creek, Turnagain Arm	no	adult female	yes
September 4, 2013	Taylor Creek, Turnagain Arm	no	unknown sex or age class	no
October 7, 2013	Hope, Turnagain Arm	yes	adult male	yes
May 26, 2014	Kincaid Park, Anchorage	yes	adult male	yes
May 26, 2014	Kincaid Park, Anchorage	yes	pregnant female	no
July 10, 2014	Car-Gottstein Park, Anchorage	no	calf unknown sex	no
August 1, 2014	Tyonek	yes	adult male	yes
August 26, 2014	Fire Island	no	adult unknown	no
September 2, 2014	Chuit River mouth	yes	adult female	yes
September 8, 2014	Indian, Turnagain Arm	yes	adult male	yes
September 27, 2014	Pt. Possession	no	adult female	yes
October 6, 2014	Potter Marsh, Turnagain Arm	no	adult unknown	no
November 1, 2014	Moose Point, south of Pt. Possession	no	adult unknown	no



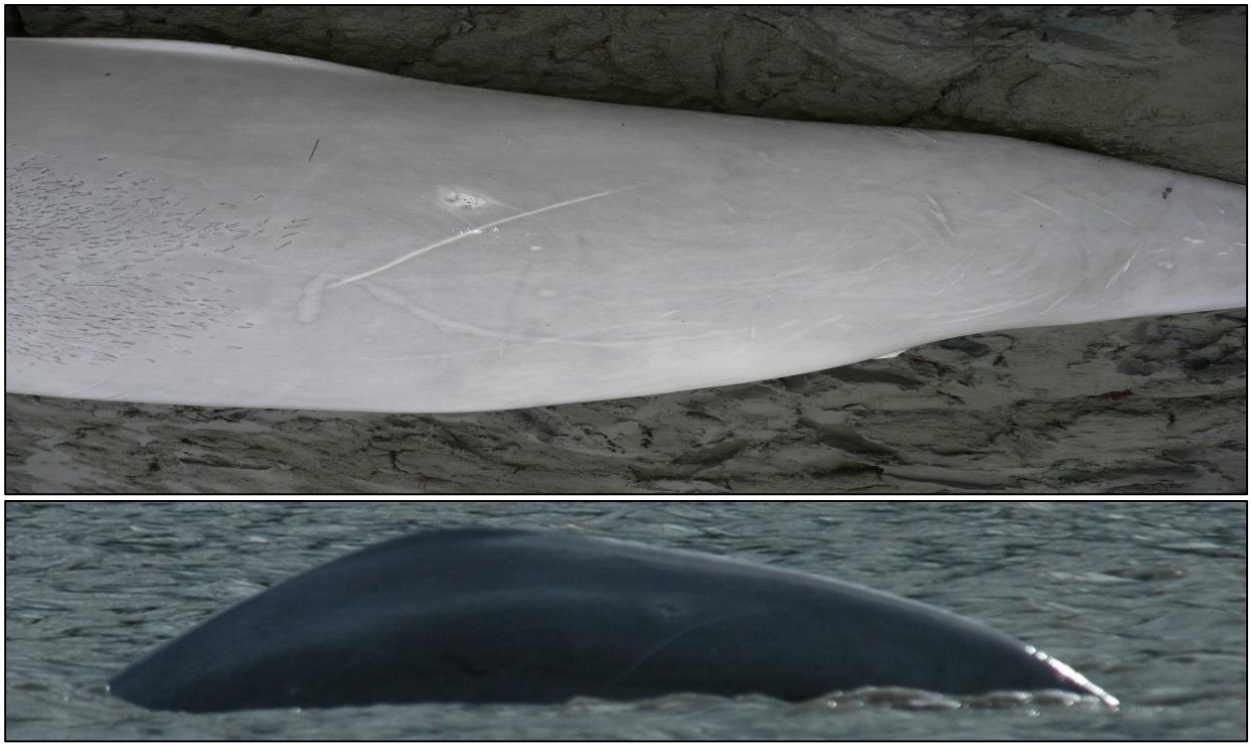
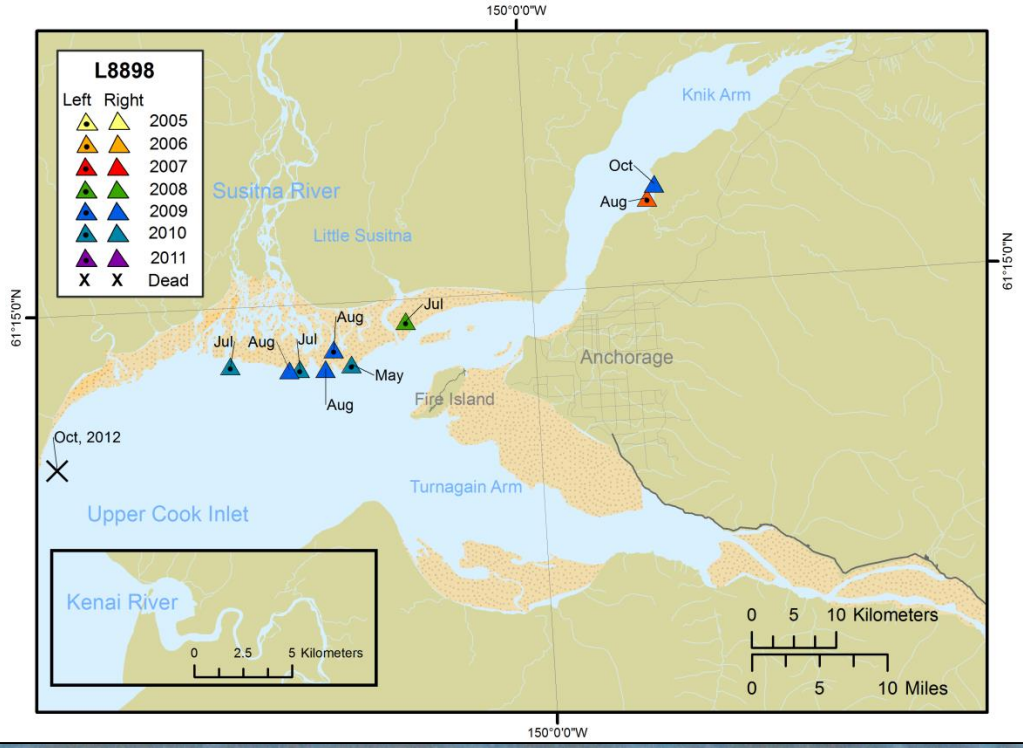


Figure 63. Sighting history (including sightings from both right- and left-side photographs) and photographs of beluga L7416. This female was found dead and pregnant in 2009 near Ship Creek in Anchorage.



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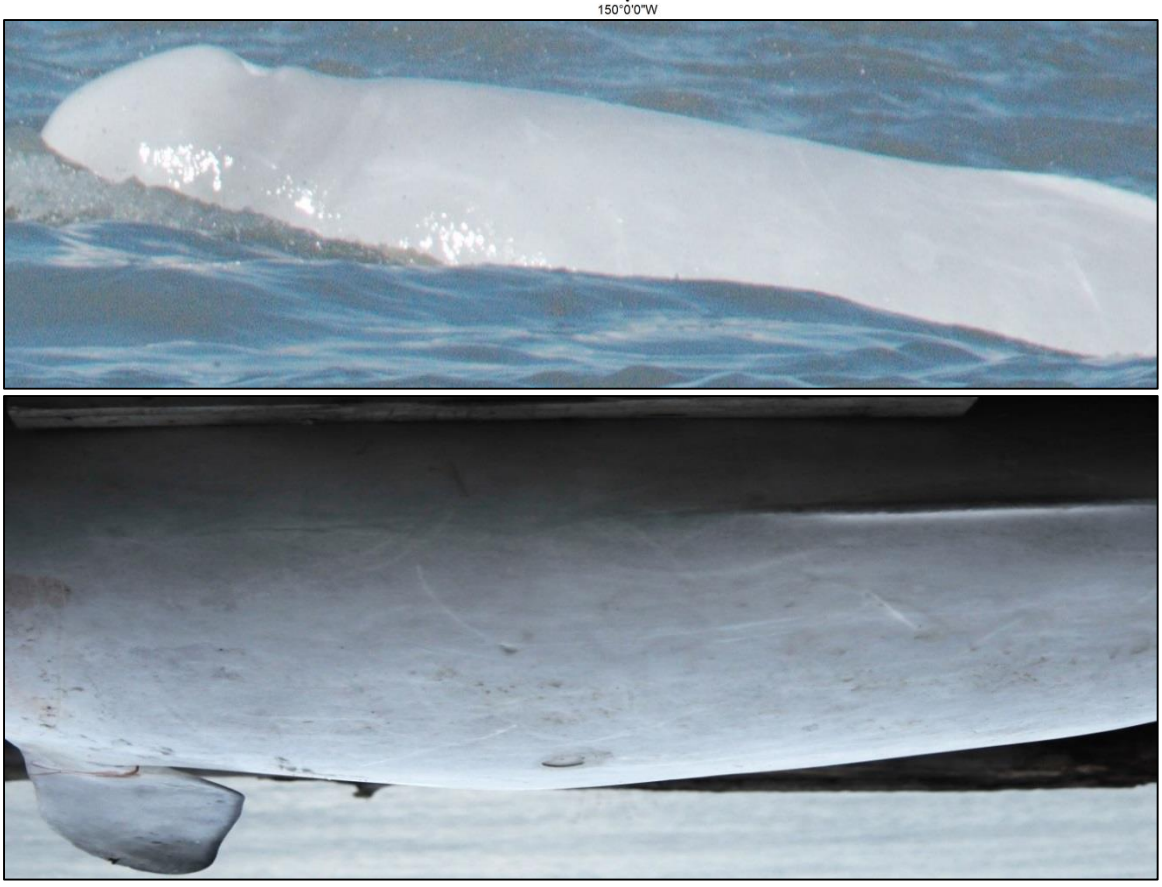

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1054 **Figure 64. Sighting history (including sightings from both right- and left-side photographs) and photographs**
1055 **of beluga L8898. This adult male was found dead in 2012 near Tyonek and necropsied in Nikiski.**

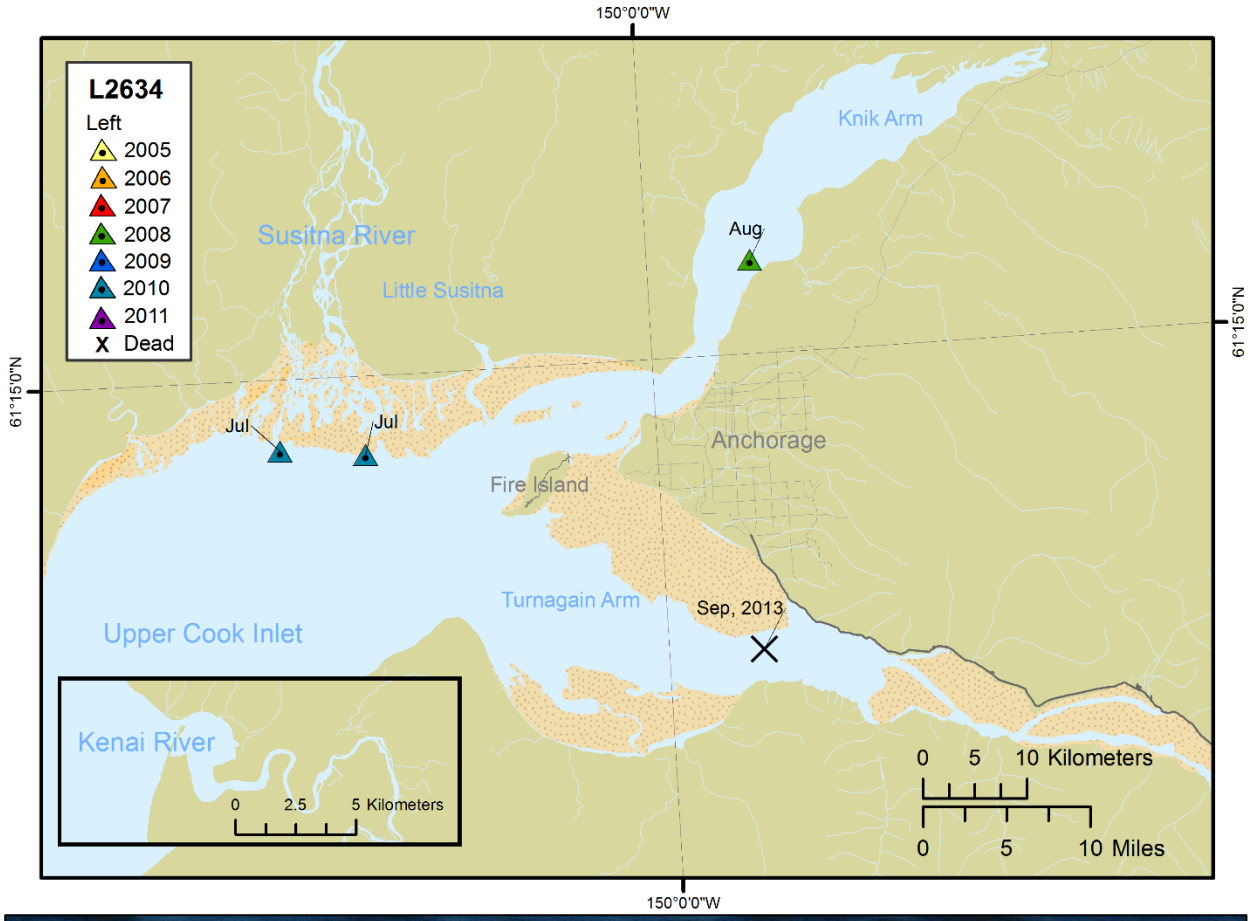


Figure 65. Sighting history and photographs of beluga L2634. This adult female was found dead in 2013 near Taylor Creek in Turnagain Arm. This beluga had been photographed live with an accompanying calf in previous years. This whale was not necropsied by NMFS or the Alaska Marine Mammal Stranding Network, and cause of death is unknown. Bottom photograph courtesy of NMFS.

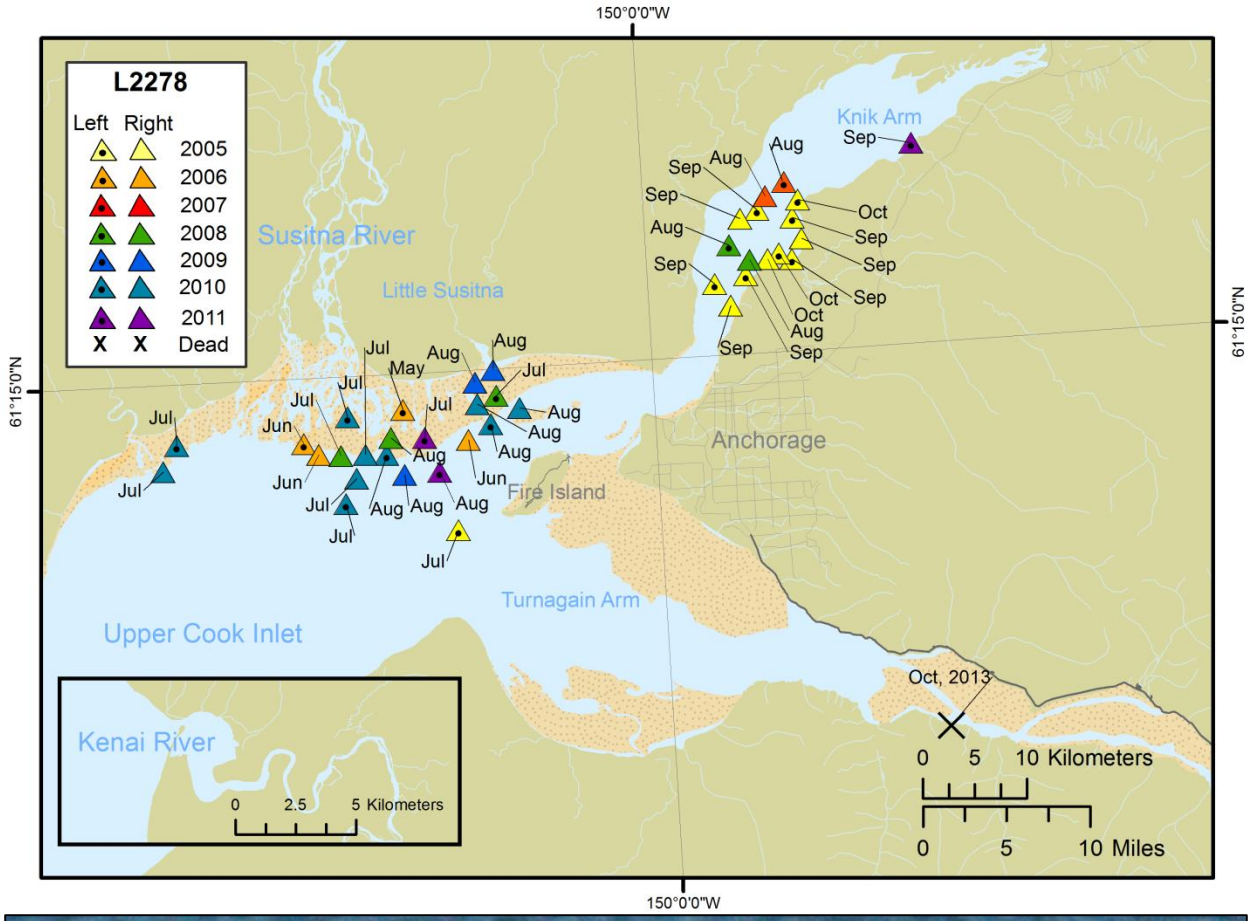


Figure 66. Sighting history (including sightings from both right- and left-side photographs) and photographs of beluga L2278. This adult male was found dead in 2013 near Hope in Turnagain Arm. Bottom photograph provided by NMFS.

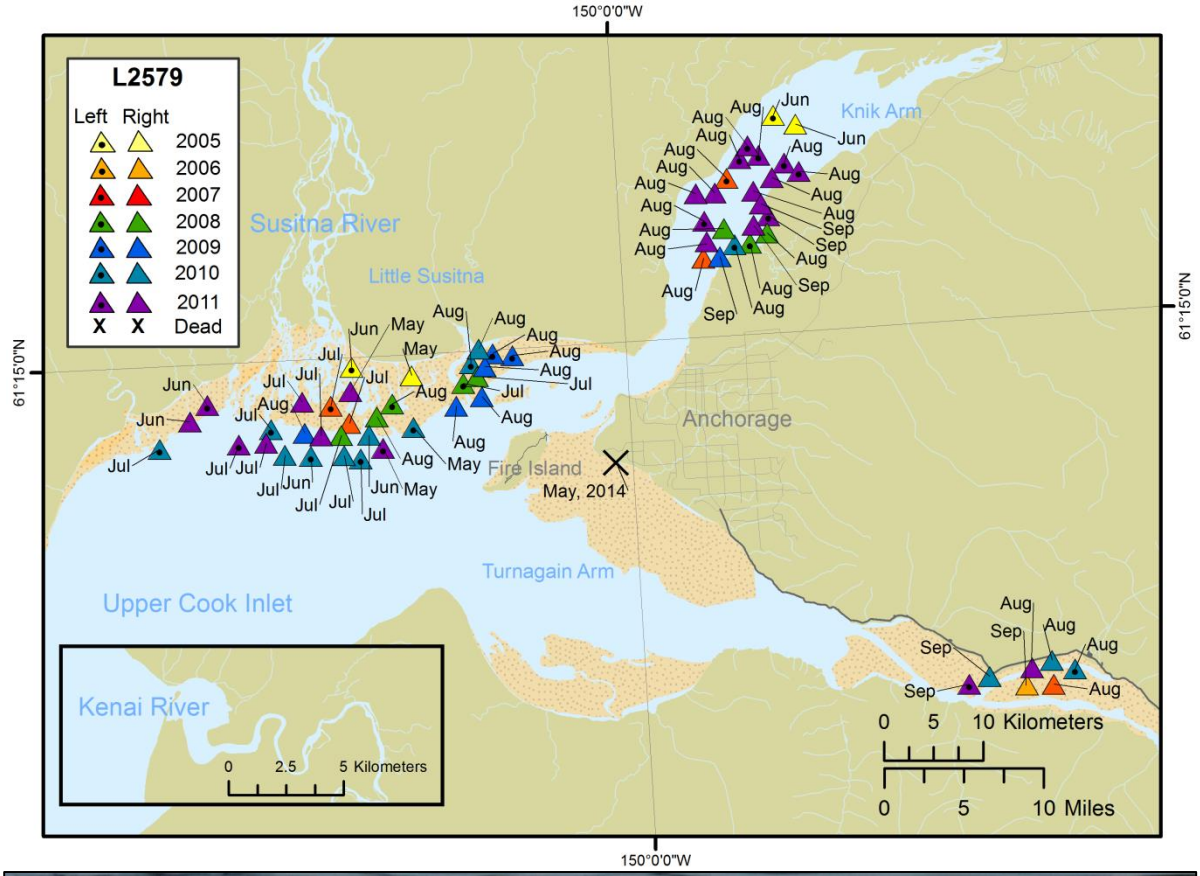
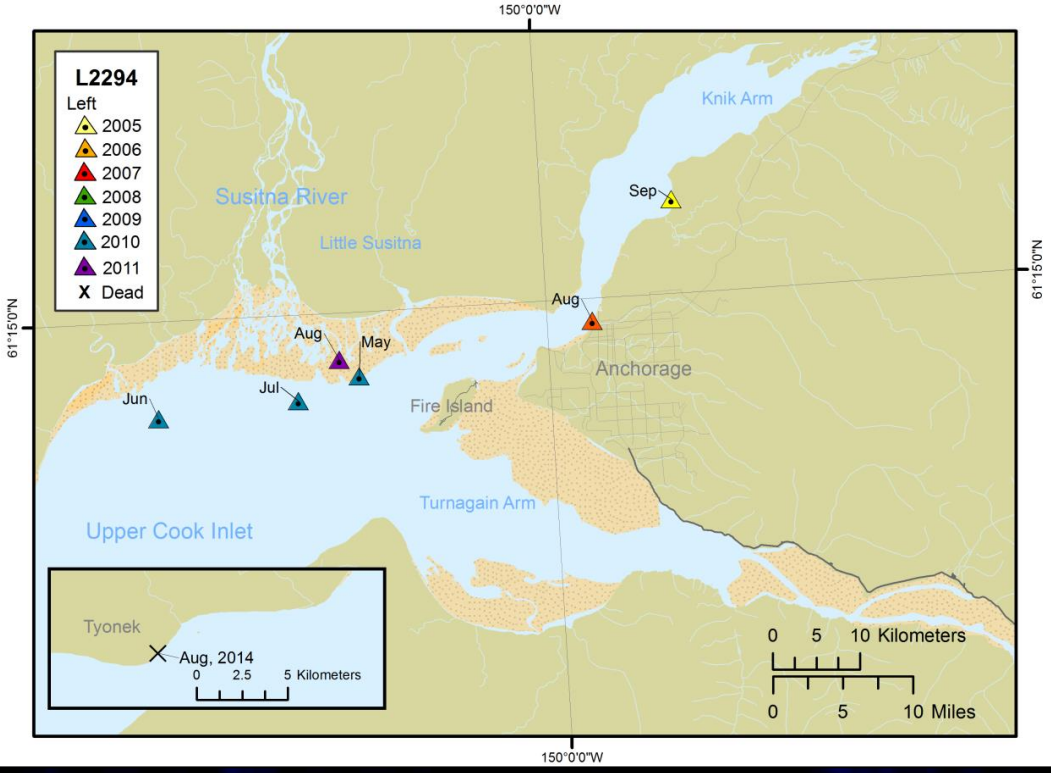


Figure 67. Sighting history (including sightings from both right- and left-side photographs) and photographs of beluga L2579. This adult male was found dead near Kincaid Park in Anchorage in 2014. This beluga was tagged by NMFS sometime between 1999 and 2002.



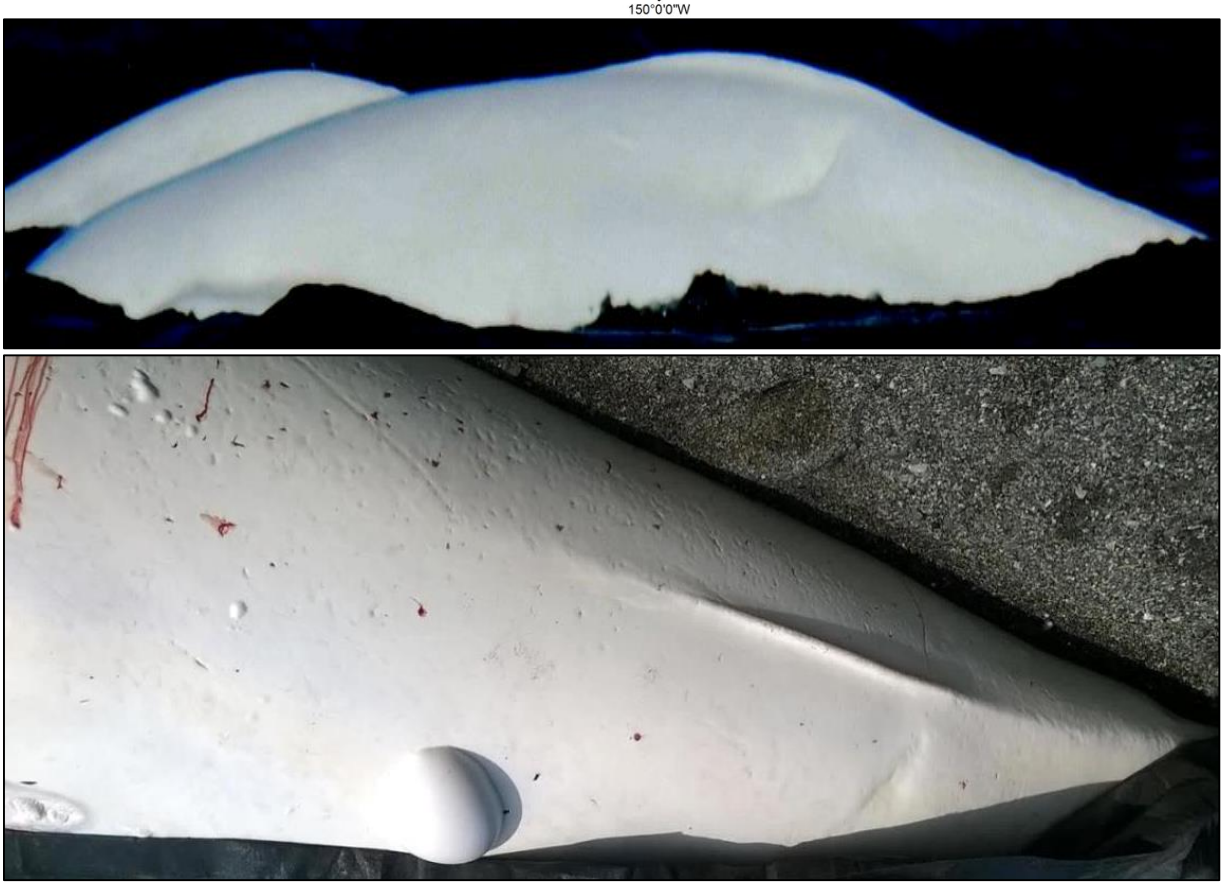


Figure 68. Sighting history and photographs of beluga L2294. This adult male was found dead in 2014 in Tyonek. Bottom photograph courtesy of NMFS.

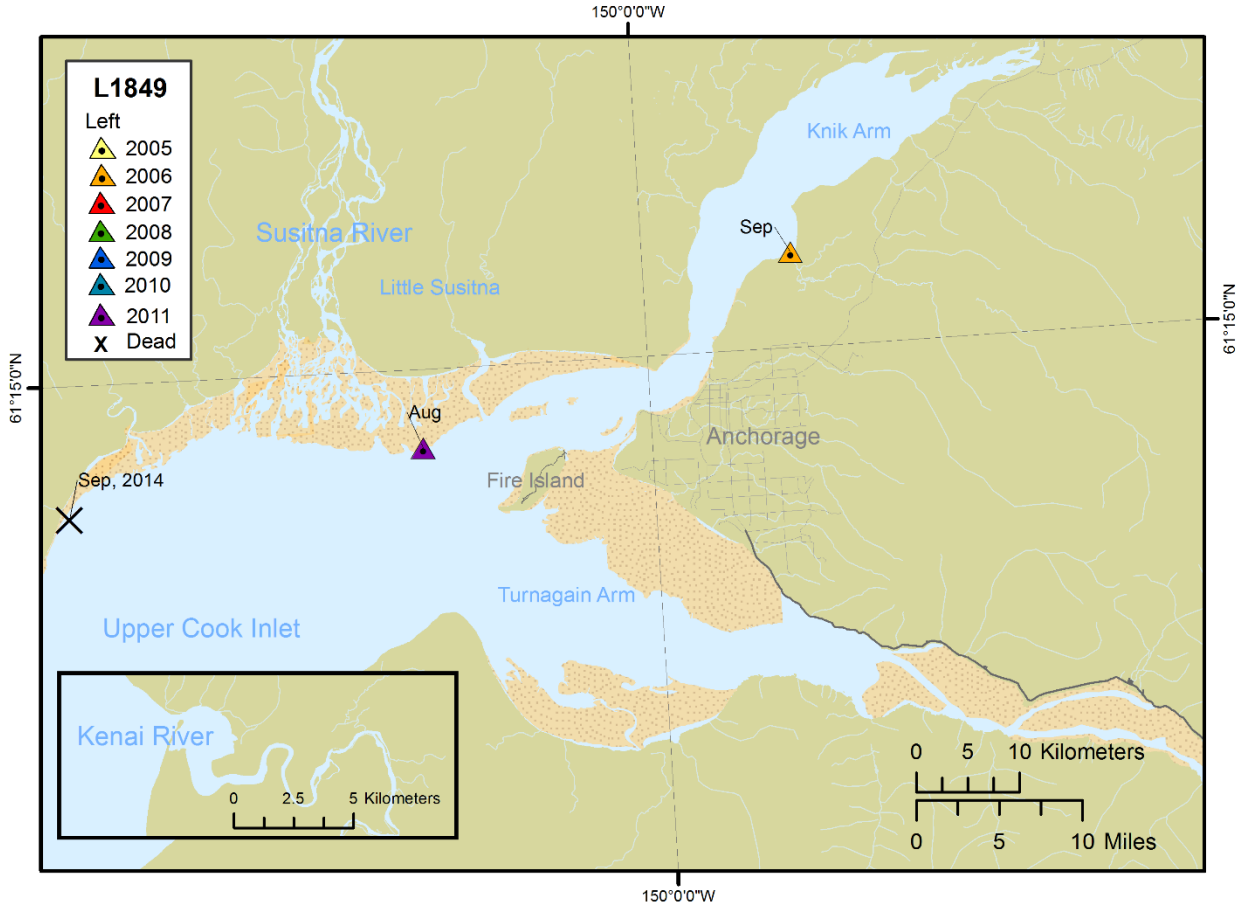
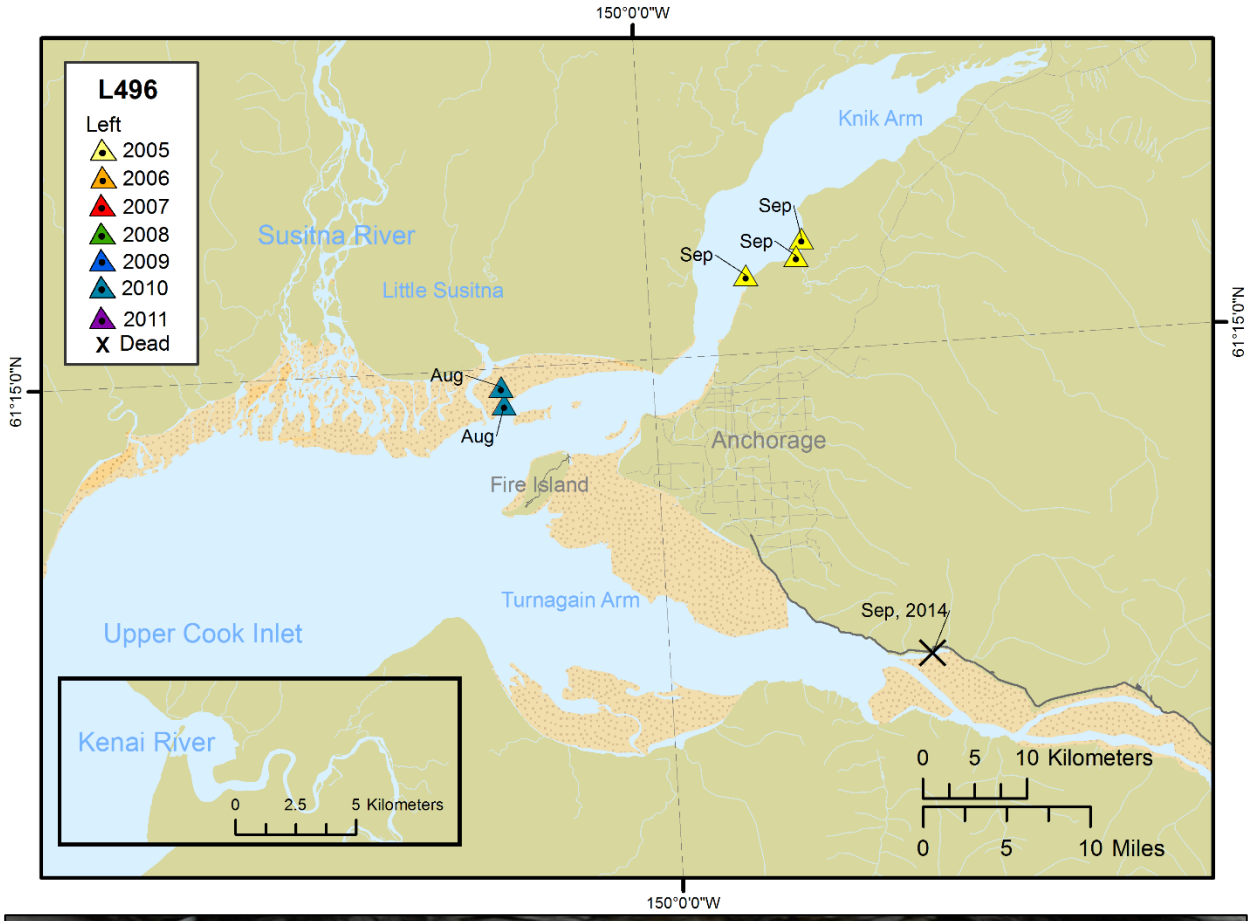


Figure 69. Sighting history and photographs of beluga L1849. This adult female was found dead in 2014 near the mouth of the Chuitna River. This beluga had been photographed live with an accompanying calf in previous years. Bottom photo provided by Dr. Pam Tuomi and Kathy Burek-Huntington.



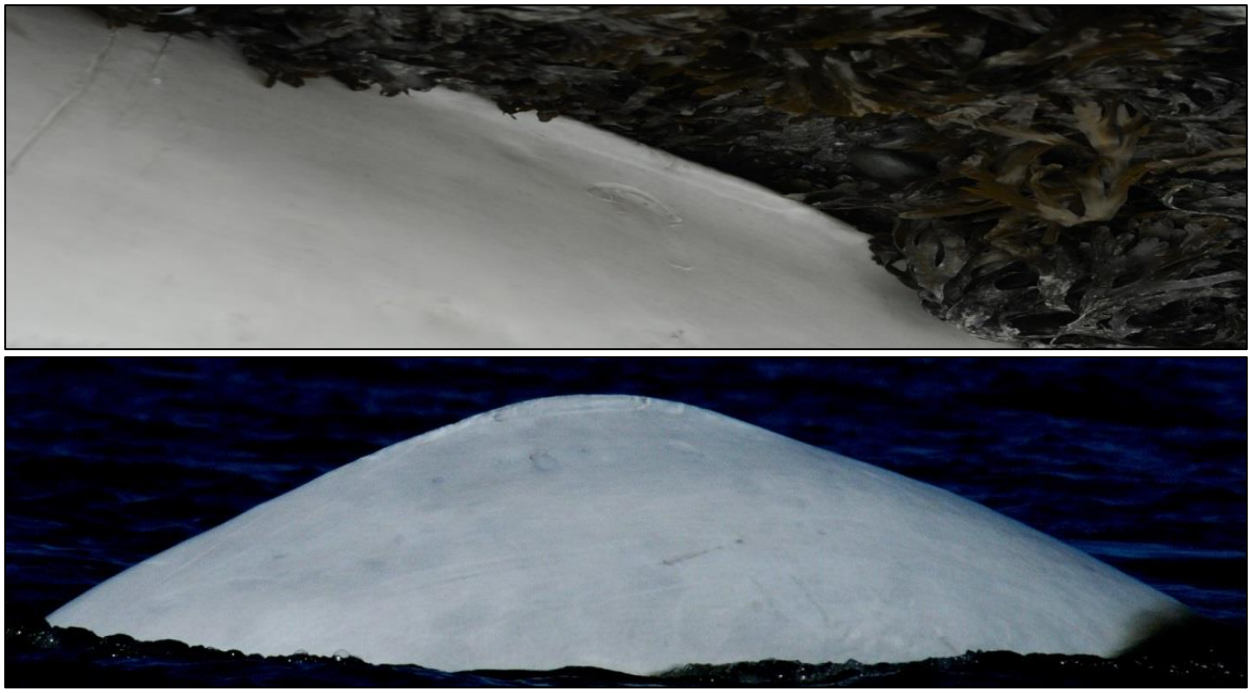


Figure 70. Sighting history and photographs of beluga L496. This adult male was found dead near Indian in Turnagain Arm in 2014.

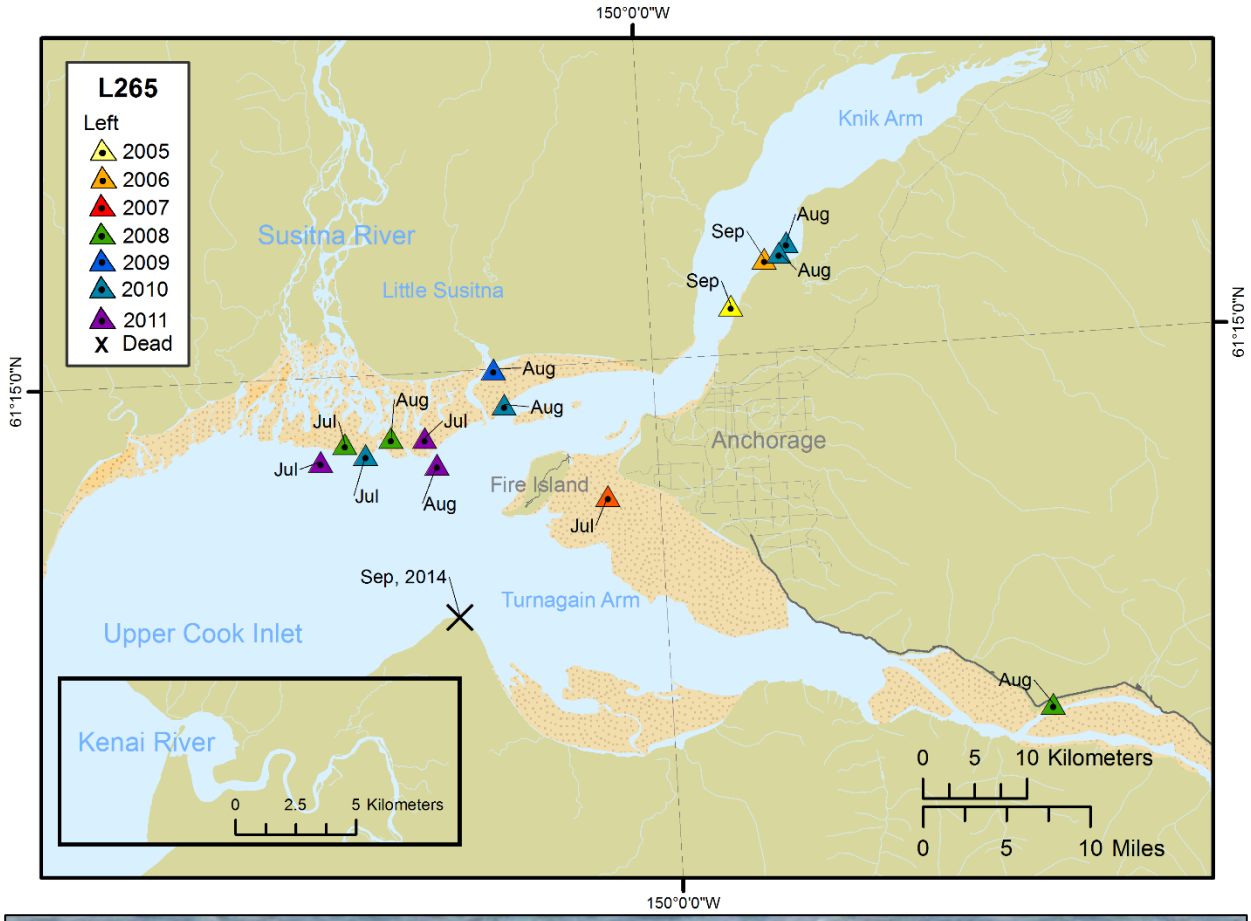


Figure 71. Sighting history and photographs of beluga L265. This adult female was found dead in 2014 near Point Possession. This beluga had been photographed live with an accompanying calf in previous years. The whale was not necropsied by NMFS or the Alaska Marine Mammal Stranding Network, and cause of death is unknown. Bottom photograph courtesy of NMFS.

As reported in our previous NPRB report (McGuire et al. 2011b), photographs of four belugas found dead between 2005 and 2008 were examined but none were identified. Photographs from seven belugas that died between 2009 and 2014 were examined, but these whales were also not identified. A guide to show stranding responders how to photograph stranded belugas in a way that will be most useful for identification of the stranded CIBW was revised (Appendix 1) and will be posted on the CIBW Photo-ID Project website, circulated among CIBW stranding responders, and shown on a poster (with handouts) to be presented at the 2015 Alaska Marine Science Symposium.

Causes of markings

Categories of markings that were assigned to marks on photographed whales included those presumed to be caused by natural sources such as other belugas, disease (Figure 72) and predation, as well as anthropogenic sources such as satellite tags, bullets (Figure 73), ship strikes (Figures 74, Figure 75), and entanglement (Figures 76). One live whale showed clear signs of rope entanglement (Figure 77). This whale was first encountered and photographed throughout the 2010 field season (McGuire and Bourdon 2012) and was also photographed in 2011, 2012, 2013. NMFS and the Alaska Marine Stranding Network were updated annually by the CIBW Photo-ID Project with sighting reports and photographs of this entangled whale.

Figure 72. Photograph of the left side of beluga L2171 showing marks that appear to be lesions.

Figure 73. Photograph of the left side of beluga L410 showing a suspected bullet wound. Note the calf to the right.

Figure 74. Photograph of the left side of beluga L3441 with a wound possibly caused by a ship strike.

Figure 75. Photograph of the left side of beluga L262 with vertical marks that may have been made by a propeller strike.

Figure 76. Photograph of the left side of beluga L2737 with a wound possibly caused by a ship strike or line entanglement.

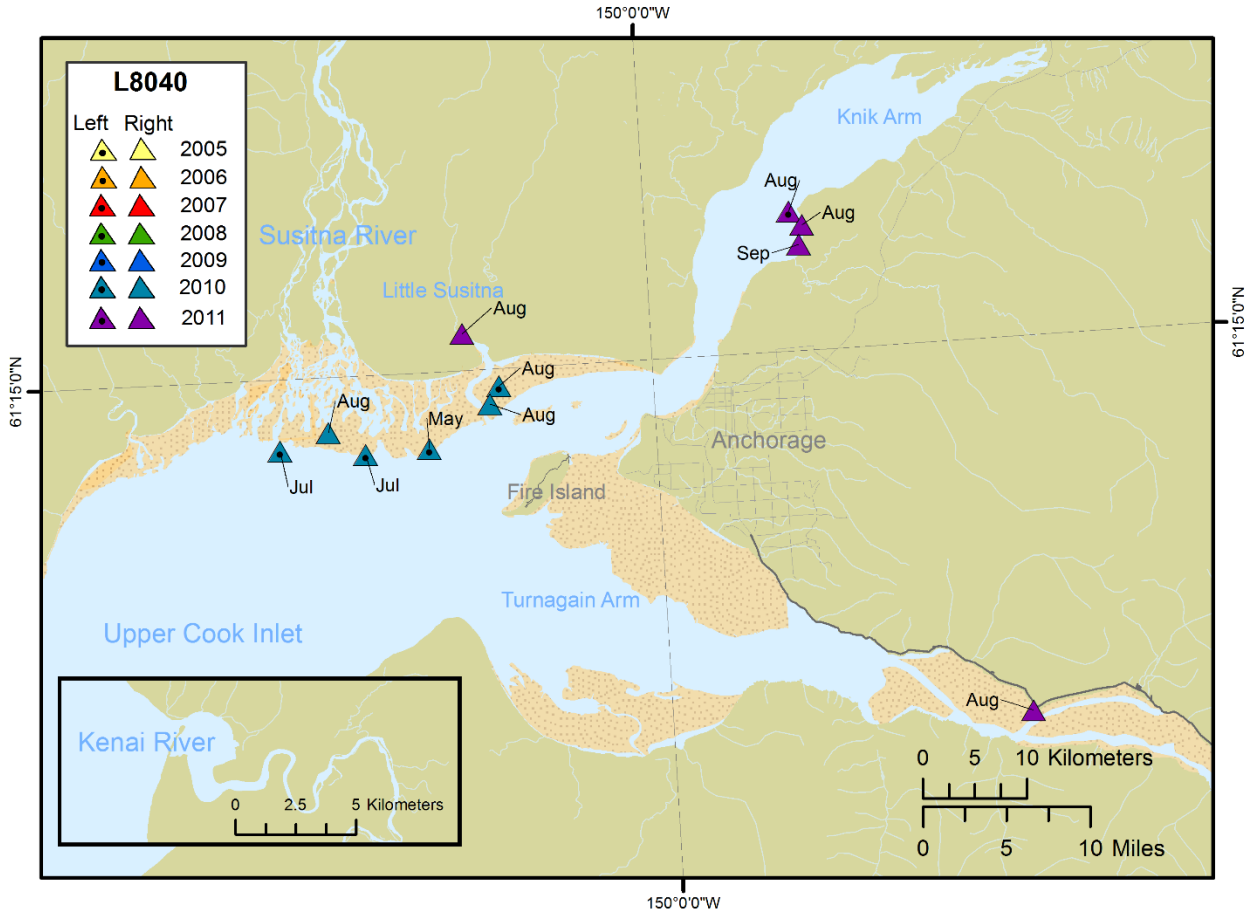


Figure 77. Sighting history (including sightings from both right- and left-side photographs) and photograph of entangled left-side beluga L8040. This whale was not seen before 2010.

DISCUSSION

Population Representation

The development of a left-side catalog provided sighting histories for 296 individually identified whales photographed between 2005 and 2011. Combining the histories of whales in the left-side catalog with histories of the 312 individuals in the right-side catalog (McGuire et al. 2014a) allows us to increase

the strength of the inferences that can be made about the CIBW population from patterns of sighting histories of individuals. The most-recent CIBW population estimate from aerial surveys is 312 whales in 2012 (Hobbs et al. 2012). Considering that during the life of the CIBW Photo-ID Project many of the individuals in the catalog have died and many calves have been born that have not yet been identified, the numbers of individuals in the catalog should not be interpreted as a population count. Nevertheless, although the catalog does not represent every individual in the CIBW population, it does contain records on the vast majority of individuals, and therefore data from individuals in the catalog should be fairly representative of the CIBW population.

We are unable to simply add the number of individuals in the two catalogs to estimate population size for CIBWs because, with the exception of the 28 dual side whales, we do not know which of the 296 left-side whales are the same individuals as the 312 right-side whales. If skin biopsies for genetic analysis of CIBWs were collected concurrently with photographs of both sides, such a determination would be possible (McGuire and Stephens 2014), but biopsy research is not being conducted on CIBW at the present time.

Range and Site Fidelity

Although the general patterns derived from sighting histories in the left-side catalog support results from the right-side catalog, the development of a left-side catalog contributed unique information about CIBWs. For example, the sighting histories of individuals in the left-side catalog increased the total number of sighting histories for CIBWs seen in Turnagain Arm and Eagle River. In Turnagain Arm, CIBWs swim from west to east with the incoming tide along a deep channel that parallels the Seward Highway on the north shore of the Arm (Markowitz et al. 2007). The position of this channel provided a highway-based photographer a view of the left sides of CIBWs as they travel up the Arm. CIBWs generally cross over to the south shore of the Arm when they exit with the falling tide and are out of range of a highway-based photographer; consequently the right-side catalog contains fewer records of individual whales in Turnagain Arm (McGuire et al. 2011b). The inclusion of sighting histories of individual CIBWs in Turnagain Arm and Eagle Bay has provided important evidence that belugas do not restrict their home ranges to any particular area. There was no indication that whales occurred in discrete subgroups endemic to any of the Upper Cook Inlet study areas; there was no evidence of a "Susitna River Delta group", a "Knik Arm group", a "Chickaloon Bay group", or a "Turnagain Arm group".

Individual CIBWs did not display fidelity to any single area of Cook Inlet. Distribution and movement patterns were examined for individual whales sighted in all seven years of the study and for whales identified by satellite tag scars. Sighting histories of these whales indicated they moved among

different areas of Cook Inlet. All of these whales were photographed in Knik Arm and the Susitna River Delta, and some were also photographed in Turnagain Arm, Chickaloon Bay/Southeast Fire Island, and the Kenai River Delta. This same pattern held true for whales in the right-side catalog (McGuire et al. 2014a), and for the dual-side whales (whales cataloged by photographs of both right and left sides).

Beluga whales encountered during photo-id surveys were rarely observed traveling between areas, but were instead encountered in distinct areas (i.e., along the Susitna River Delta, in Eagle Bay in Knik Arm, or traveling up and down Turnagain Arm). Similar patterns of localized aggregations and rapid and directed travel among areas of localized aggregations have been reported for satellite-tagged CIBWs (Hobbs et al. 2005) and beluga whales in Norway (Lydersen et al. 2001). CIBWs are not distributed uniformly throughout Upper Cook Inlet, therefore the distinct areas in which they are found (i.e., the Susitna River Delta, Turnagain Arm, and Knik Arm, particularly Eagle Bay) should warrant increased management and protection.

Whales traveling among distinct areas of Cook Inlet increase their likelihood of exposure to multiple potential threats that may be localized in particular areas. For example, the same individual whale might be exposed to noise from seismic exploration in the Susitna River Delta, vessel traffic in the shipping lanes for the Port of Anchorage, military exercises in Knik Arm's Eagle Bay, and physical habitat alteration and rock-blasting noise from in-water highway expansion activities in Turnagain Arm. Anthropogenic activities with the potential to affect CIBWs should not be considered in isolation, but rather the cumulative effects of all activities in the range of CIBWs. The potential of these cumulative activities to affect the entire population must be taken into account when making management decisions.

CIBWs also face natural threats such as mass strandings and predation events. These events have been reported to occur more often in Turnagain Arm and Knik Arm than elsewhere in Cook Inlet (NMFS 2008b). The knowledge that most or all of the CIBW population uses these areas at some time during the year underscores the threat that such events pose to the entire population, and should prompt managers to have site-specific stranding response plans ready to activate should such events occur.

Life-History Information

The compilation of long-term sighting histories of individual mothers and calves is beginning to provide the data necessary to determine several aspects of their life history, including calving interval (minimum time period between calving events), calving frequency (how often females give birth), period of maternal care/association, and survival rates of calves. It will be important to monitor these life history parameters over time, because a decline in population abundance is sometimes associated with a decrease in female age at maturity and a decrease in calving interval (Fowler 1984). The age of the CIBW photo-

id catalog is currently less than or equal to the length of time we would predict for calving intervals, calving frequency, and the period of maternal care, based on information from other beluga populations (Hobbs et al. 2008). The seven-year period of the left-side catalog, combined with infrequent annual sightings of many individuals, does not encompass enough time to determine the majority of life history attributes of such long-lived mammals, but the data from the catalog of individual CIBWs lays the foundation for determining these attributes with continued years of study. For example, one identified mother was photographed on the left-side with a maturing calf during two field seasons. The inclusion of left-side photos from 2009-2011 allowed us to see that her maturing calf continued to accompany her into a third field season, then the following year the mother was seen with a smaller calf.

Additional years of photo-id effort are needed to not only determine how long calves remain with their mothers, and how often identified mothers give birth to new calves, but also if variation exists among individual mothers. Although several mothers were photographed with neonates, calving interval cannot be determined until these same mothers are photographed with new neonates. Several mothers seen with relatively large calves in one year were photographed with smaller calves in subsequent years, but because none of the original calves were photographed as neonates, the number of years between births cannot be determined at the present time.

Combining mother/calf data from the left and right side catalogs from 2005-2011 (left) and 2005-2014 (right) allows for the creation of a comprehensive dataset on reproductive rates and birth intervals. For example, combining data from the right- and left-side catalogs for the 28 dual-side whales provided more complete information about mothers and calves than would have been provide by either catalog alone. Calves were seen on the right and left sides of their mothers, and the use of only one catalog sometimes resulted in calves being missed in the photographic record, although they were detected in photographs from the other side's catalog during the same time period.

It appears that calves are somewhat more likely to be photographed along the right sides of their mothers than along the left sides. Thirty-nine percent of individuals in the left-side catalog were classified as mothers, compared to 47% of individuals in the right-side catalog during same period. Of the 19 dual-side whales classified as mothers, 94% were photographed with calves along their right side and 72% were photographed with calves along their left side. A study of free-ranging belugas in Russia's White Sea found that young calves swam and rested along their mothers' right sides for longer periods of time than along their mother's left sides. The authors speculated that this may be because calves prefer to observe the mother with the left eye, using the right hemisphere of their brain to analyze social information (Karenina et al. 2010). Given the extremely high turbidity and practically nonexistent visibility of Cook Inlet waters, it is difficult to apply the same hypothesis to CIBWs.

Twelve calves have been identified by their own marks rather than by those of their mothers, which allow them to be tracked independently of their mothers. The mothers of most of these calves have not yet been identified. A long-term project goal is to be able to determine the period of association between identified mothers and identified calves, but this can only be done when both mother and calf have been identified. Evidence of associations over time between a mother-calf pair has been used to quantify the weakening of the mother-calf bond and to help to define the period of maternal care and association. For example, bottlenose dolphin mothers and their calves associated nearly 100% of the time in the first 3 years of life, but associations declined in most cases when the mother became pregnant again (Connor et al. 2000). Future efforts will also compare how often an identified calf is photographed with an identified mother to how often the mother and calf are photographed in the same group but are not in close physical proximity (i.e., seen in the same group, but not photographed together). The current method of defining mother-calf pairs at the level of the photo frame limits our ability to detect mothers with older calves, because the distance between mothers and offspring increases with increasing age of the calf (Mann 1997, Krasnova et al. 2006).

Until we can identify neonates and confirmed young-of-the-year calves, the exact ages of the whales in the catalog are unknown. Eighteen CIBWs were satellite tagged by NMFS between 1999 and 2002 (Hobbs et al. 2005). Eight CIBW identified between 2005 and 2011 have marks on their left sides caused by satellite tags; although the satellite tags are no longer present, we are still able to photographically track and obtain survivorship data from these eight individuals 3-12 years later. Knowledge of the years in which the satellite tags were applied would enable us to assign a relative age to re-sightings of these previously-tagged whales; we know that none of the whales were calves at the time of tagging. Details from the time of capture/tagging such as total body length and girth may provide more information about the relative age of these whales. Satellite tag type and attachment method varied among years (Rod Hobbs and Barbara Mahoney, NMFS, personal communication) and it may be possible to assign a capture/tagging date based on scar type, which in turn would provide information on survivorship, wound healing, and longevity of these mark types. We are in the process of reviewing NMFS photos of CIBWs taken during the tagging efforts to identify and assign year of capture to these previously tagged whales. It is unknown if groups of CIBWs are sexually segregated for all or even part of the year. In both the left- and right-side catalogs, we have not been able to identify any belugas as male, and have only been able to infer a beluga was female if it was accompanied by a calf. Smith et al. (1994) identified adult males by their "large size and heavy lateral musculature". We have photographed several large, white, well-muscled belugas, but at least two of these animals were closely accompanied by calves and were classified as females (sex confirmed by necropsy of dead individuals). Elsewhere in their range, outside of the breeding seasons this species segregates into groups composed of maternal pods of

adult females, calves, juveniles, and subadults, and smaller groups of adult males (Smith et al. 1994, Krasnova et al. 2009); it is unknown if this pattern also occurs in CIBWs. If adult males roam Cook Inlet as singles or in small segregated groups, the possibility exists that we are not encountering and identifying them due to a survey schedule designed to locate and photograph large conspicuous aggregations. Adult male belugas, perhaps because they were once the target of hunting, may also be more wary of vessels and may leave the area when the survey vessel approaches. The fact that the number of individuals in the photo-id catalog so closely matched the population estimate from aerial surveys suggests that most of the population is identified in the photo-id catalog and both sexes are represented. Additional evidence that the photo-id catalog contains records for males as well as females comes from the necropsy results that five of the nine dead whales with photographs were males with extensive sightings histories in the photo-id catalog.

Dead and Injured Belugas

Several photographs of CIBWs contained marks indicative of disease and trauma. Marks from trauma were attributed to predation attempts, gunshots, ship strikes, and entanglement in debris. By continuing to document the occurrence and frequency of these marks and attempting to identify mark sources, more can be learned about the incidence of risk factors that may be preventing the recovery of the endangered CIBW population. We are in the process of conducting a more-detailed examination of marks, their sizes, locations, and possible causes (McGuire et al. 2013b, 2014a). By collaborating with other investigators, particularly those authorized to investigate CIBW mortalities (NMFS, stranding groups, and subsistence users) and collect samples (e.g., skin biopsies, skin swabs) for veterinary diagnostics, we will learn more about the sources of these skin lesions.

Matching photographs of dead belugas with photographs of identified individuals in the catalog provides information necessary for understanding survivorship and population dynamics. For example, of the 16 dead CIBW who died 2009-2014 with photographs for us to examine, 81% were adults, 12% were calves, and 1 was of unknown age class. In addition, roughly one third were female, one third were male, and sex was undetermined for the remainder. There does not appear to be a clear pattern for mortality of a particular age class or sex. In several cases, sex and age-class were determined from photographs of whales that were not necropsied or otherwise examined by NMFS or the Alaska Marine Mammal Stranding Network. In order to obtain the maximum amount of information possible from a photograph of a dead whale, we have updated and will re-distribute a protocol for photographing beluga mortalities (Appendix 1). This protocol can be used as a guide for stranding responders who are willing to photo-document markings on beluga mortalities and share their photographs with the CIBW Photo-ID

Project. Linking the sighting history of an identified whale with data obtained from its necropsy increases the value of both kinds of data. For example, being able to confirm the sex of a dead whale allows us to ground truth our assumption of mother/calf relationships based on photographs of live whales. The potential exists for genetic samples taken from dead and live whales to provide information about kinship of identified individuals and we hope to be able to incorporate this type of information in the individual records in the CIBW Photo-ID catalog.

CONCLUSIONS

We developed a left-side photo-id catalog that provided sighting histories for 296 individually identified whales photographed between 2005 and 2011. These individual CIBWs did not display fidelity to any single area of Cook Inlet. Whales traveled among distinct areas of Cook Inlet, thereby increasing their likelihood of exposure to multiple potential threats. CIBWs are not distributed uniformly throughout Cook Inlet, therefore the distinct areas in which they are found (i.e., the Susitna River Delta, Turnagain Arm, and Knik Arm, particularly Eagle Bay) warrant maximum management and protection.

The compilation of long-term sighting histories of individual mothers and calves is beginning to provide the data necessary for the determination of several aspects of life history, including calving interval (minimum time period between calving events), calving frequency (how often females give birth), period of maternal care/association, and survival rates of calves; more years of data are needed to determine these life-history parameters for these long-lived mammals and to monitor them over time. Combining data from the right- and left-side catalogs provides more complete information about mothers and calves than either catalog alone.

Several photographs of CIBWs contained marks indicative of disease and trauma. Marks from trauma were attributed to predation attempts, gunshots, ship strikes, and entanglement in debris. By continuing to document the occurrence and frequency of these marks and attempting to identify mark sources, as well as by identifying stranded whales, more can be learned about the incidence of risk factors that may be preventing the recovery of the endangered CIBW population.

While not all objectives in the statement of work were fully met during the period of work for this 2-year NPRB project to catalog the left-side photographs taken 2008-2011 (see “Objectives”, pages 7-8 of this report), the stated objectives are also the objectives of the larger CIBW Photo-ID Project that includes the combined right-and left-side catalog and all surveys conducted 2005-2014 (and into 2015 and possibly beyond). All objectives are being met in the greater scope of the larger project.

MANAGEMENT IMPLICATIONS

The inclusion of left-side sighting histories, especially from individual CIBWs photographed in Turnagain Arm and Eagle Bay, has provided important evidence that belugas do not restrict their home ranges to any particular area. Individual CIBWs did not display fidelity to any single area of Cook Inlet.

CIBWs are not distributed uniformly throughout Upper Cook Inlet, therefore the distinct areas in which they are found (i.e., the Susitna River Delta, Turnagain Arm, and Knik Arm, particularly Eagle Bay) should warrant increased management and protection.

Whales traveling among distinct areas of Cook Inlet increase their likelihood of exposure to multiple potential threats that may be localized in particular areas. For example, the same individual whale might be exposed to noise from seismic exploration in the Susitna River Delta, vessel traffic in the shipping lanes for the Port of Anchorage, military exercises in Knik Arm's Eagle Bay, and physical habitat alteration and rock-blasting noise from in-water highway expansion activities in Turnagain Arm. Anthropogenic activities with the potential to affect CIBWs should not be considered in isolation, but rather the cumulative effects of all activities in the range of CIBWs and their potential to affect the entire population must be taken into account when making management decisions.

CIBWs also face natural threats such as mass strandings and predation events. These events have been reported to occur more often in Turnagain Arm and Knik Arm than elsewhere in Cook Inlet (NMFS 2008b). Photo-id has provided evidence that most or all of the CIBW population uses these areas at some time during the year underscores the threat that such events pose to the entire population, and should prompt managers to have site-specific stranding response plans ready to activate should such events occur.

Several photographs of CIBWs contained marks indicative of disease and trauma. Marks from trauma were attributed to predation attempts, gunshots, ship strikes, and entanglement in debris. By continuing to document the occurrence and frequency of these marks and attempting to identify mark sources and stranded whales, more can be learned about the incidence of risk factors that may be preventing the recovery of the endangered CIBW population.

PUBLICATIONS

This project does not currently have any peer-reviewed publications or manuscripts in review, submission, or in preparation. We plan to include results from this project in a series of manuscripts that

will combine results from the right-side catalog, the left-side catalog, and ten years of surveys (2005-2014), to be submitted in 2016.

OUTREACH

Exhibits/Demonstration Project Developed

The CIBW Photo-ID Project worked with the Pratt Museum in Homer and the Alaska SeaLife Center to provide information and photographs about CIBW and the CIBW Photo-ID Project for displays in each institution.

Community Meetings

- Collected reports and photographs from the public about sightings of CIBW. Compiled reports in project incidental sighting database, and also forwarded complied reports to NMFS. Spring/Summer/Fall/Winter 2012-2014.

- Distributed copies of the CIBW Photo-ID Project brochure to fishermen, recreational boat users and hunters at the Anchorage Small Boat Launch and Kenai City Dock; distribute pamphlets to tourists and residents as they beluga-watched along the Seward Highway along Turnagain Arm. Spring/Summer/Fall 2013-2014.

Presentations at Festivals/Events

- Shared display booth with NOAA Office of Law Enforcement at "Great Alaska Gathering" Aviation Show, Ted Stevens International Airport, Anchorage. Made and distributed pocket-sized cards for pilots, with contact numbers to call and report live and dead beluga whale sightings to NMFS and the CIBW Photo-ID Project. Staffed table with display on belugas and the CIBW Photo-ID Project. May 2014.

- Shared display booth with NOAA Office of Law Enforcement at "Great Alaskan Sportsman Show" Anchorage. Staffed table with display on belugas and the CIBW Photo-ID Project. March 2014.

- Sent project pamphlets with NOAA Office of Law Enforcement for their display booth at the Alaska State Fair, Palmer. August 2014.

Workshop Participation

- NMFS Alaska Region's Cook Inlet Beluga Whale Biopsy Workshop, Anchorage Alaska. April 2014.

Presentations in Schools (K-12, Undergraduate)

- A talk on the CIBW Photo-ID Project was given at the Four Valleys School in Girdwood, and students later participated in a land-based survey along Turnagain Arm. Students participated in interactive educational activities, such as "the blubber glove", the beluga matching game, and "name that beluga". April 2014.

- A talk on belugas and the CIBW Photo-ID Project was given at the Kincaid Elementary to the entire 5th Grade. Students participated in interactive educational activities, such as "the blubber glove", the beluga matching game, and "name that beluga". April 2014.

- Students and professors from the UAA Homer/Kenai Peninsula College Marine Mammal class accompanied project biologists during fieldwork along Turnagain Arm and the Kenai River and assisted with observations. Sept. 2013 and 2014.

- Presentation on CIBW and the Photo-ID Project to UAA Homer Marine Mammal class. Sept. 2014.

- Mentored Alaska Native Science and Engineering Program (ANSEP) Intern. Student presented a poster on her work with the CIBW Photo-ID Project as part of ANSEP graduation ceremony. July 2014.

Press Articles

- Article about the CIBW Photo-ID Project in the Redoubt Reporter. April 2014.
- Article about the CIBW Photo-ID Project in the Peninsula Clarion. January 2014.

Factsheets Produced

- Informational pamphlet updated (Figures 78 and 79) and distributed.
- Guide to how to photograph stranded CIBW updated (Appendix 1) and distributed.
- Produced business card-sized handout with information on how and where to report live and dead CIBW.

Factsheets were distributed during field work and at all public outreach events.

Video Produced

None

Radio/Television Interviews

none

Podcast and Blogs

None

Web Page or Site Developed

The CIBW Photo-ID project website (www.cookinletbelugas.org) was updated with results from this current study. The website contains a page for members of the public to report beluga sightings. The website address was distributed via the project bumper sticker (Figure 80) and project pamphlets (Figures 78 and 79).

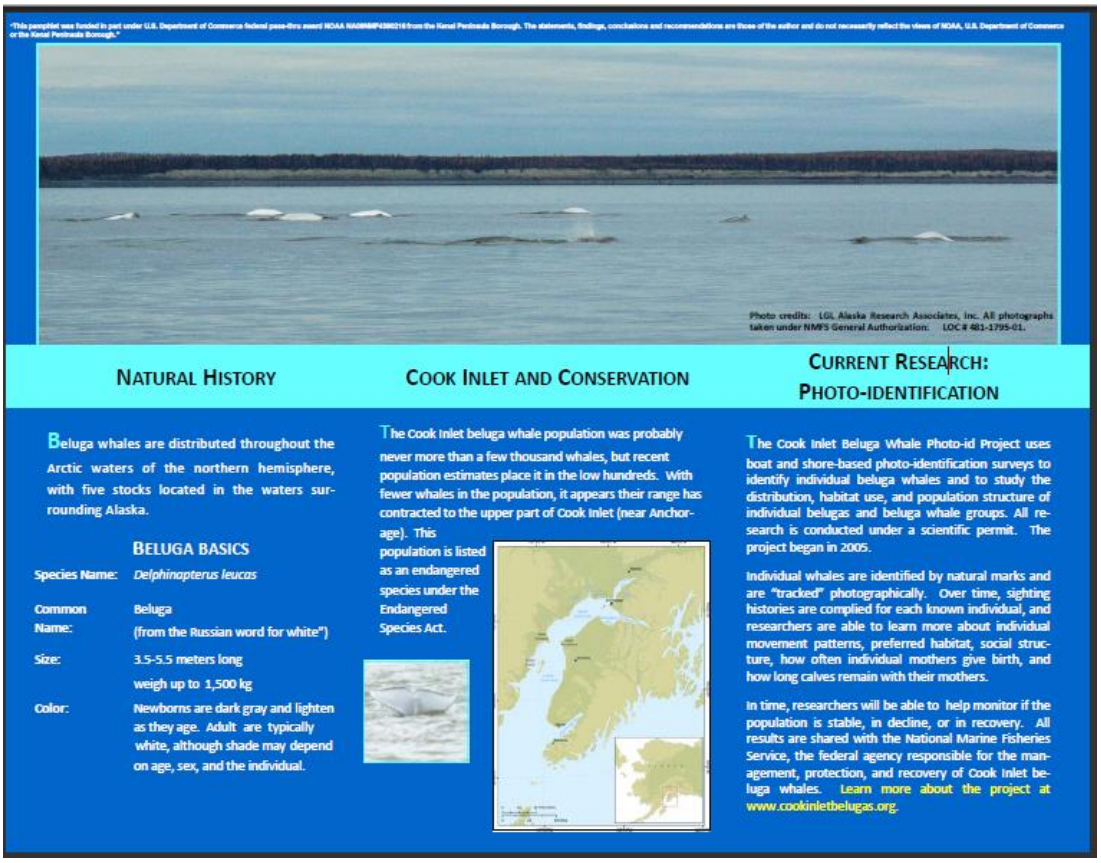


Figure 78. Inside page of tri-fold educational pamphlet about CIBWs and the CIBW Photo-ID Project.

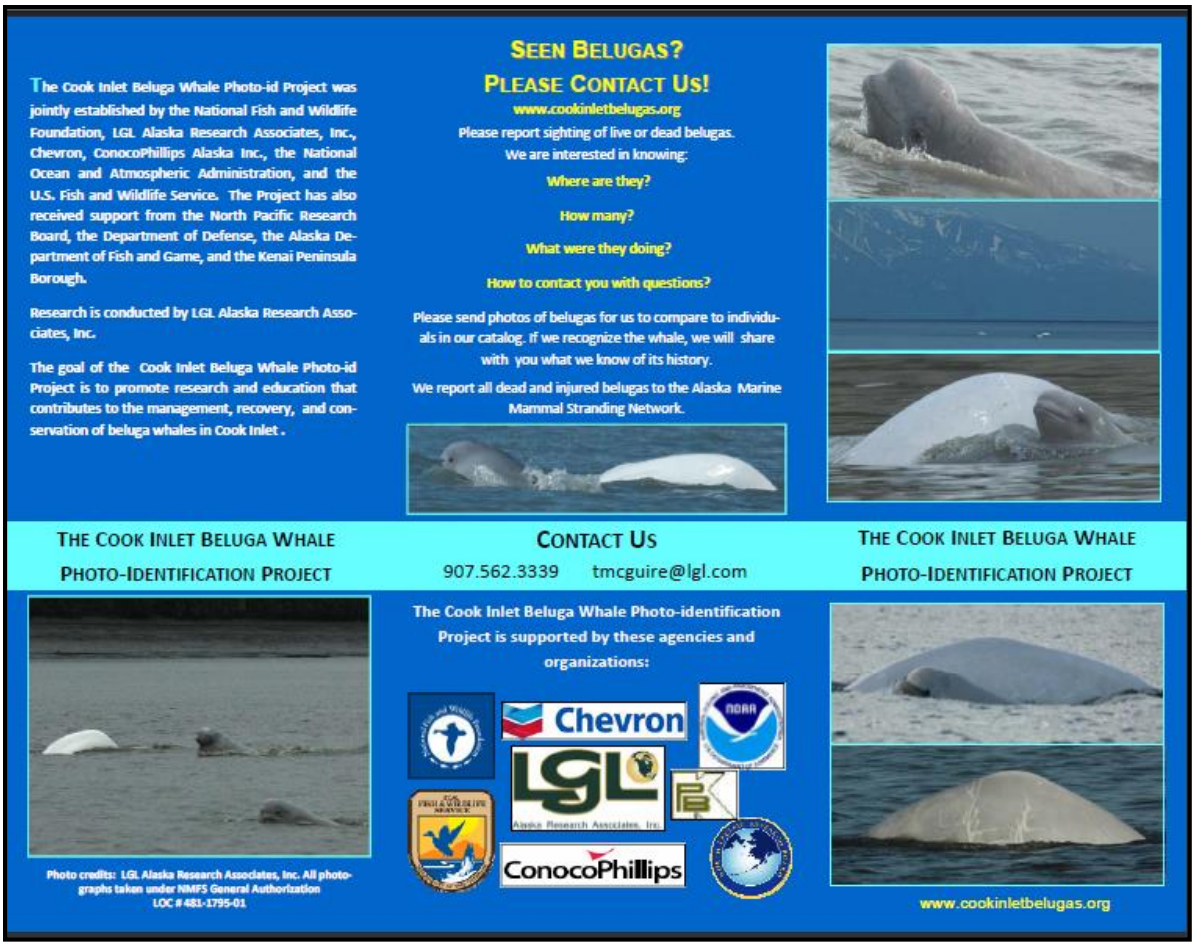


Figure 79. Outside page of tri-fold educational pamphlet about CIBWs and the CIBW Photo-ID Project.

Figure 80. The CIBW Photo-ID Project bumper sticker with website address for reporting beluga sightings and submitting photographs.

Conference Presentations

- Poster presentations about the CIBW Photo-ID Project at the Alaska Marine Science Symposium, Anchorage, Alaska. January 2014.

- Invited talk about the CIBW Photo-ID Project at the Kenai Borough CIBW Conference, Soldotna, Alaska. January 2014.

- Posters and invited talk about CIBW Photo-ID Project at the NMFS Beluga Whale Science Conference, Anchorage, Alaska. April 2014.

- Invited talk about the CIBW Photo-ID Project and panel participation at the NMFS Office of Protected Resources CIBW Conference, Anchorage, Alaska. November 2014.

- Abstracts submitted and accepted for posters about the CIBW Photo-ID Project at the Alaska Marine Science Symposium. November 2014 (January 2015).

Social Media

none

Teacher Workshops or Hosted Teacher-at-Sea

none

Books

none

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Kenai Peninsula Borough
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LITERATURE CITED

Connor, R.C., Wells, R.S., Mann, J., and Read, A.J. 2000. The bottlenose dolphin. Social relationships in a fission-fusion society. *In* J. Mann, R.C. Connor, P.L. Tyack and H. Whitehead (Editors) Cetacean Societies: Field Studies of Dolphins and Whales, page 91126. Chicago, IL: University of Chicago Press.

Fowler, C.W. 1984. Density dependence in cetacean populations. *In* W.F. Perrin, R.L. Brownell Jr., and P.D. DeMaster (Editors) Reproduction in whales, dolphins, and porpoises: Proceedings of the conference, Cetacean Reproduction, Estimating Parameters for Stock Assessment and Management, La Jolla, CA, 28 Nov-7 Dec, 1981, pp. 373-79. Reports of the International Whaling Commission, special issue 6. Cambridge: International Whaling Commission.

Funk, D.W., Markowitz, T.M., and Rodrigues, R.J. eds. 2005. Baseline studies of beluga whale habitat use in Knik Arm, Upper Cook Inlet, Alaska: July 2004-July 2005. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, in association with HDR Alaska, Inc., Anchorage, AK, for Knik Arm Bridge and Toll Authority, Anchorage, AK, Department of Transportation and Public Facilities, Anchorage, AK, and Federal Highway Administration, Juneau, AK.

Goetz, K.T., Rugh, D.J., Read, A.J., and Hobbs, R.C. 2007. Habitat use in a marine ecosystem: beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Marine Ecology Progress Series 330:247-256.

Hobbs, R.C., C.L. Sims, and K.E.W. Shelden. 2012. Estimated abundance of belugas in Cook Inlet, Alaska, from aerial surveys conducted in June 2012. NMFS, NMML Unpublished Report. 7 pp.

Hobbs, R.C., Shelden, K.E., Rugh, D.J., and Norman, S.A. 2008. 2008 status review and extinction risk assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Report 2008-02, 116 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle, WA 98115.

Hobbs, R.C., Laidre, K.L., Vos, D.J., Mahoney, B.A., and Eagleton, M. 2005. Movements and area use of belugas, *Delphinapterus leucas*, in a Subarctic Alaskan estuary. Arctic 58(4):331-340.

IUCN (World Conservation Union). 2006. IUCN Red list of threatened species. http://www.iucn.org.

Karenina, K., Giljov, A., Baranov, V., Osipova, L., Krasnova, V., and Malashichev, Y. 2010. Visual laterality of calf-mother interactions in wild whales. PlosOne 5(11):1-6.

Krasnova, V.V., Bel'kovich, V.M., and Chernetskey, A.D. 2009. Formation of behavior in the White Sea beluga calf, *Delphinapterus leucas*, during early postnatal onto genesis. Russian Journal of Marine Biology 35(1):53-59.

Krasnova, V.V., Bel'kovich, V.M., and Chernetskey, A.D. 2006. Mother-infant spatial relations in wild beluga (*Delphinapterus leucas*) during postnatal development under natural conditions. Biology Bulletin 33(1):53-58.

Kryukova, N.V. 2005. Abstract: Development of the method for photo-identification of White Sea belugas (*Delphinapterus leucas*). 19th Annual Conference of the European Cetacean Society and Associated Workshops. April 2-7, 2005. La Rochelle, France.

LGL Alaska Research Associates, Inc. 2009. Photo-identification of beluga whales in Upper Cook Inlet, Alaska: Mark analysis, mark-resight estimates, and color analysis from photographs taken in 2008. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 99 p. + Appendices.

Lydersen, C., Martin, A.R., Kovacs, K.M., and Gjertz, I. 2001. Summer and autumn movements of white whales *Delphinapterus leuca*s in Svalbard, Norway. Marine Ecology Progress Series 219:265-274.

Mann, J. 2000. Unraveling the dynamics of social life: long-term studies and observational methods. *In* J. Mann, R.C. Connor, P.L. Tyack and H. Whitehead (Editors) Cetacean Societies: Field Studies of Dolphins and Whales, pp. 45-64. Chicago, IL:University of Chicago Press.

Mann, J. 1997. Individual differences in bottlenose dolphin infants. *Family Sys.* 4:35-49.

Mann, J., and Smuts, B. 1999. Behavioral development in wild bottlenose dolphin newborns (*Tursiops* sp.). Behavior 136:529-566.

Markowitz, T.M., and McGuire, T.L., eds. 2007. Temporal-spatial distribution, movements and behavior of beluga whales near the Port of Anchorage, Alaska. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, for Integrated Concepts and Research Corporation and the U.S. Department of Transportation Maritime Administration.

Markowitz, T.M., McGuire, T.L., and Savarese, D.M. 2007. Monitoring beluga whale (*Delphinapterus leucas*) distribution and movements in Turnagain Arm along the Seward Highway. Final Report. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, for HDR and the Alaska Department of Transportation and Public Facilities.

McGuire, T. and M. Bourdon. 2012. Photo-identification of beluga whales in UpperCook Inlet, Alaska. Final report of field activities and belugas re-sighted in 2010. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 43 p. + Appendices.

McGuire, T.L., and Kaplan, C.C. 2009. Photo-identification of beluga whales in Upper Cook Inlet, Alaska. Final report of field activities in 2008. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 28 p. + Appendices.

McGuire, T. L. and A. Stephens. 2014. Report of a Workshop on Cook Inlet Beluga WhaleBiopsy. Prepared for Pacific States Marine Fisheries Commission and National Marine Fisheries Service, Alaska Region, Office of Protected Resources. 25 pages + appendices.

McGuire, T., A. Stephens, and L. Bisson. 2014a. Photo-identification of Cook Inlet Beluga Whales in the Waters of the Kenai Peninsula Borough, Alaska. Final Report of Field Activities and Belugas Identified 2011–2013. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for the Kenai Peninsula Borough. 92 p. + Appendices.

McGuire, T., A. Stephens, and L. Bisson. 2014b. Photo-identification of beluga whales in the Susitna River Delta, Upper Cook Inlet, Alaska. Final report of field activities in 2013. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation and ConocoPhillips Alaska, Inc. 20 p. + Appendices.

McGuire, T., A. Stephens, and M. Bourdon. 2013a. Photo-identification of beluga whales in Upper Cook Inlet, Alaska. Final report of field activities in 2011 and 2012 and belugas re-sighted in 2011. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation and ConocoPhillips Alaska, Inc. 32 p. + Appendices.

McGuire, T., A. Stephens, L. Bisson, and M. Bourdon. 2013b. Photo-identification of beluga whales in Eagle Bay, Knik Arm, Upper Cook Inlet, Alaska. Final report of field activities and belugas identified in 2011. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for Department of Defense, U.S. Air Force, JBER, and the Alaska Department of Fish and Game. 30 p. + Appendices.

McGuire, T.L., M.K. Blees, and M.L. Bourdon. 2011a. The development of a catalog of left-side digital images of individually-identified Cook Inlet beluga whales *Delphinapterus leucas*. North Pacific Research Board Final Report 910, 96 p.

McGuire, T., M. Blees, and M. Bourdon. 2011b. Photo-identification of beluga whales in Upper Cook Inlet, Alaska. Final Report of Field Activities and belugas resighted in 2009. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 53 p. + Appendices.

McGuire, T.L., Kaplan, C.C., and Blees, M.K. 2009. Photo-identification of beluga whales in Upper Cook Inlet, Alaska. Final report of belugas resighted in 2008. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for National Fish and Wildlife Foundation, Chevron, and ConocoPhillips Alaska, Inc. 42 p. + Appendices.

McGuire, T.L., Kaplan, C.C., Blees, M.K., and Link, M.R. 2008. Photo-identification of beluga whales in Upper Cook Inlet, Alaska. 2007 annual report. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for Chevron, National Fish and Wildlife Foundation, and ConocoPhillips Alaska, Inc. 52 p. + Appendices.

Michaud, R. 1996. The St. Lawrence beluga: A study of their distribution and social structure. Annual report 1995-1996. INESL, Tadoussac, Québec. 36 pages.

Nemeth, M.J., Kaplan, C.C., Prevel-Ramos, A.M., Wade, G.D., Savarese, D.M., and Lyons, C.D. 2007. Baseline studies of marine fish and mammals in Upper Cook Inlet, April through October 2006. Final report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK for DRven Corporation, Anchorage, AK.

NMFS. 2008a. Endangered and threatened species: endangered status of the Cook Inlet beluga whale. Federal Register 73(205):62919-62930.

NMFS. 2008b. Conservation plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). National Marine Fisheries Service, Juneau, Alaska. 122 pages.

Prevel-Ramos, A.M., Markowitz, T.M., Funk, D.W., and Link, M.R. 2006. Monitoring beluga whales at the Port of Anchorage: Pre-expansion observations, August-November, 2005. Report from LGL Alaska Research Associates, Inc., Anchorage, AK, for Integrated Concepts and Research Corporation, the Port of Anchorage, and the U.S. Department of Transportation Maritime Administration.

Rugh, D.J., Goetz, K.T., Sims, C.L., Shelden, K.W., Shpak, O.V., Mahoney, B.A., and Smith, B.K. 2006. Aerial surveys of belugas in Cook Inlet, Alaska, June 2006. http://www.fakr.noaa.gov/protectedresources/whales/beluga/survey/june2006.pdf

Rugh, D.J., Shelden, K.E.W., Sims, C.L., Mahoney, B.A., Smith, B.K., Litzky, L.K., and Hobbs, R.C. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Technical Memorandum NMFS-AFSC-149.

Rugh, D.J., Mahoney, B.A., and Smith, B.K. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. NOAA Technical Memorandum NMFS-AFSC-145.

Rugh, D.J., Shelden, K.E.W., and Mahoney, B.A. 2000. Distribution of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, during June/July 1993-2000. Marine Fisheries Review 62(3):6-21.

Shelden, K.E.W., C.L. Sims, L. Vate Brattström, J.A. Mocklin, and R.C. Hobbs. 2012. Aerial surveys of belugas in Cook Inlet, Alaska, June 2012. NMFS, NMML Unpublished Field Report. 18 p.

Shelden, K.E.W., K.T. Goetz, C.L. Sims, L. Vate Brattström, and R.C. Hobbs. 2011. Aerial surveys of belugas in Cook Inlet, Alaska, June 2011. NMFS, NMML Unpublished Field Report. 18 p.

Shelden, K.E.W., L. Vate Brattstrom, and C.L. Sims. 2010. Aerial surveys of belugas in Cook Inlet, Alaska, August 2010. NMFS, NMML Unpublished Field Report. 12 p.

Shelden, K.E.W., D.J. Rugh, K.T. Goetz, C.L. Sims, L. Vate Brattstrom, and R.C. Hobbs. 2009a. Aerial surveys of belugas in Cook Inlet, Alaska, June 2009. NMFS, NMML Unpublished Field Report. 18p.

Shelden, K.E.W., K.T. Goetz, L. Vate Brattstrom, and B.A. Mahoney. 2009b. Aerial surveys of belugas in Cook Inlet, Alaska, August 2009. NMFS, NMML Unpublished Field Report. 10 p.

Shelden, K.E.W., Rugh, D.J., Goetz, K.T., Vate Brattstrom, L., and Mahoney, B.A. 2008. Aerial surveys of belugas in Cook Inlet, Alaska, June 2008. NMFS, NMML Unpublished Field Report. 18 p. http://www.fakr.noaa.gov/protectedresources/whales/beluga/survey/june08.pdf

Smith, T.G., Hammill, M.O., and Martin, A.R. 1994. Herd composition and behaviour of white whales (*Delphinapterus leucas*) in two Canadian Arctic estuaries. Meddelelser om Grønland. Bioscience 39:175-184.

Würsig, B., and Jefferson, T. 1990. Methods of photo-identification for small cetaceans. Reports of the International Whaling Commission 12:43-52.

APPENDIX 1: CIBW PHOTO-ID PROJECT PROTOCOL FOR TAKING PHOTOGRAPHS OF DEAD BELUGA WHALES

The Cook Inlet Beluga Whale Photo-identification Study:

Photo-ID provides information about individual Cook Inlet beluga whales (CIBW) and the population as a whole, including residency/movement patterns, habitat use, reproduction, survivorship, and abundance. Over ten field seasons (2005-2014) the CIBW Photo-ID Project has developed a photo-catalog containing digital images of 312 individual CIBW possessing distinct natural markings that persist over time. Many photographs of these CIBW display marks indicative of disease and injury. By documenting the occurrence and frequency of these marks and attempting to identify mark sources, we can learn more about disease and injury affecting the endangered CIBW population. We photograph beluga mortalities in order to note those previously identified whales in the catalog that have died, and also to examine possible cause of death. Continued collaboration among research projects in Cook Inlet should increase the photographic documentation and examination of disease, injury, and mortality of Cook Inlet beluga whales.

What we're looking for:

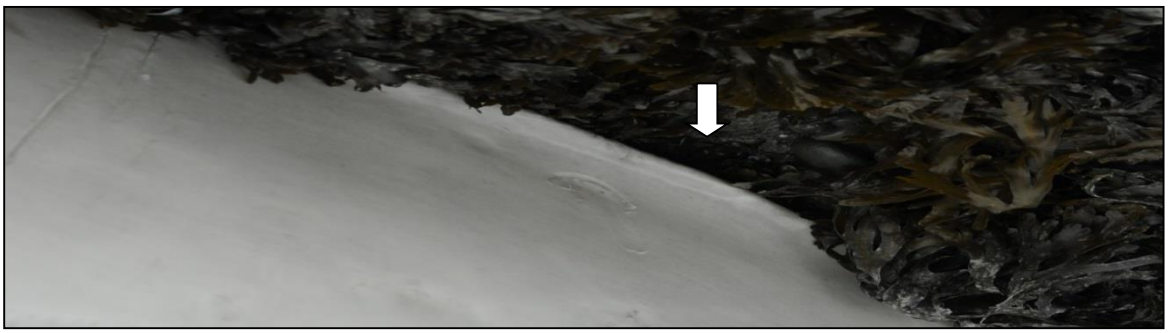
- Photos (digital preferred) of Cook Inlet belugas (dead or alive)
- High resolution images (RAW or fine JPEG)
- Enough light to view contrast
- Minimal glare
- Photos taken at 90^{o} angle to marks or wounds
- Photographs of:
    - the entire whale
    - the dorsal ridge and side(s) (When we photograph live CIBW, we rarely see the head and tail region of the whale, therefore most of the whales in the catalog are identified by marks along the dorsal and side regions), and
    - the lower abdomen (to determine sex of whale)
- Zoomed-in photos of marks
    - For dead whales, include scale in photograph (can be a ruler, coin, pencil, hand, boot, etc.) to indicate the size of the mark or wound being photographed
    - Information on whether the photograph is of the left or right side of the whale.
- Time/date stamp- make sure camera settings are accurate, or note correct date/time when submitting the photos
- Information about where the photo was taken (location and lat/long coordinates if possible, mile marker along the Seward Highway)
- Photographer name (for credits)

Things to avoid when taking a photo:

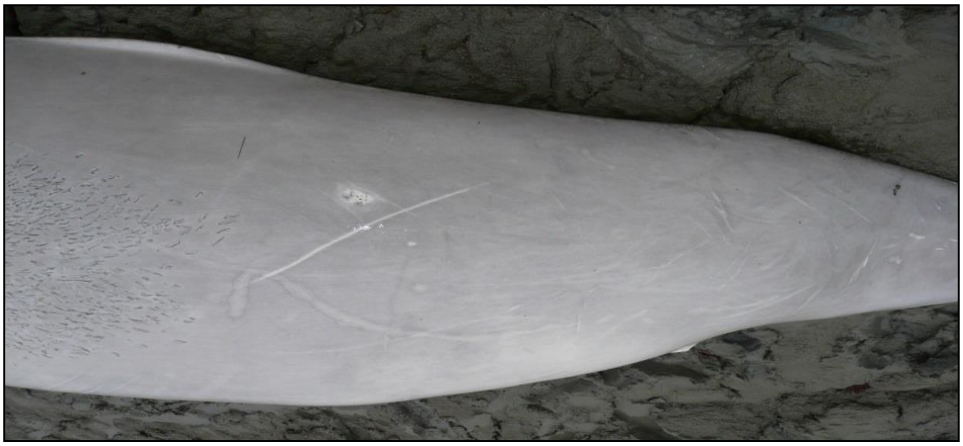
- Glare washes out parts of the photo, making it hard to distinguish between marks and skin
- Lack of scale prevents us from determining the dimensions of marks or wounds
- Low resolution images become blurry when zoomed in
- Angled photos make it hard to compare marks from photos taken at different angles. Profile shots of the sides of the whale focused around the dorsal ridge are best.
- Obstructions of marks or wounds – mud, sand, and/or blood may collect in marks. Use water to rinse the area before photographing it, if possible. Bring a bucket or something to transport water to rinse the skin of a dead whale.

Examples of photos that are useable for the Photo-ID Project:

This is an excellent photograph in which you can see the entire whale; there is low glare so the marks really show. You can see the side of the whale as well as the dorsal ridge. Photograph courtesy of NMFS.



This is an example of what can be gained by removing an obstruction. The dorsal ridge of this whale was originally covered by rockweed. This whale was identified by the mark that couldn't be seen until it was uncovered. This photo is lacking in scale and information about what side of the whale is being photographed, but is still useable.



This photo is taken at a 90 degree angle, it is in focus and you can clearly see the marks.

This photo is a good example of an abdomen shot that helps us determine the sex of the whale. Photograph courtesy of NMFS.

Examples of photographs that are not useable for the Photo-ID Project:

While this photo is in focus and you can see some marks, the Photo-ID Project cannot identify a whale from marks on the abdomen. In addition, this photo is taken at an oblique angle and we cannot determine the sex of the whale from this angle.

This photo is not useable because it is a little out of focus and it only shows the ventral side of the whale.

This photograph is a good example of the proper angle and distance from the whale; however it is unusable for photo-id. While some marks can be seen, the important parts of the body for identification (i.e., the side and dorsal ridge) are unfortunately covered up and most of the whale cannot be seen. Photograph courtesy of NMFS.

This photo is also in great focus and the proper distance from the whale, but it is taken at an angle and most of the body is out of sight, so it is unusable for photo-id. Photograph courtesy of NMFS.

How can you help?

Please report sightings of live or dead belugas. We are interested in knowing:

- Where they are
- How many there are
- What they were doing, and
- How to contact you with questions.

If you have any photographs of live or dead beluga whales to share, we would love to see them. All it takes is one good photograph! If we recognize the whale, we will share with you what we know of its history. We report all dead and injured belugas to NMFS and the Alaska Marine Mammal Stranding Network.

Please send photos/sightings to:

tmcguire@lgl.com
(907)562-3339
LGL Alaska Research Associates, Inc.
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Or visit us at

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