Photo-identification of Beluga Whales in Upper Cook Inlet, Alaska

Summary of Field Activities and Whales Identified in 2017

Prepared by:
The Cook Inlet Beluga Whale Photo-ID Project

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www.CookInletBelugas.org

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LIST OF ACRONYMS

AKR	Alaska Region
ADF&G	Alaska Department of Fish and Game
CIBW	Cook Inlet Beluga Whale
ESA	Endangered Species Act
GPS	Global Positioning System
ISO	International Standards Organization
JBER	Joint Base Elmendorf Richardson
JPEG	Joint Photographic Experts Group
LGL	LGL Alaska Research Associates, Inc.
MMPA	Marine Mammal Protection Act
MML	Marine Mammal Laboratory
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OLE	Office of Law Enforcement
POA	Port of Anchorage
SD	Secure digital
SLR	Single lens reflex
TEK	Traditional Ecological Knowledge

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ABSTRACT

More information about Alaska's endangered Cook Inlet beluga whale (CIBW) population (*Delphinapterus leucas*) is needed to develop strategies to promote its recovery. The CIBW Photo-identification (Photo-id) Project catalog and associated surveys from thirteen field seasons (2005-2017) provide information about the distribution, movement patterns, and life-history characteristics of individually identified CIBWs. This report summarizes field effort and whales identified in 2017.

In 2017, 16 vessel and land-based photo-id surveys were conducted of the Susitna River Delta, Knik Arm, the Kenai River Delta, and Turnagain Arm, bringing the total number of surveys conducted from 2005-2017 to 437. Twenty-six groups were encountered and photographed in 2017, and the largest group contained 302 whales. Most groups contained white belugas, gray belugas and calves, except for groups in the Kenai River Delta, which did not contain calves or neonates in 2017. The first neonate of the 2017 field season was seen July 21 (in the Susitna River Delta), and neonates were seen as late as September 26. Suspected feeding behavior was observed throughout the July-September 2017 field season in most of the areas in which beluga groups were encountered, with the notable exception of Turnagain Arm.

The CIBW Photo-ID Project catalog contains photographs collected between 2005 and 2017. Sighting histories have been compiled for 423 whales identified by right-side photographs, 431 whales identified by left-side photographs, and 93 whales identified as "dual" whales (i.e., individual whales whose right- and left-side catalog records are linked). Of these, 181 of the "right-side" whales and 169 of the "left-side" whales are presumed to be mothers.

Photographs of 13 belugas who stranded in 2017 were examined for possible matches to the catalog, but no matches were made. There is only one live-stranded adult to date in the 2005-2017 catalog. Although she and her calf swam away with the rising tide after the live-stranding event in 2015, she was not photographed again later that year or during the 2016 field season. This raised concerns that she may have suffered post-stranding complications and died, however she, along with a calf, was photographed on several occasions in 2017.

Ten of the 20 CIBWs originally captured and/or tagged between 1999 and 2002 were photographed alive in 2017. Biopsy samples were obtained from six whales in 2016; five of these whales were photographically matched to individuals who were already in the CIBW photo-id catalog, and four of these individuals were photographed again in 2017. In 2017, biopsy samples were obtained from twelve whales and one additional whale was darted without yielding a sample; nine of these 13 whales were photographically matched to individuals who were already in the CIBW photo-id catalog from previous years.

We are cautious in reporting life-history parameters such as reproductive or survival rates because there are many factors that affect our ability to detect, photograph, and identify individuals, particularly mothers and calves. Multivariate models are needed to quantify the effects of environmental factors and sampling bias on estimating population and life-history parameters. The next phase of the CIBW Project, now underway, includes working with colleagues to quantify sources of uncertainty and explicitly incorporate

uncertainty into models in order to allow scientists to better assess beluga population dynamics. In the meantime, these descriptive results will be useful to managers seeking to minimize effects of human activities on belugas, and to help inform future research efforts.

Approximately 90 incidental reports of sightings of CIBWs were received by the CIBW Photo-Id Project in 2017, including sightings in the Upper and Middle Inlet. Outreach activities included formal and informal presentations about CIBWs and the CIBW Photo-Id Project given to community groups and at scientific conferences.

INTRODUCTION

Alaska's Cook Inlet beluga whale (CIBW) population (*Delphinapterus leucas*) is considered a distinct population segment by the National Marine Fisheries Service (NMFS) due to geographic and genetic isolation from other beluga stocks (NMFS 2008a). A steep decline in the CIBW population was observed in the mid-1990s, and the population was designated as depleted in 2000 under the *Marine Mammal Protection Act* (MMPA). In 2008, NMFS listed the CIBW population as endangered under the *Endangered Species Act* (ESA, 73 FR 62919). Because 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 CIBWs. In addition, the ESA mandates that all federal agencies consult with NMFS regarding any action that is federally authorized, funded, or implemented, to ensure that the action does not jeopardize the continued existence of the endangered species or result in the destruction or adverse modification of its designated critical habitat.

Despite the cessation of an unsustainable level of subsistence hunting that was thought to have contributed to the initial population decline (NMFS 2008b), and despite the protections of the ESA listing, there is no evidence that the CIBW population is recovering. Although monitoring of CIBW abundance and distribution has been conducted via aerial surveys, satellite tagging, photo-identification (photo-id) surveys, and passive acoustics, many information gaps and uncertainties are associated with the current understanding of the CIBW population's lack of recovery. More information on annual abundance estimates of age-specific cohorts, habitat preferences for feeding, calving, and rearing of young, 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 direct efforts to promote recovery and conservation of the CIBW population.

Studies of CIBWs using photo-id methods have been ongoing since 2005 as part of the Cook Inlet Beluga Whale Photo-ID Project (CIBW Photo-ID Project), with primary geographic focus in Upper Cook Inlet. The CIBW Photo-ID Project has confirmed that most CIBWs possess distinct natural marks that persist across years, and these marks can be effectively identified and re-sighted with digital photography. The photo-id catalog and associated surveys provide information about the distribution, movement patterns, and life-history characteristics of individually identified beluga whales, including mothers with calves (McGuire and Stephens 2017). The CIBW Photo-ID Project has been supported by research grants and contracts from a variety of sources (Table 1) between 2005 and 2017.

This report presents results of vessel-based photo-id surveys of the Susitna River Delta and the Kenai River Delta, and land-based surveys of Knik Arm and Turnagain Arm in 2017. It describes the groups encountered and the individual whales in those groups that were identified from photographs taken during the surveys.

METHODS

Project activities consisted of field surveys, photo processing, cataloging of photos, data entry, database management, data analysis, reporting, and outreach.

Field Surveys

Survey effort

Dedicated photo-id surveys were conducted from small vessels and from shore July through October 2017 in Cook Inlet, Alaska (Figure 1). Boat-based surveys planned for late May/early June were cancelled due to vandalism of the research vessel and theft of an engine the day before surveys were scheduled to begin in May and the subsequent time needed to make repairs and replace equipment. Survey effort was focused in Upper Cook Inlet, primarily in the Susitna River Delta (defined here as the area between the Beluga River and the Little Susitna River), Knik Arm, Chickaloon Bay, Fire Island, the Kenai River Delta (defined as the area between the Kasiloff River and Nikiski) and Turnagain Arm (Figure 2). Survey schedules varied according to those combinations of season, location, and tide that provided the greatest likelihood of detecting whales. These combinations were derived from results of NMFS aerial surveys (Hobbs et al. 2015; Rugh et al. 2000, 2004, 2005, 2006, 2010; Shelden et al. 2013, 2015a&b), other studies of CIBWs (Funk et al. 2005, Markowitz and McGuire 2007, Markowitz et al. 2007, Nemeth et al. 2007, Prevel-Ramos et al. 2006), as well as from ongoing photo-id surveys in this area (McGuire et al. 2008, 2009, 2011a&b, 2013a&b, 2014a&b, McGuire and Stephens 2017). Survey schedules were also based on seasonal and tidal patterns from incidental reports of CIBW sightings in the area (reported to NMFS and to the CIBW Photo-ID Project via an existing observer network and the project website www.cookinletbelugas.org). Established general survey routes were followed, although deviations were made depending on where beluga groups were encountered. Surveys lasted approximately six hours, although the exact duration of surveys depended on hours of daylight, tidal conditions, if whale groups were encountered, and size and behavior of whale groups. Tidal information was obtained from the program JTides (www.arachnoid.com/JTides/), TIDES.net, and www.Tides.info.

Vessel-based surveys

In 2017, vessel-based surveys were conducted from the R/V *Yemaya*, a 6.4 m (21 ft) Proman 650 Zodiac® powered by a 4-stroke 150 hp Yamaha motor. The research vessel usually carried one skipper and one observer/photographer. Vessel position was recorded with a Garmin™ GPS (Global Positioning System) Map 76C.

Boat-based surveys in 2017 were scheduled to encounter the largest groups of belugas. Surveys were not appropriate for line-transect methods designed to estimate abundance. A whale group generally was only approached once per survey and usually followed in the manner described by Würsig and Jefferson (1990): the research vessel approached slowly, parallel to the group, and matched group speed and heading in order to obtain images of lateral sides of individuals while minimizing disruption of the group. At times, the boat drifted with the engine off, or was at anchor with the engine off, and whales

were photographed as they passed by. Researchers noted the position of whales relative to the vessel and GPS-logged tracks of the vessel were used to estimate approximate whale group positions. The majority of the vessel-based surveys were centered around low tide.

All vessel surveys were conducted under NMFS MMPA/ESA Scientific Research Permit # 18016. Vessel-based surveys of middle and upper Knik Arm were not conducted in 2017 in order to avoid disruption of beluga studies (visual and acoustic) being conducted in Eagle Bay by research teams with the Department of Defense.

Shore-based surveys

Shore-based surveys were conducted from observation stations along Turnagain Arm and at the mouth of Eagle River in Knik Arm. Photo-id surveys along Turnagain Arm generally began three hours before high tide, based on results from previous research that indicated that this was when belugas were most likely to be present (Markowitz and McGuire 2007). The observer(s) drove south and east from Anchorage along the Seward Highway adjacent to Turnagain Arm and stopped at turnouts along the highway, alternating 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, or remained in one area if whales remained there milling or if several groups of whales travelled by the turnout. Most photographs were taken from sites where whales approached closest to shore and that afforded relatively easy vehicle access.

A survey of the Eagle River Flats of Knik Arm (Figures 1 and 2) was conducted from the north shore of the mouth of the river by a team of observers led by Joint Base Elmendorf Richardson (JBER), with invited participation by a CIBW Photo-ID team member. The survey was scheduled around the low tide, as this provided the greatest likelihood of detecting whales at this location (Funk et al. 2005, McGuire et al. 2008, JBER 2010). Observers were stationed at the mouth of Eagle River and had views of Eagle Bay and Eagle River.

Land-based surveys in the Kenai River Delta were conducted from sites overlooking the mouth of the Kenai River or the Port of Kenai dock during times when the survey vessel could not be safely operated (e.g., small-craft advisories, extreme low tide, duck hunters firing over the water).

Survey data

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

For groups with multiple records on a single day, the best record was selected at the end of the survey, which was either the highest count (for groups that merged) or the count considered by all observers to be the most accurate. Group size was usually difficult to determine for groups greater than about 35 individuals, and counts provided are best estimates of the number of whales seen at the surface, rather than the actual number of whales in the group (i.e., correction factors were not applied). In cases when it was unclear if multiple groups encountered on the same day in similar locations were the same group, photo-id records were reviewed and if the same individuals were photographed in the same groups on the same day, the groups were re-classified as the same single group.

Behavioral data were collected using focal group sampling (Mann 2000). Behavior was recorded as activities (i.e., group behavior patterns of relatively long duration) or events (i.e., individual behavior patterns of relatively short duration, such as discrete body movements; Martin and Bateson 1993). Group activity was recorded at the beginning and end of each group encounter, and approximately every five minutes during the encounter. Events were noted as they were observed throughout the group encounters, although it should be clarified that the observers were focused on photographing whales, not observing all events. Activities were classified into primary and secondary activities. Primary activities appeared to be the dominant behavior of the group, and secondary activities occurred sporadically during primary activities. For example, a group might be recorded to have the primary activity of traveling (most of the group most of the time), with the secondary activity of diving (some of the group some of the time). A tail slap or spy hop would be an example of a discrete event by an individual, not a group activity.

Behavioral activities were defined as follows:

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

Diving – movement directed downward through the water column.

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

Feeding confirmed – beluga was seen with a prey item in its mouth.

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

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

Patrolling – beluga(s) swimming back and forth along the same linear pathway, close to shore or an exposed tidal flat.

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

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

surfacing patterns. Environmental conditions were noted hourly or when conditions changed. Environmental variables recorded included Beaufort sea state, swell height, cloud cover, glare, visibility, wind speed and direction, air temperature, precipitation, water temperature at the surface, and water depth.

Digital photographs of beluga whales were collected using a digital SLR camera with a telephoto zoom lens (100-400 mm) with auto-focus. Typical settings included shutter speed priority, dynamic-area autofocus, 100-800 ISO, and shutter speed of 1/1,000 sec or faster. Photographs were taken in JPEG format. Photographs were stored on compact flash or SD memory cards. Photographs taken by the public and shared with the CIBW Photo-ID Project were taken on a variety of cameras and cell phones.

Archiving and Analysis of Data from Field Surveys

Photographs were downloaded from the memory card onto a computer hard drive and archived to external hard drives to preserve the original data before any further processing. All photo-id data, survey data, and photographs were integrated into the CIBW Photo-ID Project database. Data associated with each photograph included the metadata, such as the original camera settings, the time the original photograph was taken, and the dates and locations photos were taken. Time was synchronized between the GPS and the cameras in the field, and the time and date stamps of the photos were linked to those of the trackline of the vessel when both were uploaded into the database, which allows for geo-referencing of the photos. Locations of beluga whale sightings and survey routes were mapped in QGIS version 3.2 (http://www.qgis.org/) and figures were prepared showing survey routes, group location, group size, and group color composition for each survey conducted.

Processing of Photographs

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 marks were obvious even in poor quality photographs, the photo was considered for inclusion in the catalog.

All suitable quality images were cropped to show only the focal whale. When an original field photograph contained more than one whale, each whale was cropped individually and given a separate file name. Cropped images were separated into left and right sides of whales. Daily photo samples (i.e., all cropped photos taken on a single survey day) were sorted into temporary folders. Each temporary folder contained all the cropped images taken of the same individual beluga on a single day (this could be 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. Images within 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. Temporary folders that were not matched to individuals within the

photo-id catalog were archived and periodically re-examined for matches to the catalog as it developed and photos from new field seasons were added.

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 during 1999-2002. The CIBW Photo-ID Project depends on existing marks and does not apply marks to whales. Mark-type categories were created in order to facilitate cataloging. Computer software specialized for this species was developed by the project 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 are most useful for matching marks used to identify individual whales. Profile images were divided into 11 sections along the right and left halves 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 than were the other five body sections. "Profile completeness" was determined by the number of sections with high quality images; a right or left-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 and extending to the base of the tail. In order to be included in the catalog and given a unique ID number, a whale had to have a complete profile set. Whales with complete profile sets were considered 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 two or more years were matched, regardless of profile completeness. All matches in the existing catalog were reviewed and verified by at least two experienced photo-analysts.

Classification of mothers and calves in photographs

Identified belugas were classified as presumed mothers if they appeared in the same uncropped photo frame with a calf or neonate alongside them. Belugas were classified as calves if they were gray, relatively small (i.e., <2/3 the total length of adult belugas), and photographed alongside a larger, lighter-colored 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 identified presumed mothers and calves. Sighting records for presumed 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. 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 (the majority of photographed calves cannot be identified as individuals because they are either not well marked with the long-lasting marks used for photo-id, or they are not photographed with enough of the body above water to allow marks to be seen).

Classification of dual-side whales

Whales were classified as dual-side whales if they met the criteria to be classified as individuals in the right- and left-side catalogs and if marks that spanned both sides of the bodies could be used to link the two sides. Dual-side whales are given catalog names that begin with the prefix D, followed by the catalog number of the side that was first entered into the respective right-side or left-side catalog. For example, a whale identified on the right side as R100 and on the left as L220 would have the dual name of D100.

Classification of previously satellite-tagged whales

Previous photo-id reports have documented CIBWs with scars from satellite tags attached by NMFS during 1999-2002 (McGuire and Stephens 2016). A whale was classified as a "confirmed satellite-tagged" individual if the following were visible in photographs: scars with a distinct shape (circular, crescent-shaped, or band-like); scars in an obvious pattern (depending on the tag type and attachment used, tags caused scars in pairs, trios, or up to five); and/or scars in known tagging locations on the body. In some cases, biopsy scars were seen in addition to the tag scars and were used as additional evidence of a tagging event (biopsy samples were collected during capture for tagging). Individuals with photographs of scars that were similar to "confirmed tagging scars" but were less distinct in shape, pattern, or placement were classified as "suspected satellite-tagged" individuals. Individuals classified as satellite-tagged whales were differentiated from one another based on photographs showing a combination of natural marks and tag scars to avoid mistakenly matching similar scar patterns caused by the same tag type. Two experienced photo-analysts independently reviewed all photographs currently in the CIBW Photo-ID Project catalog to classify images of individuals bearing satellite-tag scars.

Classification of biopsied whales

A feasibility study for remote biopsy of CIBWs was conducted in 2016 (McGuire et al. 2017a), followed by a second field season in 2017 (McGuire et al. 2018b). Photographs were taken of whales at the time of biopsy in order to try to match them to individuals in the CIBW Photo-Id catalog. Genetic sex determined from biopsy samples was used to examine the sex of suspected mothers in the catalog; results from the 2017 biopsy study were not available at the time of this report.

Identification of Stranded Belugas

Stranding response to live and dead stranded marine mammals in general, and of endangered CIBWs in particular, is regulated by NMFS. Designated responders in the Alaska Marine Mammal Stranding Network may respond to CIBW strandings only if activities are first authorized by NMFS on a per-case basis; these activities fall under the umbrella of the permit held by NMFS.

When stranded (dead or alive) belugas were encountered during surveys, or when informed of stranded belugas by the Alaska Marine Mammal Stranding Network, and as authorized by NMFS, CIBW Photo-ID Project biologists photographed stranded belugas or relied on other stranding responders to obtain photographs of stranded belugas. The

project developed a protocol for photographing stranded belugas for identification marks that was distributed to members of the Alaska Marine Mammal Stranding Network and posted on the NMFS AKR website https://alaskafisheries.noaa.gov/sites/default/files/stranded-cibwphotoprotocols15.pdf and on the CIBW Photo-ID Project website www.cookinletbelugas.org. Photographs of stranded belugas were examined for marks that could be used to compare to records from the 2005-2017 catalog. Sex and relative age (i.e., neonate, calf, juvenile, adult) of dead whales were determined from necropsy reports and/or photographs and were entered into the records of individuals in the photo-id catalog.

Database Development

All photo-id data (2005–2017) are consolidated into a single integrated database. Data from surveys included the survey route, environmental conditions, photographs, and group size, color, and behavior. Data associated with each photograph included the "metadata", such as the original camera settings, the time the original photograph was taken, and the lighting conditions. Catalog data also 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, and the number of temporary folders yet to be matched.

Sighting Histories

Sighting histories (i.e., dates and locations of sightings) were compiled for cataloged belugas in order to examine residency and movement patterns. These sighting histories include information from surveys conducted during 2005-2017 and are presented graphically for select individuals according to year and geographic area. Locations of cataloged beluga whale sightings were mapped in QGIS version 3.2 (http://www.qgis.org/).

Incidental Beluga Sighting Reports and Photographs

Incidental beluga sighting reports were collected by the CIBW Photo-ID Project from the public and colleagues via email, phone calls, public presentations, and conversations in the field. The project website (www.cookinletbelugas.org) contains a page for the public to report CIBW sightings. The website address was distributed via the project bumper sticker, wallet-sized cards, project pamphlets, and public outreach. Incidental beluga sighting reports were entered into the project database and shared with the NMFS AKR and NMFS's Marine Mammal Lab (MML).

RESULTS

Surveys

Survey effort, number of whales, and whale groups encountered in 2017

There were 16 photo-id surveys of Upper Cook Inlet conducted in 2017 (Table 2). The fieldwork completed in 2017 brought the project total to 437 photo-id surveys conducted in Cook Inlet over thirteen consecutive field seasons (Table 2).

There were 26 groups encountered in 2017 (Table 3; Figure 5). Maps of daily whale group sighting locations and survey routes in 2017 are presented in Appendix A. Figure 7 summarizes the locations of all groups encountered 2005-2017. Mean group size in 2017 was greatest in the Susitna River Delta and smallest in the Kenai River Delta (Table 3). Group size in the Susitna River Delta ranged from 2 to 302 whales (Table 4). The largest of these groups was seen on August 5. Group size in Turnagain Arm in 2017 ranged between two and 36 whales, with the largest group seen on Sept 6 (Table 5). Group size in the Kenai River Delta in 2017 ranged between two and four belugas; and only one group (of 44) was seen in Knik Arm (Table 5).

Survey conditions in 2017 provided good visibility (on a scale of good/fair/poor) on all vessel-based survey days in the Susitna River Delta (Table 6), and on fewer than half of the land-based survey days elsewhere (Table 7). The fair to poor conditions were generally due to fog patches, and periods of high winds and rain. In some cases, survey conditions were good then worsened to the point the survey was curtailed. For example, on August 6, 2015, survey conditions quickly deteriorated due to increasing winds and building seas, and the survey vessel had to seek shelter in the Little Susitna River.

Color composition and age class of groups encountered during surveys in 2017

Color and age-class composition of groups varied somewhat by survey date and area (Tables 4, 5, and 8). More neonates were seen in the Susitna River Delta than in other areas (Table 8). Groups with calves and neonates occurred in the same general locations as groups without calves or neonates (Figure 8), with the exception of the Kenai River Delta, where they were not seen in 2017. The percentage of groups containing whales of unknown size class was highest in Turnagain Arm; unknown age classes did not occur in Knik Arm or the Kenai River Delta.

The first neonate sighting of the year in the Susitna River Delta was on July 21 in 2017. Neonates in Knik Arm were seen on the one day of surveys conducted there, August 21. Neonates in Turnagain Arm were first seen on September 6, although they may have been present in groups there earlier in the field season when size/age class could not be determined for all whales in the group (due to distance from the land-based observer). Groups with neonates occurred in the same general locations as groups without neonates, (Figures 8 and 10) with the exception of the Kenai River Delta, where they were not seen in 2017.

Feeding and reproductive behavior of whale groups encountered in 2017

Suspected feeding behavior was seen in most of the areas in which beluga groups were encountered in 2017 (Figure 12) consistent with patterns from previous years of the study (Figure 13; McGuire and Stephens 2017, McGuire et al. 2017c), with the notable exception of Turnagain Arm where feeding behavior (suspected or confirmed) was not observed in 2017 (Tables 9 and 10). Suspected feeding behavior was observed throughout the July-September field season.

CIBW births (suspected or confirmed) were not observed during photo-id surveys in 2017.

Stranded belugas photographed in 2017

Photographs of thirteen belugas that stranded in 2017 were shared with the CIBW Photo-Id Project by NMFS and by other members of the Alaska Marine Mammal Stranding Network (Table 11). There were seven males, three females, and three individuals of unknown sex. Five stranded individuals were adults, three were subadults, four were calves, and one was a fetus. Twelve of the strandings were of dead belugas. The other stranding was a live neonate that was taken into captivity by NMFS, deemed non-releasable, and currently resides at SeaWorld San Antonio.

Incidental sighting reports of belugas in 2017

The CIBW Photo-Id Project received 89 incidental reports of CIBW sightings in 2017 (Table 12). Sightings were reported by fisher folk, pilots, the media, law enforcement officers, vessel operators, tourists, biologists, educators, students, regulators, port operations staff, environmentalists, and energy-sector employees (oil and gas, coal, tidal power). Many reports were solicited and received during outreach activities (Appendix B). In 2017, belugas were reported April through November, as far north as Knik Arm and as far south as Kalgin Island.

Human Interactions 2017

Human activities with the potential to affect belugas were noted during photo-id surveys (Tables 6 and 7). In the majority of instances, these activities were incidental in the sense that the people conducting them were likely unaware belugas were even present. In a few cases when activities appeared to be intentionally directed at belugas and potentially harmful, the National Oceanic and Atmospheric Administration (NOAA) Office of Law Enforcement (OLE) was alerted.

In 2017, aircraft (e.g., small recreational aircraft, large commercial aircraft, military jets, and military transport) were noted flying over belugas during all surveys of the Susitna River. Other human activities that were observed near belugas included dredging at ports, set nets and set-net boats in the Susitna River Delta, dipnetting at Ship Creek, noise from weapons firing at military and recreational shooting ranges and from duck hunters, and research activities (including the photo-id survey vessel, aerial drones, and remote biopsies of belugas from vessels and shore in 2017).

Other Marine Mammals Encountered During CIBW Surveys or Reported to the Project, 2015-2016

The following marine mammals were encountered during photo-id surveys for CIBWs, or were reported incidentally in 2017:

Harbor seals (*Phoca vitulina*) were commonly encountered in all areas surveyed. The largest (often over 200 seals) and most persistent haulout occurred at the mouth of the Susitna River. Harbor seals and belugas were often observed in the same areas, such as the mouths of the Big and Little Susitna rivers, Eagle River, the Kenai River, and at Bird Point in Turnagain Arm.

The following marine mammals, occasionally reported in Upper Cook Inlet in previous years of the study (McGuire and Stephens 2017), were not encountered during surveys in 2017: Steller sea lions (*Eumetopias jubatus*), humpback whales (*Megaptera novaeangliae*), harbor porpoises (*Phocoena phocoena*), Dall's porpoises (*Phocoenoides dalli*), fin whale (*Balaenoptera physalus)* and orcas (*Orcinus orca*). One dead gray whale (*Eschrichtius robustus*) was reported by the Alaska Marine Mammal Stranding Network, and MML reported seeing one live gray whale during biopsy surveys.

Catalog Development and Current Status 2005-2017

The CIBW Photo-Id Project took 32,088 photographs in 2017. The public and colleagues provided photos of incidental sightings and stranded belugas, sharing approximately 400 photos in 2017. Colleagues from MML also shared photos taken during their CIBW biopsy and aerial drone surveys in 2017, and records from individuals identified during these surveys have been included in the catalog (McGuire et al. 2018b).

In order to conserve project funds, beginning in 2006 only photographs of the right sides of the whales were cataloged and images of the left sides of the belugas were archived without cataloging. The choice of the right side over the left side was arbitrary at the time it was made. Funding was later obtained that allowed for the cataloging of all left-side photos taken between 2005 and 2011, and later those from 2012-2016 (McGuire et al. 2011a, 2014b; 2018a; Table 1). This current report represents the first time in eleven years that the right- and left-side catalog have been updated simultaneously with results from the previous year's field season.

Sighting Histories of Identified Belugas 2005-2017

The following summary of sightings between 2005 and 2017 is for individuals in the right-side catalog, the left-side catalog, the dual catalog, and for subsets of particular interest.

Right-side catalog 2005-2017

The 2005-2017 right-side catalog contains records for 423 individuals (Figure 14A), with 171 individuals photographed in 2017. Three new individuals were added to the catalog that were first photographed in 2017. There were 23 individuals added to the catalog that had been photographed in previous years but did not meet the criteria to become catalog

individuals until the photos from 2017 were added to their sighting records. Fourteen percent of the whales in the right-side catalog were seen over the 13-year period spanning 2005 to 2017 (i.e., they were photographed in both 2005 and in 2017; Table 13). Seven individuals in the right-side catalog have been matched to photos of dead individuals. Because 10 years is the maximum gap between resightings of any individual in the catalog, an individual was suspected to have died if it had not been photographed after 2006 (although seven years was the maximum gap between resightings of individuals in the right-side catalog, ten years was the maximum gap in the left-side catalog; to be conservative and consistent in estimating the number of whales that had died, the same criterion from the right-side catalog was applied for left-side whales, i.e., an individual was suspected to have died if it had not been photographed since 2006.) There are 21 individuals in the right-side catalog suspected to have died based on the lack of sightings after 2006, and another seven confirmed dead (from stranding records), leaving 395 individuals in the right-side catalog that may still be in the population in 2017.

Left-side catalog 2005-2017

The 2005-2017 left-side catalog contains records for 431 individuals (Figure 14B), with 194 individuals photographed in 2017. Two new individuals were added to the catalog that were first photographed in 2017. There were 36 individuals added to the catalog that had been photographed in previous years but did not meet the criteria to become catalog individuals until the photos from 2017 were added to their sighting records. Fourteen percent of the whales in the left-side catalog were seen over the 13-year period spanning 2005 to 2017 (i.e., they were photographed in both 2005 and in 2016; Table 13). Ten individuals in the left-side catalog have been matched to photos of dead individuals. Because 10 years was the maximum gap between resightings of individuals, an individual was suspected to have died if it had not been photographed after 2006. There are 41 individuals in the left-side catalog suspected to have died based on the lack of sightings after 2006, and another ten confirmed dead (from stranding records), leaving 380 individuals in the left-side catalog that may still be in the population in 2017.

Dual catalog 2005-2017

The 2005-2017 dual-side catalog contains records for 93 individuals (i.e., individuals whose right- and left-side catalog records are linked). In 2017, there were 36 dual-side linkages made for individuals in the catalog, many from photos showing both sides of a whale that were photographed during biopsy (n=1) and/or from an aerial drone (n=30; (McGuire et al. 2018b). One dual-side individual who was photographed as recently as 2017 was identified in photographs taken by NMFS in 1998, giving it a 20-year sighting history (Figure 15).

Identified individuals with satellite-tag scars

A total of 20 CIBWs were captured and 18 of these were tagged by NMFS between 1999 and 2002); 12 of the 20 were female. Details about the capture and tagging, as well as whale movements during the life of the tags, are presented in Shelden et al. 2018. Fourteen individuals in the photo-id catalog were confirmed as whales bearing scars from

satellite tags, and a 15th individual in the catalog was identified as a whale that had been captured but not tagged (Table 14). Details on the photo-id records of these individuals are presented in McGuire and Stephens (2016). Twelve of these 15 individuals have photo-id records on both the right and left sides (i.e., they are dual-side whales). Nine of the 15 individuals were each photographed with an accompanying calf at least once during 2005-2017. Ten of the 15 photo-identified satellite-tagged/captured whales were photographed in 2017; this represents 50% of the 20 CIBWs originally captured and/or tagged between 1999 and 2002. Three satellite-tagged whales were confirmed dead between 2001 and 2017. Two photo-identified whales with satellite tag scars have not been resighted since 2007, which falls one year short of our current criteria of assuming an individual is dead if it has not been seen since 2006.

Six individuals in the photo-id catalog have been identified as individuals in the photos taken at the time they were captured and tagged between 1999 and 2002 (Table 15); three of these were females and three were males (confirmed via DNA collected during capture). The three photo-identified tagged females were each photographed with an accompanying calf at least once during 2005-2017. One of the whales that was captured but not tagged was also matched to the photo-id catalog; this whale was a female (confirmed via DNA collected during capture) who has not been photographed since 2007, has not been photographed with a calf, and will be presumed dead if another year passes without it being photographed.

Identification of stranded belugas 2005-2017

Thirteen stranded CIBWs have been identified as individuals in the 2005-2017 photo-id catalog. All 13 of these identified whales were adults; 12 were dead and one was alive. Of the 12 dead whales, six were males and six were females. Two of the males had scars from satellite tags. One of the females was pregnant at the time of stranding. Sighting histories of identified stranded whales are presented in McGuire and Stephens (2017). None of the 13 whales that stranded in 2017 whose photographs were provided and reviewed were matched to any individual in the catalog (Table 11). In most cases the carcasses were too decomposed to allow identifying marks to be seen from photographs. Five of the stranding were of individuals that were too young (i.e., young of year calf or fetus) to have been in the catalog.

The only live-stranded adult to date in the 2005-2017 catalog stranded in 2015 in Turnagain Arm. The Alaska Marine Mammal Stranding Network photographed the stranding from a NMFS hexacopter and from a NMFS observer on the mudflats and shared the photos with the CIBW Photo-ID Project. The adult was identified as beluga D1032, first seen in 2008, and presumed to be a female because she stranded with a live calf at her side. Although she and her calf were seen to swim away with the rising tide after the live-stranding event in 2015, she was not photographed again later that year or during the 2016 field season, which raised concerns that she may have suffered post-stranding complications and died. However, she was photographed on several occasions in 2017 along with a calf (Figure 16).

Identification of biopsied whales 2016 and 2017

Biopsy samples were obtained from six whales in 2016; five of these whales were photographically matched to individuals who were already in the CIBW photo-id catalog, and the sixth has been entered as a new individual in the catalog (Table 16; McGuire et al. 2017b). Genetic sex determined from biopsy skin samples indicates that five of the whales biopsied in 2016 were female and one was male. Three of the females have been photographed with an accompanying calf at least once between 2005 and 2017. Four of these individuals were photographed again in 2017.

In 2017, biopsy samples were obtained from twelve whales and one additional whale was darted without yielding a sample; nine of these 13 whales were photographically matched to individuals who were already in the CIBW photo-id catalog from previous years (Table 16; McGuire et al. 2018b). Results from genetic sex determination were not available from NMFS at the time of this report, so we do not yet know the sex of these individuals. Three of these individuals have been photographed with an accompanying calf at least once between 2005 and 2017

One of the whales biopsied in 2017**,** D2379, had a pronounced concavity behind the dorsal crest (Figure 17). This individual was first photographed as a large calf in 2005, was not photographed in 2006 or 2007, but was seen to have a slight sway in the back in photos from 2008 that appeared to become more pronounced with each year. In 2017, this individual was photographed during photo-id surveys in July and August and during biopsy surveys in September (Figure 17).

Reproductive Histories

Number of presumed mothers in the 2005-2017 catalog

There are currently 181 presumed mothers in the right-side catalog, which represents 43% of the individuals in the right-side catalog. There are currently169 presumed mothers in the left-side catalog, which represents 39% of the individuals in the left-side catalog.

To date, there are 15 females of known sex (i.e., sex was confirmed from genetics taken during satellite tagging, biopsy, or necropsy; McGuire and Stephens 2017). Ten of the 15 known-sex females had been classified as presumed mothers based on their photo-id records 2005-2017. Another known-sex female has been classified as possible mother based on ambiguous photos in which a calf may have been alongside the mother but could not be confirmed. Four of the known-sex females have not been photographed with a calf.

DISCUSSION

Seasonal and Spatial Patterns of Beluga Group Encounters

The seasonal distribution patterns of CIBWs in Upper Cook Inlet during the 2017 field season were consistent with patterns found in previous years of this study (McGuire and Stephens 2017; McGuire et al. 2017c) and in other studies (Moore et al. 2000; Hobbs et al. 2005; Nemeth et al. 2007; Shelden et al. 2015 a, b, 2018). These studies, as well as reports of incidental observations, found that beluga groups are concentrated along the Susitna River Delta in mid-July, peaking mid- to late July through mid-August. Beluga groups begin to appear in Knik Arm and Turnagain in early/mid-August, just as the large groups in the Susitna River Delta are breaking up, peak in mid- to late August through mid-September, then taper off for the rest of the ice-free season. Beluga groups appear in the Kenai River Delta in September. The seasonal distribution patterns during the ice-free months are likely in response to patterns of seasonal migrations of prey (e.g., eulachon runs in May, followed by salmon runs late July to early August; NMFS 2008b).

Patterns in Group Size

The occurrence of larger beluga groups in the Susitna River Delta relative to groups found in other areas of Cook Inlet during the summer months is consistent with patterns reported by NMFS from aerial surveys conducted in June and August of multiple years (Shelden et al. 2015 b; 2018), and with those observed in previous years of the CIBW photo-id study (McGuire and Stephens 2017; McGuire et al. 2017c).

Between 2005 and 2012, mean and maximum group sizes during photo-id surveys had varied somewhat from year to year but stayed within the same general range (McGuire and Stephens 2017). However, starting in 2012, there were noticeable increases in group size (both mean group size and annual maximum group size).

One possible explanation for this is that over time the photo-id surveys became selectively more focused on targeting large groups in order to maximize the number of whales photographed per survey. Additionally, the survey team became more experienced in predicting when and where to find large groups of belugas. There is no doubt that fluctuations in beluga encounter rates were related to annual differences in photo-id survey effort (i.e., total hours spent on surveys, months surveyed, and areas searched). However, the change in survey effort alone does not explain the trend in increasing group size: the largest group of every year 2005-2017 always occurred in the same area (Susitna River Delta) and during the same general time period (mid-July to early August), and there was still a pattern of these groups becoming noticeably larger beginning in 2012 and continuing to increase in 2013 and 2014, with a record high to date of a group of 313 whales in 2015. (McGuire and Stephens 2017). The maximum group size of 302 in 2017 is consistent with the pattern of larger groups seen in recent years.

Results from the 2016 field season had provided a remarkable exception to this general pattern; maximum and mean group sizes in both the Susitna River Delta and Knik Arm fell to approximately half of the sizes encountered the previous year. The largest group seen in the Susitna in 2016 fell to numbers not seen since 2011. Conversely, the largest

group ever seen in Turnagain Arm during the history of the project was seen in 2016 and was almost four times the size of the largest group seen there the previous year. Group sizes in Turnagain Arm in 2017 returned to pre-2016 levels. The underlying causes of these patterns will likely only be understood by examining them in the context of other annual changes in environmental conditions, especially the variations in the timing and strength of annual fish migrations (see Moore et al. 2000, NMFS 2016, and Bechtol et al. 2016 for discussions of distribution and seasonal movements of beluga prey and identification of data gaps). Modeling of the interactions of all contributory factors involved is needed to tease out any true inter-annual patterns from those influenced by sampling.

The 2017 field season marked a return to the Kenai River Delta to conduct photo-id surveys. Surveys had been conducted here 2011-2013 as a result of dedicated funding from the Kenai Peninsula Borough during this time but had not been conducted in other years of the 2005-2016 CIBW Photo-ID Project history. As in previous years, group sizes in the Kenai River were smaller than in other parts of the survey area. Not only were groups smaller than elsewhere, but photo-identification of individuals in groups indicates that groups here are often smaller than they appear. For example, shore-based observers counted a group of five belugas in the Kenai River on September 20, but photographs of the individuals taken at closer range in a boat revealed there were only three individuals that were dispersed and erratic in their movement and surfacing patterns. Larger groups have been incidentally observed outside of the mouth of the Kenai River than have been seen entering it, and the same pattern has been observed at the mouths of Eagle River and the Little Susitna River.

Color and Age Composition of Groups

There is little evidence to suggest that CIBW groups encountered during the ice-free field season are segregated according to age-class. As in previous years of the study, most of the groups encountered in 2017 contained roughly equal proportions of white and gray whales, and most of the groups contained calves and/or neonates. Notable exceptions in 2017 were the groups in the Kenai River Delta that did not contain calves or neonates; observers were close enough to these small groups that these age classes were not simply missed by observers. All groups seen in the Kenai River Delta during previous survey years did contain calves and some also contained neonates. This difference may simply be an artifact of small samples sizes in this area.

Although the majority of groups were mixed with respect to color and age-class, within mixed groups there was occasionally stratification by subgroups (examples occurred on July 26 and August 6) where there were small subgroups of only white belugas that then joined the larger mixed groups.

Although not quantified, observers had the impression that white beluga whales were more likely to be detected than gray beluga whales, as gray belugas tended to blend with the turbid gray waters of Cook Inlet. This suspected bias in detection towards white whales seemed greater with distance from the observer. Behavioral differences between white and gray belugas, however, may have resulted in an opposite bias. Observers also had the impression that gray animals were more likely to approach the survey boat and to

remain near the boat. Therefore, although white belugas were more likely to be detected at a distance, gray belugas may have been more likely to be photographed from vessels. Environmental conditions, most notably ambient light, may also have resulted in some variability in color assigned to whales during surveys. Color composition was most difficult to determine in Turnagain Arm, where whales were often far from the land-based observers and harder to detect in the often-rough water resulting from the usually strong Turnagain winds.

General Patterns of Habitat Use by CIBWs

Beluga whales encountered during all photo-id surveys of Cook Inlet in 2017 were rarely observed traveling among survey areas but were instead encountered in distinct "hot spots" at river mouths in predictable seasonal patterns that had been observed in previous years. Similar patterns of localized aggregations and rapid and directed travel among these areas of localized aggregations have been reported for satellite-tagged CIBWs (Hobbs et al. 2005) and beluga whales in Norway (Lydersen et al. 2001). The seasonal distribution and tidally driven movement patterns are likely in response to patterns of seasonal migrations of prey (e.g., eulachon runs in May, followed by salmon runs late July to early August; NMFS 2008b), and access to habitat, as well as by variations in water temperature, ice coverage, and river discharge (Goetz et al. 2007, 2012; Ezer et al. 2013).

Photo-id and satellite tracking evidence shows that individually identified belugas move among hotspots. But because sightings of belugas transiting between known hot spots (i.e., the Susitna River Delta, Knik Arm, the Kenai River Delta, and Turnagain Arm) are relatively infrequent, it remains unknown if there are distinct movement corridors (e.g., deeper channels or shorelines) among areas or if movement patterns are more diffuse and variable. For example, although whales in the Kenai River Delta have been identified as the same individuals seen in the Susitna River Delta, Knik Arm, and Turnagain Arm, we do not know their travel route between upper and middle Cook Inlet. For CIBW conservation and protection of critical habitat, the identification and protection of movement corridors that link hot spots would seem to be as essential as the identification and protection of the hot spots themselves.

Extent of Habitat Used and Incidental Sightings

Traditional Ecological Knowledge (TEK) reports that the historic range of CIBWs included the Lower Inlet, defined here as the area of Cook Inlet south of the East and West Forelands (Huntington 2000, Braund and Huntington 2011). Aerial surveys have indicated that the distribution of CIBWs has changed significantly since the 1970s, when surveys were initiated. There has been a northward contraction of the CIBW core range into Upper Cook Inlet, as well as a shift west toward Anchorage (Rugh et al. 2010). Aerial surveys often detected belugas south of the Forelands prior to 1996 (Rugh et al. 2000, 2010), but since then they were only seen in the Lower Inlet in 1997, 2001, and 2012 (Rugh et al. 2010, Shelden et al. 2015a), and were only seen in the Middle Inlet (area around the Forelands) in 2006 and 2012 (Shelden et al. 2015a). Satellite-tagged whales were last tracked in the Middle Inlet in 2003 (Shelden et al. 2018). Incidental sightings of CIBWs south of the Upper Inlet have been reported to NMFS on occasion

(Vate-Brattstrom et al. 2010), but not as often and not in the large numbers that were historically reported (Vate-Brattstrom et al. 2010, Dutton et al. 2012).

The CIBW Photo-ID Project has received incidental sighting reports of belugas as far south as Kachemak Bay in the Lower Inlet, and around Kalgin Island, Redoubt Bay, and the Kenai River Delta in the Middle Inlet. Reports from the Kenai River were first received in 2007, then yearly between 2008 and 2017 (with the exception of 2016, when reports of belugas south of the Upper Inlet were not received). Incidental sightings of belugas outside of the Upper Inlet appeared to increase since 2011 when dedicated outreach efforts were undertaken in this area (McGuire et al. 2014a, McGuire and Stephens 2017). It is unknown if the observations of belugas during photo-id surveys and from incidental sightings in the Middle and Lower Inlet represent range expansion, or if they are simply the result of increased observer and reporting effort in the area; regardless of what prompted the reports, they indicated that belugas are present outside of the Upper Inlet.

Outreach efforts by the CIBW Photo-ID Project have not only provided an opportunity to share information about belugas and the CIBW Photo-ID Project with the public, but have also enabled us to increase public awareness of the avenues for reporting beluga sightings (i.e., reporting free-swimming belugas to the CIBW Photo-ID website, and contacting the NMFS Stranding Hotline to report stranded belugas). Incidental sighting reports received from the public and colleagues are used by the CIBW Photo-ID Project to help plan surveys, to monitor general CIBW distribution and movement patterns annually, and to look at beluga presence information for specific areas and/or seasons where baseline studies are lacking. Incidental reports are consolidated annually and shared with NMFS and other CIBW researchers and displayed publicly on the project website. NMFS uses incidental sighting reports in scientific publications and presentations on CIBW distribution patterns and trends, and in endangered species consultations for development projects in Cook Inlet.

Habitat Use by Individuals

As indicated in the maps of the individual sighting histories in McGuire and Stephens 2017 and in Figures 13-15 in this report, individually identified belugas did not display fidelity to any single area of Cook Inlet, but instead were found in specific locations. The same was true of the individuals tracked with satellite tags (Shelden et al. 2018).

In general, the more robust the sighting record of an identified individual (i.e., the more times and years an individual is photographed), the more likely it is to have been photographed throughout the survey area in the Upper Inlet, without displaying obvious preference for, or avoidance of, any particular area. There are two interesting exceptions: the first is the female D111, who was captured and tagged by NMFS in 2000. Her seventeen-year span of records from both tagging and photo-id show her using Knik Arm and the Susitna River Delta, but never Turnagain Arm. Based on photo-id records alone, we had assumed sampling bias may have been the reason we never detected her in Turnagain Arm, because groups encountered in Turnagain Arm typically yield a much lower percentage of identified whales than groups encountered in other areas, which is likely a result of greater sighting distances in Turnagain Arm compared to other areas.

After matching her photo-id records with her photos taken at the time of capture, we were able to see that her satellite tagging records also indicated that she never entered Turnagain Arm while being tracked. A second whale, D403, has scars indicating it was captured and tagged by NMFS sometime between 1999 and 2002, and is presumed to be a female based on the close accompaniment of a calf in photos. Like D111, she has never been photographed in Turnagain Arm, despite being photographed almost every year during 2005-2017 and having conspicuous markings that should have still been detectable even at sighting distances often experienced in Turnagain Arm.

Photo-identified males and females were found in the same groups and areas at the same time and did not appear to be using habitats differently (McGuire et al. 2017c). We will be examining these data further to see if there are differences at a finer scale within the groups. This analysis will be greatly aided once the genetic sex from the whales biopsied in 2017 has been determined and incorporated into the sightings records of these individuals.

Feeding Habitat and Behavior

Feeding behavior in 2017 was observed along the Susitna River Delta and at the mouth of the Kenai River, but not in Turnagain Arm or Knik Arm. Feeding behavior had been observed in all of these sub-areas in previous years of the study (McGuire and Stephens 2017, McGuire et al. 2017c). It is unknown if the differences in 2017 were simply due to the smaller sample size, or if they were due to changes in timing of fish runs and/or changes in feeding behavior. Possible correlations among beluga group size, timing and strength of fish runs, and feeding behavior (and inter-annual variations in all of these factors) will be investigated in future work.

Calving Behavior/Calf-Rearing Habitat and Seasonality

Unlike other beluga populations, the scientific literature had not identified distinct calving grounds for CIBWs because births in the wild had not been documented previously. To our knowledge, our observation of a CIBW birth on July 20, 2015 in the Susitna River Delta is the first documentation of a CIBW birth and provides evidence to support the designation of the Susitna River Delta as CIBW calving grounds. Our documentation of a second suspected birth in the same area almost a year to the day later further supports this. The documentation of a suspected birth in Turnagain Arm in 2016 suggests that calving is not restricted to the Susitna River Delta. We did not observe births in 2017.

The first neonates encountered during each field season 2005-2017 were always seen at the Susitna River Delta in July and were later seen in the other areas where groups were encountered. Within the broad area defined as the Susitna River Delta, neonates were seen in the river mouths of the Susitna River and Little Susitna River, and along the mudflats between the two rivers. No particular location could be singled out as a calf-rearing habitat because calves and neonates have been seen in all parts of the survey area where belugas were encountered.

Seasonality of beluga calving in the Canadian Arctic has been determined using seasonal differences in proportions of calves, juveniles, and adults (Smith et al. 1994). Based on

the presence of calves sighted in summer aerial surveys, Calkins (1983) speculated that calving might occur between mid-June and mid-July in the larger estuaries of western Upper Cook Inlet. Our observations of the confirmed and suspected births, as well as our documentation of the dates of the first neonate of each year, indicate that calving for CIBWs encountered in the survey areas begins in mid- to late July/early August, generally coinciding with our observed timing of annual maximum group size. Evidence also suggests that the calving season extends into September and likely into October, as we have seen a suspected birth in September of 2016 and have photographed neonates as late as October (McGuire and Stephens 2017). It seems likely that we underestimate the number of neonates in groups, and perhaps fail to detect births later in the season (i.e., after July) when beluga groups move over to Turnagain Arm, where distance between land-based observers and whales is greater.

Is the 2005-2017 Photo-id Catalog Representative of the CIBW Population?

The number of identified individuals in the photo-id catalog is not a population estimate, although the number of individuals photographed each year does provide a minimum estimate of the number of CIBWs alive each year. We are unable to simply add the number of individuals in the right- and left-side catalogs to estimate population size for CIBWs for several reasons. With the exception of the 93 dual whales, we do not know which of the 431 left-side whales are the same individuals as the 423 right-side whales. If skin biopsies for genetic analysis continue to be collected concurrently with photographs of both sides of the whales, as they were during the 2016 CIBW biopsy feasibility study (McGuire et al. 2017a) and if photographs from subsequent biopsy studies and from aerial drones continue to be shared with the CIBW Photo-ID Project (McGuire et al. 2018b) more of the left- and right-side sighting records of individuals in the catalog will be able to be linked. In addition, many variables determine if an individual will be identified from photos. The photo-id sighting history of an animal depends on the availability and identifiably of the animal. Availability factors include the behavior of the animal (i.e., reaction to the research vessel or land-based photographer, surfacing behavior, other behavior), affinity of the individual for the study area, and survey effort. Factors contributing to identifiability include the experience and skill of the photographer, boat driver, and photo-analysts; the quality of the camera and lens; weather conditions; and the conspicuousness and distinctiveness of the identifying mark. The distance between the whale and photographer, which is constrained by the survey area, animal behavior, and research permit restrictions, also affects identifiability. Estimating population size from photo-id data first requires models that consider these variables and the role they play in the probability that a whale is identified.

The most-recent CIBW population estimate from aerial surveys in 2016 was 328 whales, with a range between 279 and 386 whales (https://alaskafisheries.noaa.gov/node/56813). An integrated population model (IPM) that combined data from aerial surveys, photo-id, and hunting produced a higher estimate of around 100 additional whales for the same time period (Jacobson et al. in prep). The fact that the number of individuals in the photo-id catalog, after subtracting known- and presumed-dead individuals (resulting in 395 in the rights-side catalog, 382 in the left-side catalog), approximates the maximum population estimates from recent aerial surveys and the IPM suggests that much of the population has

been identified (if the population estimates are accurate). Considering that during the duration of the CIBW Photo-ID Project several of the individuals in the catalog have died without photographs 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 appear to contain records on the majority of individuals, and therefore data from individuals in the catalog should be representative of the CIBW population. As discussed previously, we have confirmed that both sexes are represented in the catalog. The shape of the discovery curve, representing the number of new individuals added to the catalog every year, is leveling off, which further supports the idea that most of the population (or the portion of the population that is available to us with current survey methods) has been identified. Life-history data derived from the catalog should therefore be generally characteristic of the CIBW population.

Mortality of Identified Individuals

NMFS reports that there were 73 dead CIBWs recorded between 2005 and 2015, although the age and sex of these individuals are not stated (NMFS 2016). In 2016, six dead CIBWs were reported to the CIBW Photo-ID Project, and 13 were reported in 2017; resulting in a minimum of 92 dead CIBWs between 2005 and 2017.

The CIBW Photo-ID Project was provided with or took photos of 35 of these individuals between 2005 and 2017. There does not appear to be a clear pattern for mortality of the dead photographed whales in terms of age class or sex; 60% were adults, 8.6% were subadults, 20% were calves, one was of unknown age class, and 8.6% were fetuses. In addition, 15 were female, 13 male, and sex was undetermined for the remainder suggesting an even sex ratio.

Twelve dead-stranded whales have been matched to individuals in the 2005-2017 catalog, and six of these were males and six were females, again suggesting a 50:50 sex ratio in the population represented by the catalog.

Linking the sighting history of a stranded 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. Genetic identification of individuals also allows for the validation of photo-id of these same individuals. For example, a beluga that died in 2015 had been photo-identified as an individual that had been satellite-tagged in 2002 and later resighted between 2005 and 2015; genetic comparisons of samples taken during capture for tagging and from the dead animal confirmed it was the same individual (McGuire and Stephens 2016). 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 into the individual records in the CIBW Photo-ID Project catalog.

Incorporating both the actual number of dead-stranded belugas and those predicted to have died based on a cessation of photo-id sighting records will be useful for population models. The number of stranded animals reported annually is surely an underestimate of the number of deaths, given that many carcasses are not encountered, others are not

reported, and some are not investigated. Winter strandings, strandings in remote parts of Cook Inlet, and strandings of calves are likely to be underestimated because of detectability issues.

In order to obtain the maximum amount of information possible from a photograph of a dead whale, we have updated and distributed a protocol for photographing beluga mortalities (available at www.cookinletbelugas.org). 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.

Information from Live Strandings

Photo-identification of live-stranded animals can also provide information about the survival of individuals post-stranding. For example, NMFS provided the CIBW Photo-ID Project with photos of a mother and calf who live-stranded in 2015 and were seen to swim away from the stranding on the rising tide. The mother was photographically identified as R1032, who was first photographed in 2008 and every year after for six years. Despite a very conspicuous mark and previously strong sighting record, she was not photographed again in 2015 after the stranding event, nor was she photographed in 2016, raising concerns she may have died from complications post-stranding. However, photos of her taken alive in 2017 (with a calf) confirmed that she survived the live-stranding experience.

Photographs taken of the calf that live stranded in 2017 have been shared with the CIBW Photo-ID Project by the Alaska Marine Mammal Stranding Network (including the Alaska Sea Life Center). Analysis of photographs from the Alaska Sea Life Center, taken while this male calf was in their facilities, is allowing us to create a reference set of photos to help assign relative age to photographs of free-swimming CIBW calves in the catalog, and will be useful in helping us in our collaborations to estimate calf survival and reproductive rates of individual mothers and eventually for the population as a whole.

Number of Presumed Mothers in the 2005-2017 Catalog

It seems likely that photo-id methods underestimate the number of presumed mothers, and thus females, in the CIBW population within a field season. We only classified individuals as "presumed mothers" if there was clear evidence of a calf alongside them in the same photo frame. We classified whales as "potential mothers" when calf accompaniment was ambiguous, either because of uncertainty about which adult in the photo frame was the parent of the calf, uncertainty differentiating calves from juveniles (for larger light-gray whales), or because too little of the suspected calf was visible above the surface of the turbid water to confirm that it was a calf. Our current method of defining mother-calf pairs at the level of association within 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. 2009). With each additional field season, however, we increase the chances that we photograph the actual number of mothers in the population over the course of the study. Forty-three percent of individuals in each the right-side and left-side catalogs have been classified as presumed mothers based on their 2005-2017 sighting histories.

Adding biological information obtained from invasive CIBW studies allowed for the validation of assumptions that had been made about individuals in the catalog based solely on their photo-id histories. We were able to use the information from the 23 individuals (eight males and fifteen females) for which sex had been genetically determined from samples collected during satellite tagging captures, strandings, and biopsy to test and refine our classification of mothers (McGuire and Stephens 2017).

Approximately two-thirds of the 15 photo-identified females of genetically confirmed sex had been classified as presumed mothers based on their photo-id histories. In other words, 10 individuals that had been presumed to be mothers based on their sighting histories with calves were later confirmed to be females from genetic samples. However, this means that one-third of the genetically confirmed photo-identified females had not been classified as presumed mothers in the photo-id catalog, although one was classified as a potential mother. Photo-id records of genetically confirmed females that were not classified as presumed mothers may have been too sparse and/or the whales may simply have not been photographed when they had calves with them. Alternatively, it is possible they were relatively young females and had not yet reached reproductive maturity. Another possibility is that these females without calves were of reproductive age, but for some unknown reason were not reproducing, or had lost their calves. For example, beluga D16854, first photographed in 2014 and confirmed genetically as a female from a biopsy in 2016, was not photographed with a calf until 2017. Photo-id sighting history data for many of these females of confirmed sex will need to be combined with data from NMFS on age, reproductive hormones, and contaminate burdens in order to better understand which of these processes may be occurring.

Reproductive Rates of Individuals and the Population

We are collaborating with colleagues from Montana State University, NMFS MML, and ADF&G to use both survey data and photo data from the 2005-2017 CIBW Photo-ID database to construct models to estimate reproductive rates and examine their implications for CIBW population viability and recovery.

CONCLUSIONS

The CIBW Photo-ID Project used non-invasive, observational methods to provide longitudinal data about CIBW population characteristics, habitat preferences, and individual life histories of approximately 400 whales over a 13-year period. The strength of the CIBW Photo-ID Project will continue to grow with the proportion of the CIBW population that is identified and re-sighted. The number of whales in the catalog is always increasing as more years of fieldwork are conducted, but also as more of the archived photos from previous years of fieldwork are cataloged. Filling in the gaps in the catalog and updating both catalogs allowed us to obtain more information about life histories of individuals, including reproductive females and their calves.

The utility of the individual sighting records in the photo-id catalog is greatly increased with the addition of biological information obtained from other sources, such as satellite tagging, biopsy, aerial imagery, and stranding response. Together these data help form a more comprehensive picture of an identified individual, framing the biological information from tissue samples within the context of historical data gained from photo-id, such as movement patterns, reproductive history, relative age, and social associations. To date, biological information obtained from skin samples has allowed us to know the sex of some individuals (from genetic samples collected during tagging, strandings, and biopsy). Additional information that can be provided from biological samples and incorporated into the catalog includes age, reproductive status, familial relationships, diet, and contaminant loads.

We obtained estimates of beluga encounter rates, group sizes, and relative color- and size-class composition from surveys and the number of identified presumed mothers in 2017. We describe patterns and trends that are apparent within the data, while also pointing out sources of sampling bias and how these may affect the data from photo-id surveys and identification of individuals. We are cautious in reporting life-history parameters such as reproductive or survival rates because there are many factors that affect our ability to detect, photograph, and identify individuals, particularly mothers and calves, which could result in biased estimates. Multivariate models are needed to quantify the effect of these factors (and their interactions) on estimating these population and life-history parameters. The next phase of the CIBW Project, now underway, includes working with colleagues to construct models to quantify these biases and confounding variables and explicitly build them into models that will allow scientists to better assess the significance of the patterns for understanding beluga population dynamics. In the meantime, these descriptive results will be useful to managers seeking to minimize effects of human activities on belugas, and to help inform future research efforts.

Insights were recently gained into the population decline of the endangered St. Lawrence Estuary belugas by constructing an integrated model from multiple datasets, which revealed patterns and population dynamics that any single dataset alone would not have been able to explain (Mosnier et al. 2015). An integrated population model using three datasets (aerial surveys, photo-id data, and hunting data) was recently developed to estimate population size and trends for CIBW (Jacobson et al. in prep). The continuation of a long-term, Inlet-wide, photo-id dataset and its incorporation into in an integrated model with additional datasets (e.g., , acoustic surveys, biopsy sampling, stranding data,

photogrammetry studies from aerial drones), that appropriately accounts for sampling constraints and biases inherent to each method, will help with efforts to understand the continued lack of recovery of the CIBW population.

RECOMMENDATIONS

In order to maximize the utility of the CIBW Photo-ID Project to provide information needed for decision making to recover and conserve the CIBW population, we recommend the following:

- continue photo-id surveys to add to the long-term dataset of a long-lived species,
- incorporate biological information from other studies with information contained in the photo-id catalog,
- continue to team with colleagues to construct models to maximize the information collected by the CIBW Photo-ID Project,
- collaborate with colleagues to integrate multiple datasets into an integrated model, and
- continue to communicate project results to managers, colleagues, and the public.

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TABLES

Table 1. Funding for the 2005–2017 CIBW Photo-ID Project cataloging and fieldwork. NFWF = National Fish and Wildlife Foundation (with non-Federal match from Chevron, ConocoPhillips, Unocal, Donlin Gold, Royal Caribbean Cruise Lines, and Wells Fargo); NPRB = North Pacific Research Board; JBER = Joint Base Elmendorf Richardson, Department of Defense; ADF&G = Alaska Department of Fish and Game; KPB = Kenai Peninsula Borough; NMFS AKR = National Marine Fisheries Service, Alaska Region.

	Funding for:		
Year	**Left-side catalog***	**Right-side catalog***	**Fieldwork***
2005	NPRB	NFWF	NFWF
2006	NPRB	NFWF	NFWF
2007	NPRB	NFWF	NFWF
2008	NPRB	NFWF	NFWF
2009	NPRB	NFWF	NFWF
2010	NPRB	NFWF	NFWF
2011	NPRB	NFWF; JBER/ADF&G; KPB	NFWF; KPB
2012	NMFS AKR	NMFS AKR; KPB	NFWF; KPB
2013	NMFS AKR	NFWF; KPB	NFWF; KPB
2014	NMFS AKR	NFWF; NMFS AKR	NFWF; NMFS AKR
2015	NPRB	NFWF/NMFS AKR (cooperative agreement)	NFWF/NMFS AKR (cooperative agreement)
2016	NFWF/NMFS AKR (cooperative agreement)	NFWF/NMFS AKR (cooperative agreement)	NFWF/NMFS AKR (cooperative agreement)
2017	NMFS AKR	NMFS AKR	NMFS AKR

* The CIBW Photo-ID Project donated staff time for all years and projects.

Table 2. Number of CIBW Photo-ID Project surveys conducted in Cook Inlet, Alaska between 2005 and 2017 according to survey sub-area and year.

	Year													
Sub-Area	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	***Total Number of Surveys***
Susitna River Delta	16	17	5	8	13	14	11	13	8	9	10	11	9	**144**
Knik Arm	32	13	5	9	10	9	16	12	3	7	4	8	1	**128**
Turnagain Arm	0	4	5	12	12	15	16	15	12	8	8	7	3	**117**
Chickaloon Bay/Fire Island	4	1	1	2	1	0	2	5	2	2	1	0	0	**21**
Kenai River Delta	0	0	0	0	0	0	4	14	6	0	0	0	3	**27**
Annual Number of Survey Days*	52	35	16	31	36	38	49	59	31	26	23	26	16	**437**

* Because multiple sub-areas may have been visited on a single survey day, the number of surveys according to sub-area will not always add to the total number of annual surveys.

Table 3. Photo-identification survey effort and beluga whale groups encountered in Upper Cook Inlet, Alaska in 2017.

	2017			
	Susitna River Delta	**Knik Arm**	**Turnagain Arm**	**Kenai River Delta**
Range of Survey Dates	July 21 – Aug 6	Aug 21	Aug 27 – Sept 26	Sept 19 – Sept 21
Number of Surveys	9	1	3	3
Number of Groups Encountered	15	1	7	3
Number of Belugas Encountered	1,589	44	87	9
Mean Number of Groups per Survey	1.7	1.0	2.3	1.0
Mean Number of Belugas per Survey	176.6	44.0	29.0	3.0
Mean Group Size	105.9	44.0	12.4	3.0
Maximum Group Size	302	44	36	4

Table 4. Composition and size of the 15 groups sighted during vessel-based surveys of the Susitna River Delta in 2017. (Neonates are separate from calf total. Unknown = beluga of unknown color and size. y = yes, color-class present, but could not be quantified.)

2017	# White	# Gray	# Calves	# Neonates	# Unknown	Group Size
July 21	18	12	5	0	0	35
July 21	3	1	1	0	0	5
July 21	8	2	0	0	0	10
July 21	y	y	y	1	50	51
July 22	y	y	y	2	150	152
July 26	55	30	20	5	0	110
July 27	85	80	29	5	101	300
July 27	1	0	0	1	0	2
July 28	43	47	15	7	0	112
Aug 3	40	30	10	3	70	153
Aug 4	100	80	20	4	0	204
Aug 4	1	1	0	0	0	2
Aug 5	148	y	y	4	150	302
Aug 5	18	15	8	3	6	50
Aug 6	y	y	y	3	100	103

Table 5. Composition and size of groups sighted during land- and vessel-based surveys in Knik Arm, Turnagain Arm, and the Kenai River Delta in 2017. (Neonates are separate from calf total. Unknown = beluga of unknown color and size. x = could not be determined. y = yes, color-class present, but could not be quantified.)

2017	Sub-Area	Platform	# White	# Gray	# Calves	# Neonates	# Unknown	Group Size
Aug 21	Knik Arm	land	12	23	6	3	0	44
Aug 27	Turnagain Arm	land	8	x	x	x	x	8+x
Sept 6	Turnagain Arm	land	5	3	2	x	0	10
Sept 6	Turnagain Arm	land	y	y	y	1	35	36
Sept 26	Turnagain Arm	land	3	4	1	0	3	11
Sept 26	Turnagain Arm	land	6	7	2	1	0	16
Sept 26	Turnagain Arm	land	0	1	1	0	0	2
Sept 26	Turnagain Arm	land	1	0	0	0	3	4
Sept 19	Kenai River Delta	vessel	2	2	0	0	0	4
Sept 20	Kenai River Delta	land and vessel	2	1	0	0	0	3
Sept 21	Kenai River Delta	land	2	0	0	0	0	2

Table 6. Daily range of environmental conditions measured during vessel-based surveys conducted in 2017 in the Susitna River Delta, Upper Cook Inlet, Alaska. Sea ice was not present on any survey days in 2017.

	Daily Ranges											
Date	**Start Time**	**End Time**	**Surface Water Temp (°C)**	**Air Temp (°C)**	**Wind Speed (km/hr)**	**Wind Dir.**	**Cloud Cover (%)**	**Precipitation**	**Visibility**	**Swell (m)**	**Beaufort Sea State***	**Other Human Activities Noted**
Jul 21	08:00	16:33	13.0–24.0	17.6–24.0	0–20	SE	0–40	none	good	0–1	0–1 (4 near Fire Island)	aircraft, set net vessels returning to dock, lots of gunshots heard around Beluga River
Jul 22	09:00	16:10	14.0–14.7	16.6–16.7	0–7	NE	5	none	good	0	0–1	aircraft
Jul 26	12:34	18:36	14.3–14.6	15.3–16.6	0–4.8	NW	100	rain	good	0–0.5	0–2	dipnetting Fish Creek; aircraft
Jul 27	13:12	18:38	12.8–15.5	18.4–19.3	7.5–10.2	W, then SE	25–30	none	good, some fair (fog patches)	0–1	1–3	aircraft; set net vessels returning to dock
Jul 28	13:45	19:52	12.6–14.8	15.2–16.4	0–14	W, then SW	100	occasional rain	good	0–0.5	1–2	aircraft
Aug 3	06:45	13:51	11.8–14.7	14.2–16.6	3.5–11.5	SE, then S	100	light rain, then none	good	0–1.0	1–2	set nets; aircraft (including hexacopter); 2 other beluga research vessels
Aug 4	07:45	15:00	14.3–14.8	15.0–18.4	0–6.4	SE, then E	25–75	none	good	0–0.5	0–2	aircraft (including hexacopter); 2 other beluga research vessels; floating discharged phosphate tracer canister near Fire
Aug 5	08:52	17:00	14.1–14.9	16.6–23.7	0–9.3	SE, then NE	20–25	0	good	0.25	1–2	aircraft (including hexacopter); 2 other beluga research vessels
Aug 6	09:04	17:21	14.5–15.8	14.7–19.1	5.8–10.0	S, then W	30–100	0	good, some fair (fog patches)	0–0.25 (rough W of Fire Island, sheltered in Little Su	1–2	aircraft (including hexacopter); 2 other beluga research vessels

* Beaufort Sea State: 0 = sea like a mirror; 1 = ripples without foam crests; 2 = small wavelets, crests do not break; 3 = large wavelets, crests begin to break, scattered white caps

Table 7. Daily sighting conditions during land-based surveys conducted in 2017 in Knik Arm, Turnagain Arm, and the Kenai River Delta, Cook Inlet, Alaska.

Date	Survey Area	Survey Start Time	Survey End Time	Sea Ice?	Visibility	Beaufort Sea State*	Other Human Activities Noted
Aug 21	Knik Arm	10:58	15:30	no	good	1	none
Aug 27	Turnagain Arm	08:47	12:50	no	fair	2	none
Sep 6	Turnagain Arm	17:33	20:23	no	fair	2 – 3	film crew filming belugas from land
Sep 26	Turnagain Arm	09:00	15:00	no	fair to poor (fog)	1 – 2	none
Sep 19	Kenai River Delta	08:15 – 10:25; 12:35 – 18:03		no	good	0 – 2	duck hunters in blinds along shore firing over water
Sep 20	Kenai River Delta	08:30 – 10:30; 14:00 – 18:31		no	good	1 – 2	boats dredging at boat ramp; hammering along dock, barges and small vessels
Sep 21	Kenai River Delta	08:00 – 11:05; 15:15 – 16:45		no	fair to poor (wind and rain)	1 – 3	none

* Beaufort Sea State: 0 = sea like a mirror; 1 = ripples without foam crests; 2 = small wavelets, crests do not break; 3 = large wavelets, crests begin to break, scattered white caps

Table 8. Percent color/age-class composition of beluga whale groups sighted during surveys of Upper Cook Inlet, Alaska in 2017 (excluding those groups for which an age/color class could not be determined).

2017	% of groups per sub-area with:				
Sub-Area	**White**	**Gray**	**Calves**	**Neonates**	**Unknown**
Susitna River Delta	100	93	80	73	47
Knik Arm	100	100	100	100	0
Kenai River Delta	100	67	0	0	0
Turnagain Arm	86	83	83	40	50

Table 9. Summary of primary and secondary activities of beluga groups encountered in 2017 during vessel-based photo-identification surveys in the Susitna River Delta, Upper Cook Inlet, Alaska.

Date	Group Size	Primary Group Activities Noted	Secondary Group Activities Noted	Additional Group Activities Noted
Jul 21	35	traveling	none	whales against bank traveling in a tight group to the west
Jul 21	5	diving	feeding suspected	occasionally traveling
Jul 21	10	diving	feeding suspected	occasionally traveling
Jul 21	51	diving	feeding suspected	whales spread out over approx. 1 mi in clumps of 2 and 3 between Fire Island and Beluga River; some whales diving in deeper water, others up on shallow mudflats. Honking
Jul 22	150	diving	feeding suspected	also traveling and milling in clumps, feeding close to shore, traveling between rips; three subgroups merge into single big one
Jul 26	110	traveling	feeding suspected	whales in tight formation patrolling along shore, except for three white ones on edge of group who are diving in deeper water, group very vocal
Jul 27	300	traveling	feeding suspected	occasional milling – group spread over several miles W to E, traveling W. honking and vocalizing
Jul 27	2	traveling		mother and calf traveling close to shore, hard to approach
Jul 28	112	feeding suspected	traveling	two large groups merged. Socializing, milling, diving. Traveling in 2 m of water; snorting, lots of tail waving, head standing, rolling around in groups of 2 and 3. Group had been in shallow water along mudflat, headed up Susitna River with incoming tide.
Aug 3	153	feeding suspected	traveling	also socializing and milling, snorting, vocalizing, large group split into two, we followed the one heading W, then second group to E
Aug 4	204	traveling	milling	also some diving, group tightly bunched, traveling in clusters of 5 – 8 whales, traveling E, hugging shore, vocal, snorting
Aug 4	2	milling	diving	hard to photograph, barely surfacing, off mudflats, appears to be avoiding boat, we don't persist; suspect a mom/calf pair, but can't see enough to confirm
Aug 5	302	traveling	feeding suspected	group tightly bunched, traveling along edge of mudflats. Had been two groups that merged into one; salmon (spp?) see jumping out of water by boat.
Aug 5	50	feeding suspected	patrolling	at mouth of Little Susitna River
Aug 6	103	traveling	feeding suspected	originally group of 14 white whales entered mouth of Little Susitna River, later joined by larger group of about 80, mixed white, grays, calves, neonates, later joined by more whales; socializing, patrolling, tail slapping

Table 10. Summary of primary and secondary activities of beluga groups encountered in 2017 during land-based photo-identification surveys in the Knik Arm, Turnagain Arm, and the Kenai River Delta, Cook Inlet, Alaska.

Date	Survey Area	Group Size	Primary Group Activities Noted	Secondary Group Activities Noted	Comment
Aug 21	Knik Arm	44	milling	traveling	whales in river and bay; 1 white apart from group surfacing very slowly
Aug 27	Turnagain Arm	8	traveling		whales traveling up the Arm with incoming tide; spawned-out pink salmon (*Oncorhynchus gorbuscha*) swam by onshore observer, other salmon (spp?) swam by more strongly; seals fishing in cove by belugas
Sep 6	Turnagain Arm	10	milling		milling 10-20 m from N. shore, then 1/3 of way across Arm to S. shore
Sep 6	Turnagain Arm	36	traveling	milling	group mid channel, off Bird Point
Sep 26	Turnagain Arm	11	traveling	milling	milling around Bird Point; lots of surface activity and vocalizing
Sep 26	Turnagain Arm	16	milling	traveling	
Sep 26	Turnagain Arm	2	milling		
Sep 26	Turnagain Arm	4	traveling		whales headed toward 20 Mile River
Sep 19	Kenai River Delta	4	milling	traveling	
Sep 20	Kenai River Delta	3	feeding suspected	milling and traveling	belugas and seals feeding on same school of fish
Sep 21	Kenai River Delta	2	traveling	milling	harbor seal lunges out of water chasing fish; belugas milling around retaining wall just up river from Senior Center

Table 11. Summary of stranded Cook Inlet beluga whales with photographs provided to the CIBW Photo-ID Project 2017. AMMSN = Alaska Marine Mammal Stranding Network, n/a = not applicable.

Year	Date	Location	Type of Stranding	Necropsy performed by AMMSN?	Number of Belugas	Age Class (as listed on necropsy form)	Sex	Useable Photos for ID?	Comment on Unusable Photos	Matched to Catalog Whale?	NMFS AKR Stranding ID
2017	Jun 15	near Hope, Turnagain Arm	dead	yes	1	fetus	unk	no	advanced decomp, too young	n/a	2017-052
2017	Aug 22	Fire Island, Anchorage	dead	no	1	calf	unk	yes	young of year, too young for catalog	n/a	2017-167
2017	Sep 22	Nikiski, Pt. Possession/ Moose Point	dead	yes	1	adult	female	possibly	advanced decomp		2017-197
2017	Sep 22	Nikiski, Pt. Possession/ Moose Point	dead	yes	1	subadult	male	possibly	some good marks despite decomp	no	2017-198
2017	Sep 22	Nikiski, Pt. Possession/ Moose Point	dead	yes	1	calf	unk	no	advanced decomp	no	2017-199
2017	Sep 26	Trading Bay	dead	yes	1	adult	female	possibly	decomp	no	2017-206
2017	Sep 30	Trading Bay	live	n/a	1	calf	male	no	young of year, too young for catalog	no	2017-209
2017	Oct 1	Nikiski, half mi from Boulder Point	dead	yes	1	adult	male	no	decomp, blurry photos	no	2017-215
2017	Oct 3	Coastal Trail Anchorage (by Ship Creek)	dead	yes	1	calf	male	no	abrasions, too young for catalog	no	2017-217
2017	Oct 7	Campbell Point, Anchorage (east of Fire Island)	dead	yes	1	adult	female	possibly	some good marks despite decomp	no	2017-221

Year	Date	Location	Type of Stranding	Necropsy performed by AMMSN?	Number of Belugas	Age Class (as listed on necropsy form)	Sex	Useable Photos for ID?	Comment on Unusable Photos	Matched to Catalog Whale?	NMFS AKR Stranding ID
2017	Oct 12	3.5 mi S of Pt. Possession	dead	yes	1	subadult	male	possibly	some good marks despite decomp	no	2017-222
2017	Oct 22	2 mi S of Pt. Possession	dead	yes	1	adult	male	no	advanced decomp, abrasions, laying on back	no	2017-228
2017	Oct 24	Potter Marsh, Anchorage	dead	yes	1	subadult	male	possibly	some good marks despite decomp	no	2017-230

Table 12. Summary of approximately 89 incidental sighting reports of Cook Inlet belugas shared with the CIBW Photo-ID Project in 2017. Shaded cells indicate beluga sightings were reported. x indicates no sightings reported. See Figure 1 for a map showing locations of places where sightings were reported.

2017	Susitna Delta	Knik Arm	Turnagain Arm	Chickaloon Bay/Fire Island	Kenai River/ Delta	Port of Anchorage	Other
January	x	x	x	x	x	x	x
February	x	x	x	x	x	x	x
March	x	x	x	x	x	x	x
April		x		x		x	West Kalgin Island/Drift River; Tyonek
May		x				x	x
June		x	x		x	x	x
July		x	x	x	x	x	x
August				x	x	x	x
September							Anchorage (Carr-Gottstein to Kincaid)
October		x		x	x		Anchorage (Ship Creek, and Carr-Gottstein to Kincaid)
November	x	x	x	x	x		
December	x	x	x	x	x	x	x

Table 13. Summary of the number of individual CIBWs and their sighting histories in the 2005-2017 photo-id catalog.

Number of:	**Left-side Catalog**	**Right-side Catalog**
Individuals in 2005-2017 Catalog	431	423
Individuals photographed in 2017	194	171
Individuals in catalog first photographed in 2017	2	3
Individuals photographed pre-2017 who achieved catalog criteria with inclusion of photos from 2017	36	23
Maximum years between sightings of an individual	10	7
Individuals presumed dead based on lack of resightings (i.e., not seen since 2006; using 10-year gap as most conservative)	41	21
Dead individuals matched to the catalog	10	7
Individuals presumed alive = (individuals in catalog – individuals presumed dead – identified dead)	380	395
Individuals presumed to be mothers	169	181
Individuals seen in each year of the 13-year study	5	2
Individuals photographed in both 2005 and 2017 (13-year span)	62	59
Longest sighting record*, in years	20	20
Maximum number of days photographed	50	44

* Photographed by NMFS in 1998 and last photographed in 2017.

Table 14. Sighting records of satellite-tagged individuals identified in the 2005-2017 CIBW Photo-ID Catalog, according to year photographed. (P = photographed, X = not photographed, D = confirmed dead). Years w/out resights refers to the maximum number of years between resights.

CIBW Photo-id Catalog Number	NMFS CIBW Tagging Number	Sex**	Photo-graphed with a Calf 2005-2017?	05	06	07	08	09	10	11	12	13	14	15	16	17	Years w/out Resights	Comments
L2191*	none (captured, not tagged)	F	no	x	x	P	x	x	x	x	x	x	x	x	x	x	10	
D103	CI-01-06	F	yes	P	P	P	P	P	P	P	P	P	P	P	P	P	0	
D2303	CI-02-05	M	no	x	P	P	P	P	P	P	P	P	P	**D**	D	D	1	confirmed dead 2015
D111	CI-00-02 "Paul(a)"	F	yes	P	x	P	P	P	P	P	P	P	P	P	P	P	1	
D115	CI-02-08	M	no	P	P	P	P	P	P	P	P	x	**D**	D	D	D	1	confirmed dead 2014
D2204	CI-02-06	M	no	P	P	P	x	x	x	x	x	x	x	x	x	x	10	
D243	CI-01-01	F	yes	P	x	P	P	P	P	P	P	P	P	P	x	P	1	
D49	Unable to match	unk	yes	P	P	x	P	x	P	P	P	P	P	P	P	P	1	
D549	Unable to match	unk	yes	P	P	x	x	P	x	P	P	P	P	P	P	P	2	
R6	Unable to match	unk	yes	P	P	x	x	P	P	x	P	x	P	P	x	P	2	
L17368	Unable to match	unk	no	x	x	x	P	x	P	P	x	x	x	x	x	x	6	
D875	Unable to match	unk	no	P	x	P	P	P	P	P	P	x	P	P	P	P	1	
D403	Unable to match	unk	yes	P	P	x	P	P	P	P	P	x	x	P	P	P	2	
D75	Unable to match	unk	yes	P	P	P	P	P	P	P	x	P	P	P	P	P	1	
D5319	Unable to match	unk	yes	x	x	P	x	P	P	P	P	P	P	P	P	P	2	
#tagged and/ or captured CIBW seen per year				**11**	**9**	**10**	**10**	**11**	**12**	**12**	**11**	**8**	**10**	**10**	**8**	**10**		

* captured but not tagged

** determined genetically from samples taken during capture

Table 15. Summary of CIBWs captured and satellite-tagged between 1999 and 2002 and matches to individuals in the 2005-2017 photo-id catalog.

NMFS CIBW ID Tagging Number	Capture Location	Capture Date	Sex	Color (assigned during capture)	Length (cm)	Photo-ID Catalog Number	Dead?	Last Photographed	Photographed with a Calf 2005-2017?
no number (captured, not tagged)	Little Susitna	May 31, 1999	F	gray	230	L2191		2007	no
CI-9901	Little Susitna	May 31, 1999	M	white	370	possible match			
no number (captured, not tagged)	Knik Arm	Sep 8, 2002	F	light gray	274	no match (no tagging photos to examine)			
CI-0001	Knik Arm	Sep 13, 2000	M	white	413	possible match			
CI-0002	Knik Arm	Sep 13, 2000	F	white/gray	272	D111		2017	yes
CI-0101	Little Susitna	Aug 10, 2001	F	gray	257	D243		2017	yes
CI-0102	Knik Arm	Aug 11, 2001	M	white	323	possible match			
CI-0103	Knik Arm	Aug 12, 2001	F	white	312	possible match			
CI-0104	Knik Arm	Aug 13, 2001	F	white	340	no match (no tagging photos to examine)	may have died in 2001 post-tagging		
CI-0105	Knik Arm	Aug 13, 2001	F	white	357	possible match			
CI-0106	Knik Arm	Aug 15, 2001	F	white	401	D103		2017	yes
CI-0107	Knik Arm	Aug 20, 2001	M	white	442	no matches (blurry tagging photos)			
CI-0201	Little Susitna	Jul 29, 2002	M	white	412	possible match			
CI-0202	Little Susitna	Jul 30, 2002	F	white/gray	340	possible match	may have died in 2002 post-tagging		
CI-0203	Knik Arm	Jul 31, 2002	F	white	366	possible match			
CI-0204	Little Susitna	Aug 1, 2002	F	white	379	no post-2002 photos	confirmed dead post-tagging Aug 9, 2002		

NMFS CIBW ID Tagging Number	Capture Location	Capture Date	Sex	Color (assigned during capture)	Length (cm)	Photo-ID Catalog Number	Dead?	Last Photographed	Photographed with a Calf 2005-2017?
CI-0205	Knik Arm	Aug 2, 2002	M	white/gray	386	D2303	confirmed dead June 12, 2015	2015	no
CI-0206	Knik Arm	Aug 3, 2002	M	white/gray	353	D2204		2007	no
CI-0207	Knik Arm	Aug 3, 2002	F	white	374	possible match	may have died in 2002 post-tagging		
CI-0208	Knik Arm	Aug 4, 2002	M	white/gray	376	D115	confirmed dead May 26, 2014	2014	no

Table 16. Summary of photo-id matches made to the 18 individuals biopsied and one darted with no sample during the 2016 and 2017 CIBW Biopsy Study.

Biopsy Date	Biopsy ID	CIBW Photo-ID Catalog ID	Year First Identified in CIBW Photo-ID Catalog	Photographed in 2017?	Genetic Sex*	Photographed with a Calf 2005-2017?
August 13, 2016	DL-CIB16-31	R18703	2016	no	female	no
August 15, 2016	DL-CIB16-32	D16873	2010	yes	male	no
August 16, 2016	DL-CIB16-33	L18698	2011	no	female	no
August 19, 2016	DL-CIB16-34	D16854	2014	yes	female	yes***
August 19, 2016	DL-CIB16-35	D154	2005	yes	female	yes
August 20, 2016	DL-CIB16-36	D220	2005	yes	female	yes
September 2, 2017	DL-CIB17-01	L18630	2015	yes	**	no
September 2, 2017	DL-CIB17-02	D19173	2016	yes	**	no
September 2, 2017	DL-CIB17-03	D2379	2005	yes	**	yes
September 2, 2017	DL-CIB17-04	no match	n/a	yes	**	n/a
September 2, 2017	hit, dart stuck	L10517	2011	yes	**	no
September 3, 2017	DL-CIB17-05	R1187	2008	yes	**	yes
September 3, 2017	DL-CIB17-06	no match	n/a	yes	**	n/a
September 4, 2017	DL-CIB17-07	L2366	2005	yes	**	no
September 7, 2017	DL-CIB17-08	no match	n/a	yes	**	n/a
September 8, 2017	DL-CIB17-09	no match	n/a	yes	**	n/a
September 9, 2017	DL-CIB17-10	R624	2005	yes	**	yes
September 9, 2017	DL-CIB17-11	L10344	2011	yes	**	no
September 9, 2017	DL-CIB17-12	R18993	2016	yes	**	no

* genetic sex from biopsy samples determined by Nick Kellar, NMFS Southwest Fisheries Science Center
** genetic sex unavailable at time of this report
*** first seen with a calf in 2017

FIGURES

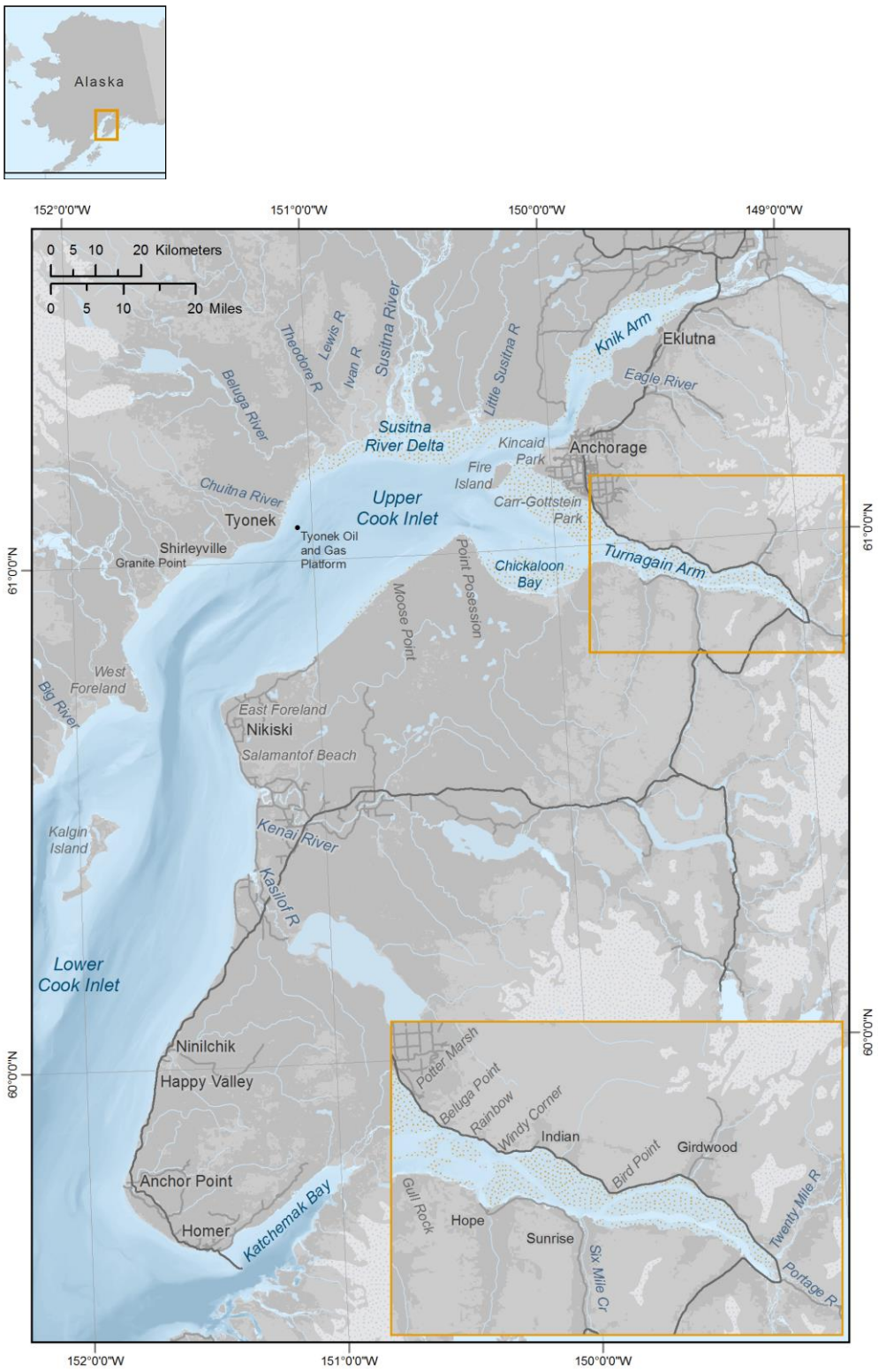


Figure 1. Map of Cook Inlet, Alaska, showing major features discussed in text.

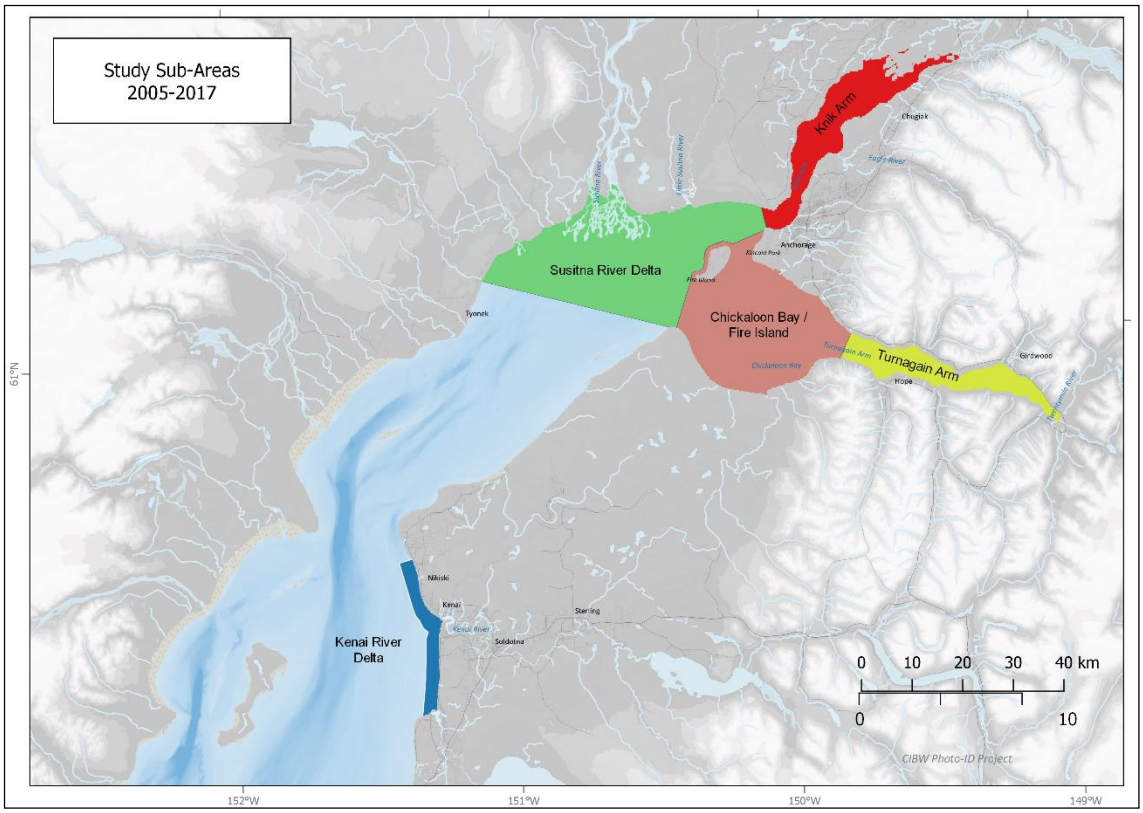


Figure 2. Map of Middle and Upper Cook Inlet, Alaska, showing boundaries of five survey sub-areas within the study area.

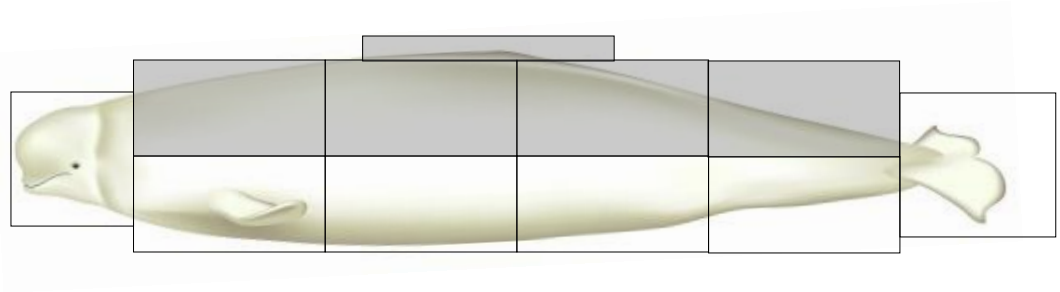


Figure 3. Body segments used when cataloging photographs of belugas for photo-id. The five shaded areas were the critical sections used in matching marks. Beluga illustration courtesy of Uko Gorter.

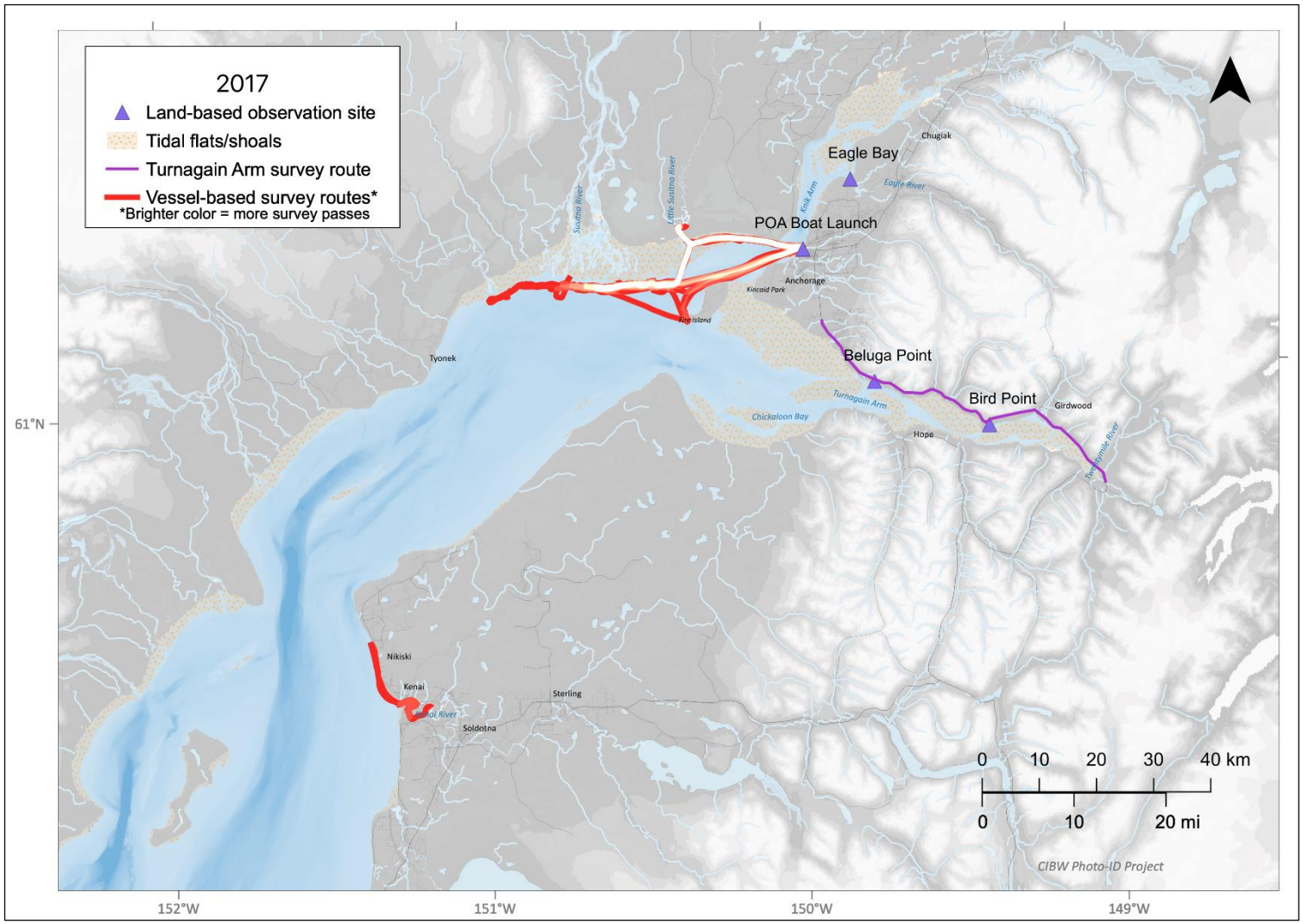


Figure 4. Vessel routes (from daily GPS track lines) with land-based stations and survey routes for all photo-id surveys conducted in 2017. Level of effort of the vessel-based surveys is indicated by the intensity of the colors of the track lines. See Table 1 for exact number of surveys. POA = Port of Anchorage.

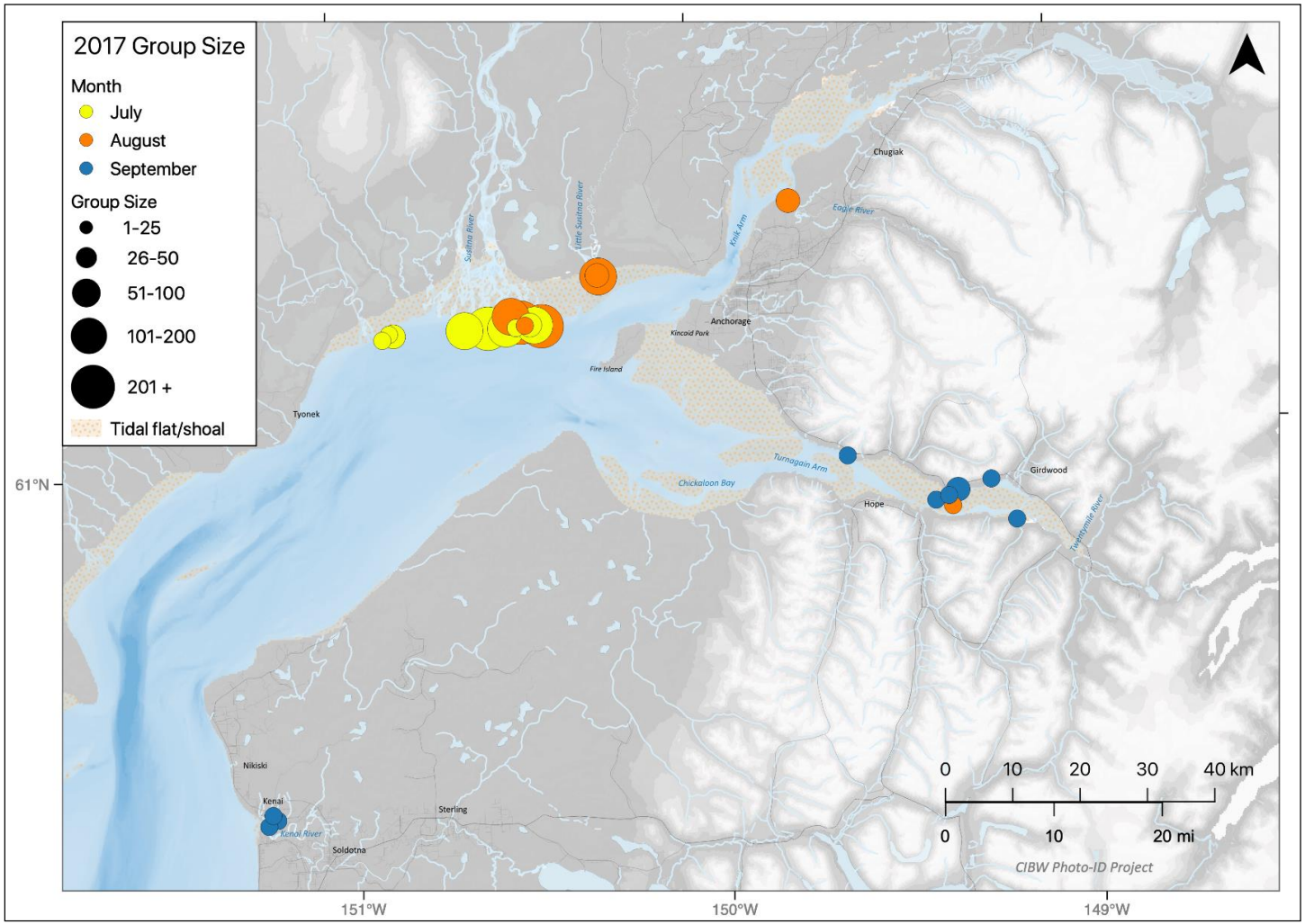


Figure 5. Size, month, and location of beluga whale groups encountered during photo-id surveys conducted in 2017.

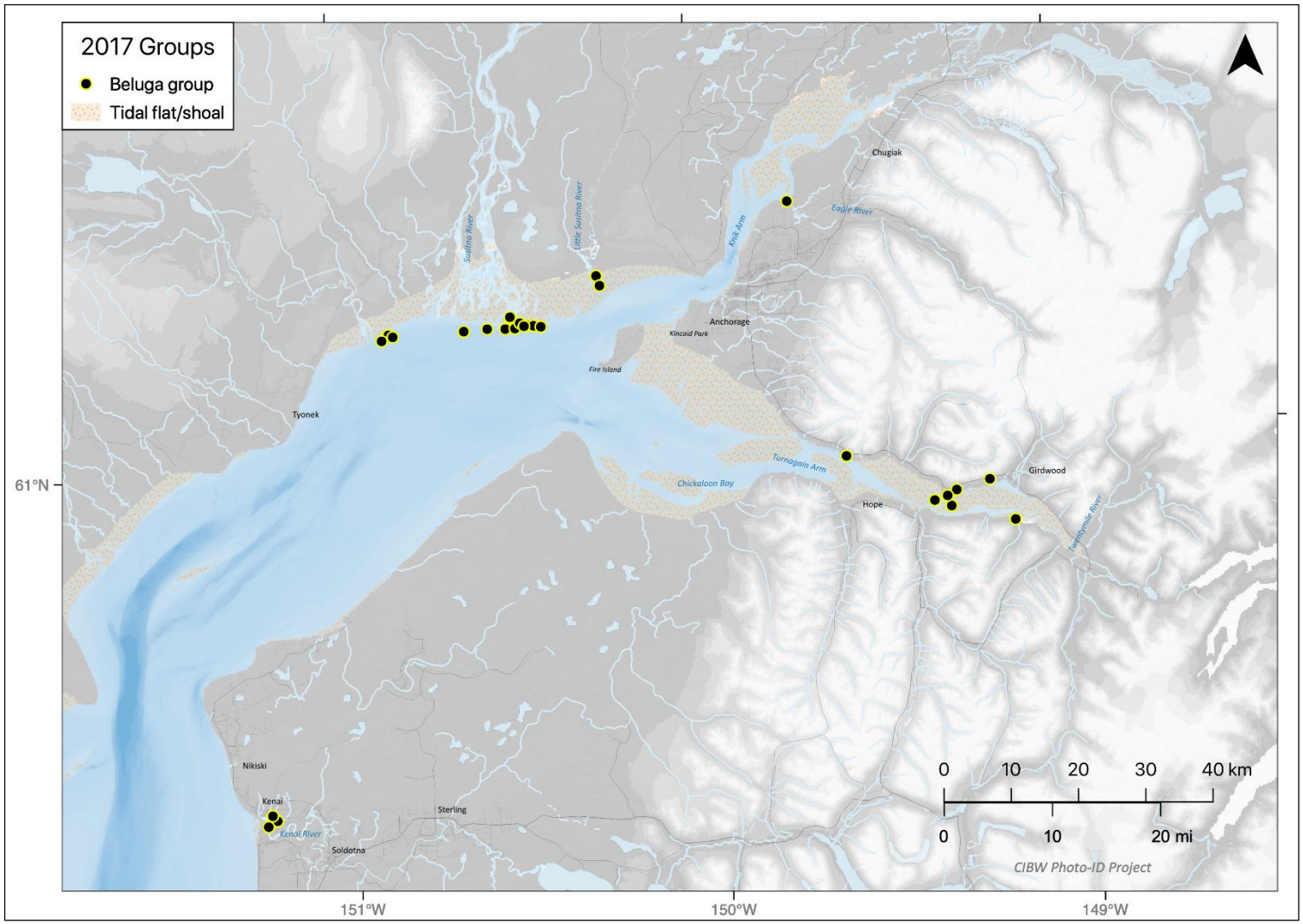


Figure 6. Beluga whale groups encountered during all photo-id surveys conducted in 2017.

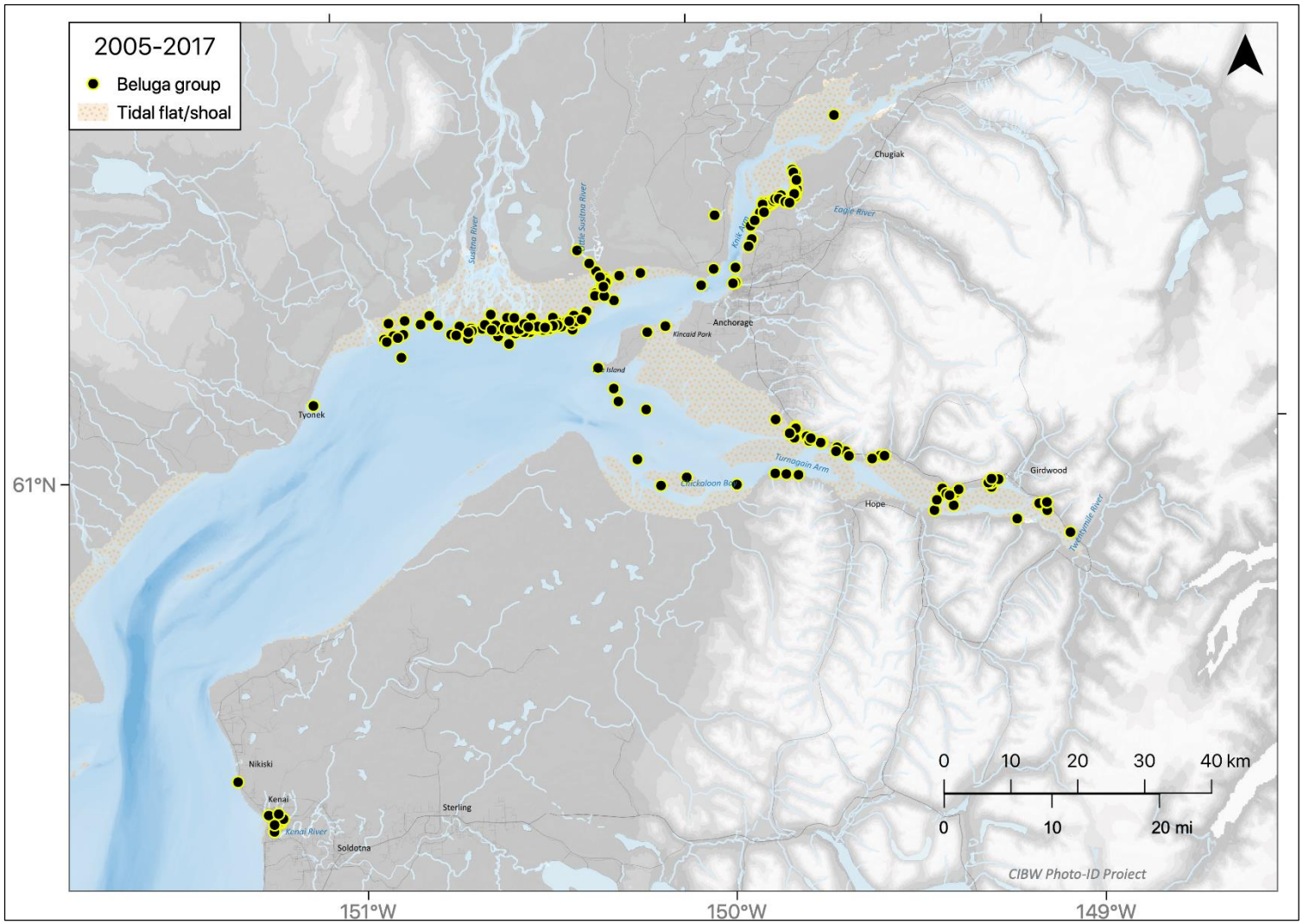


Figure 7. Beluga whale groups encountered during all photo-id surveys conducted from 2005-2017.

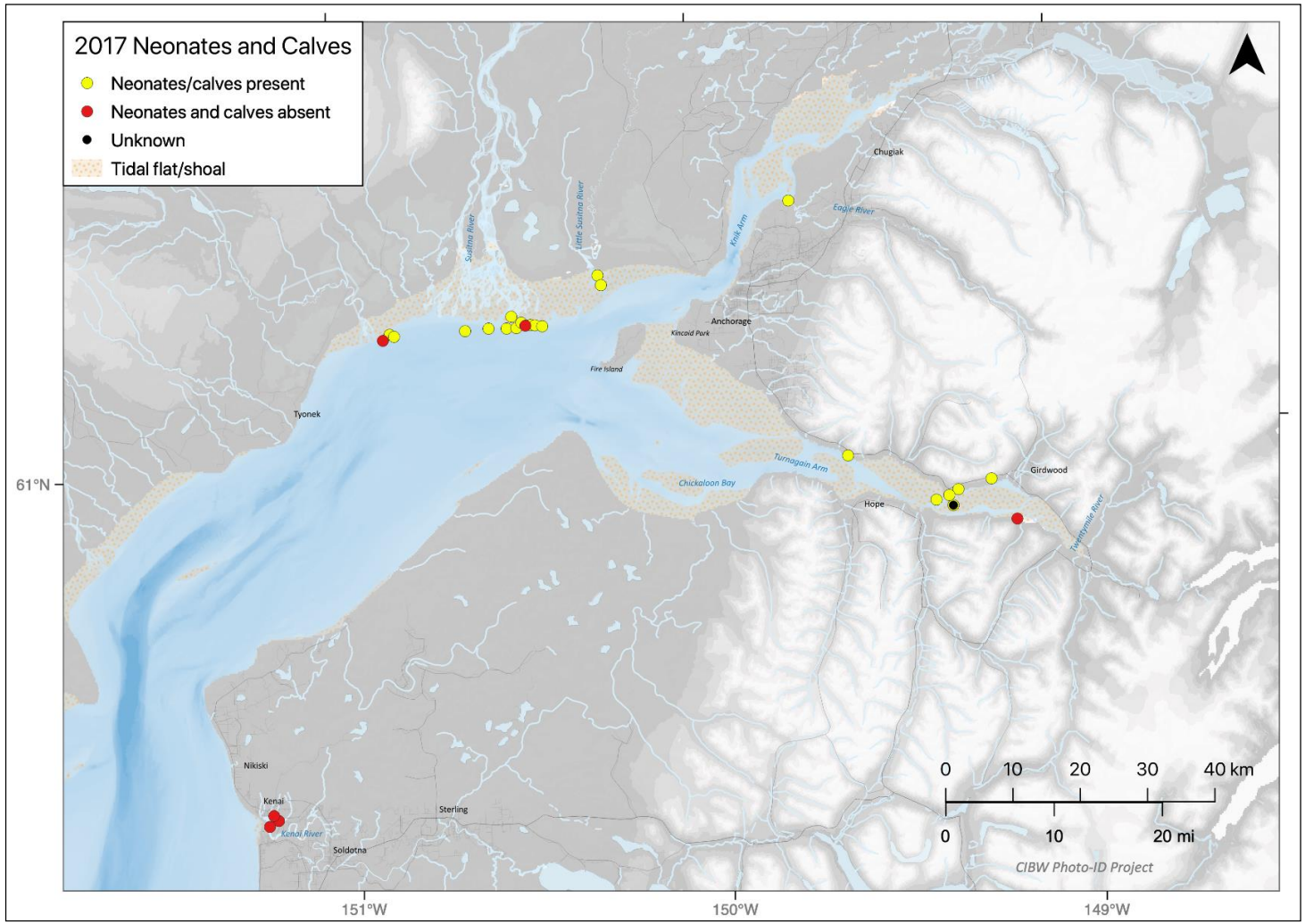


Figure 8. Location of groups with and without calves and/or neonates encountered during photo-id surveys conducted in 2017.

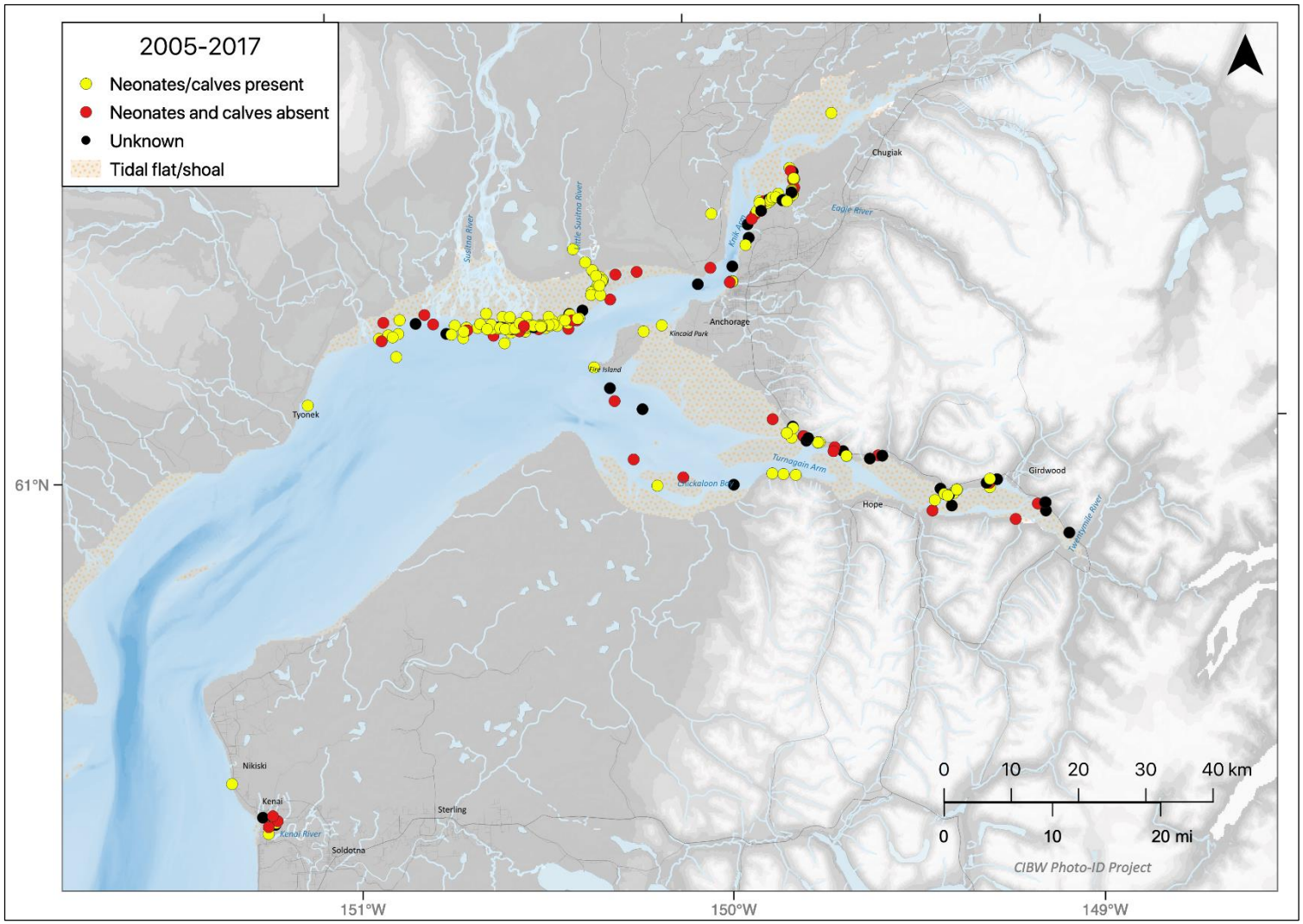


Figure 9. Location of groups with and without calves and/or neonates encountered during photo-id surveys conducted 2005-2017.

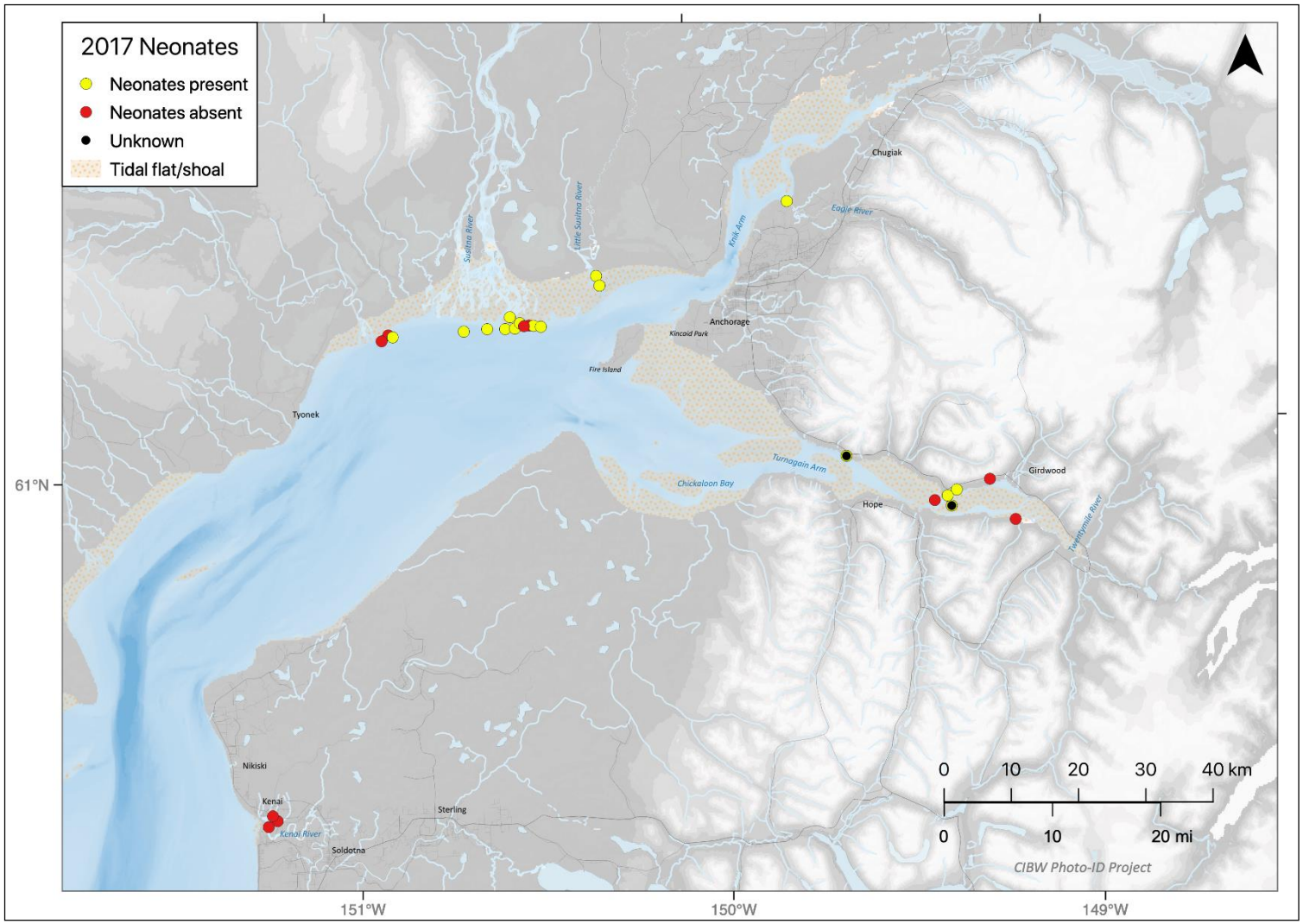


Figure 10. Location of groups with and without neonates encountered during photo-id surveys conducted in 2017.

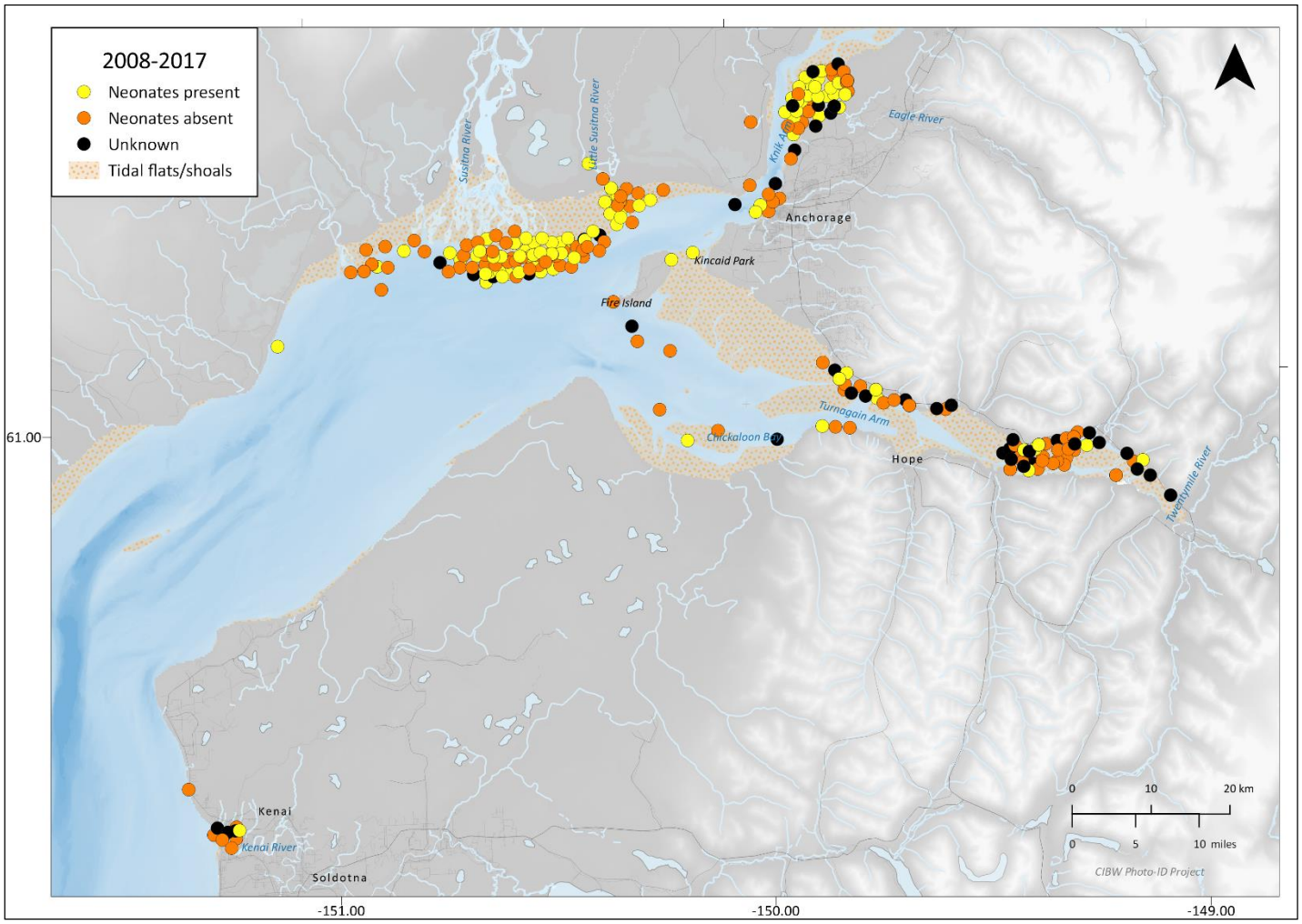


Figure 11. Location of groups with and without neonates encountered during photo-id surveys conducted 2008-2017. The group at the mouth of the Chuitna River was observed in 2005, before neonates were recorded separately from calves, but it is included here because a neonate is clearly visible in photographs taken of this group.

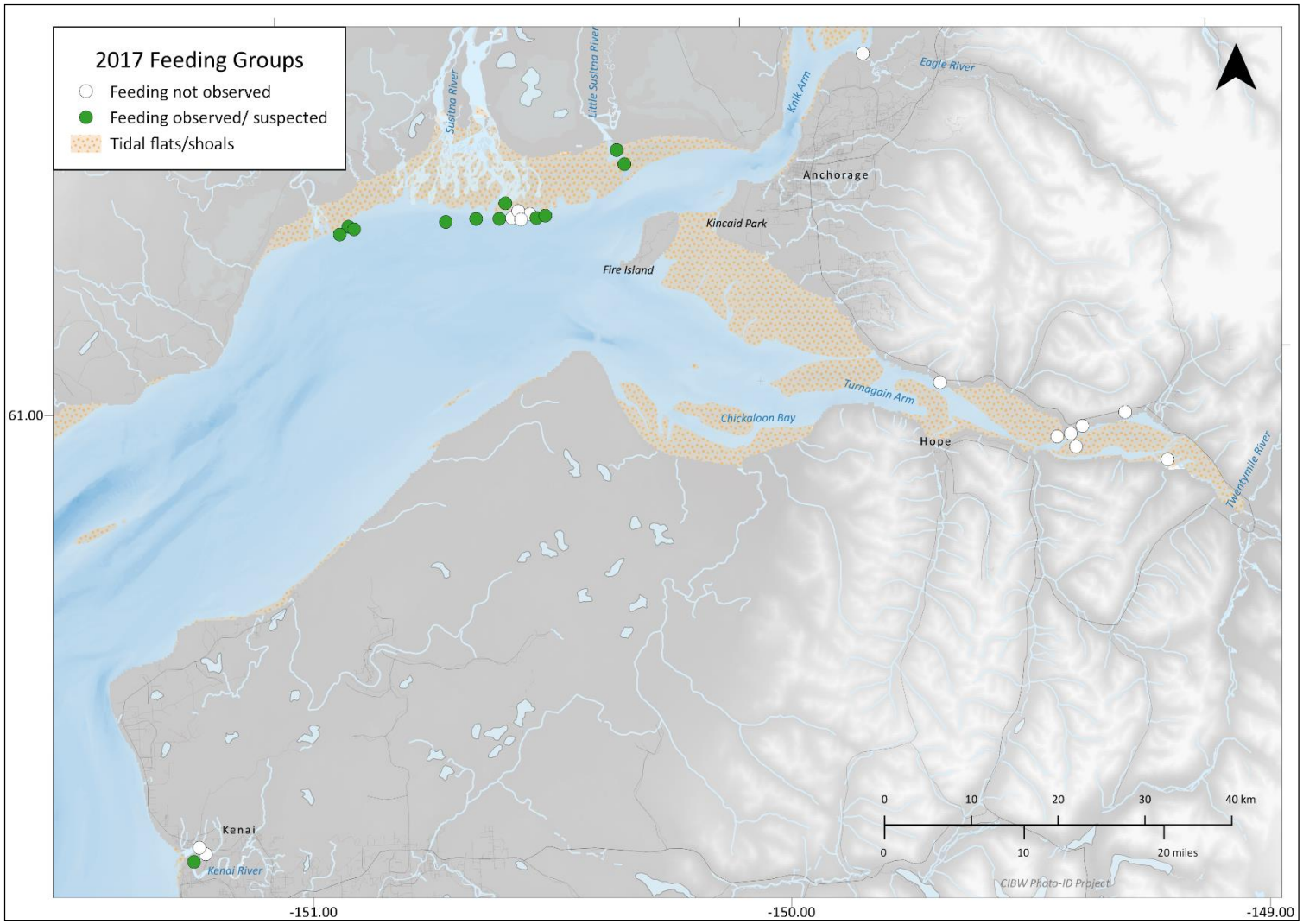


Figure 12. Location of groups with and without observations of feeding behavior (suspected or confirmed) during photo-id surveys conducted in 2017.

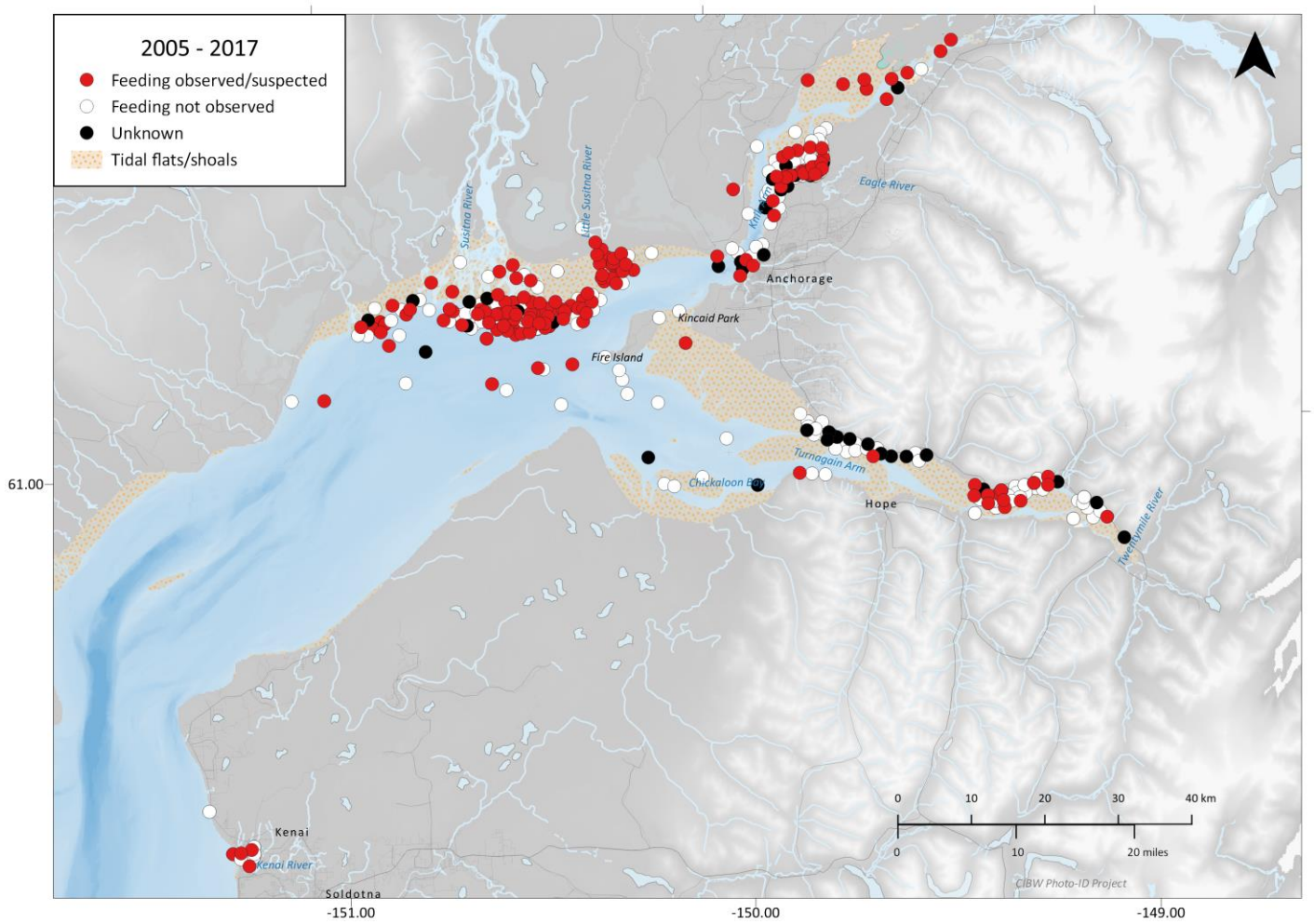
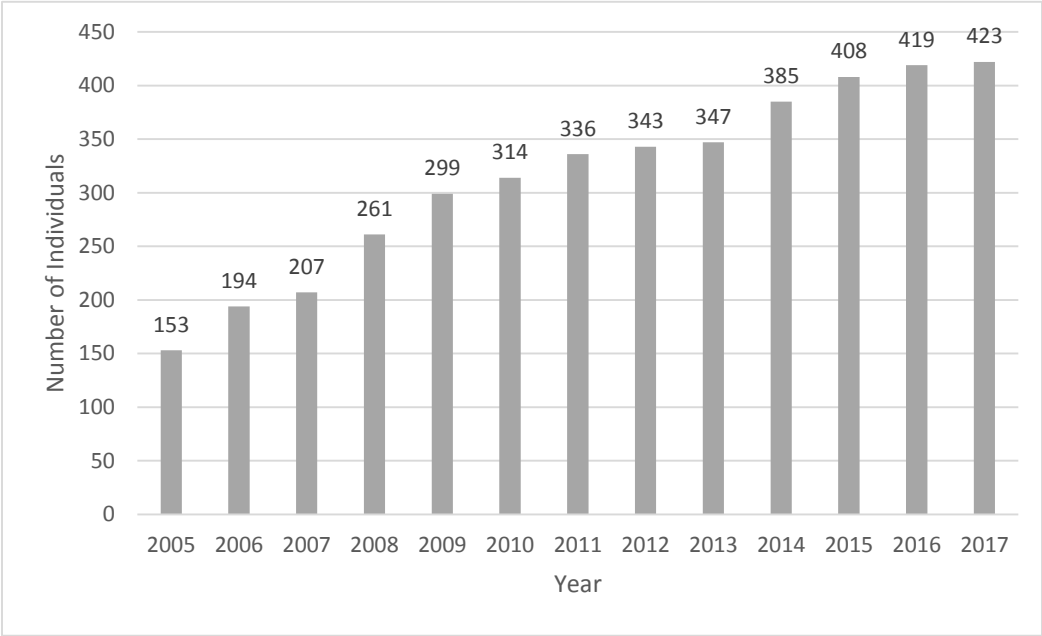
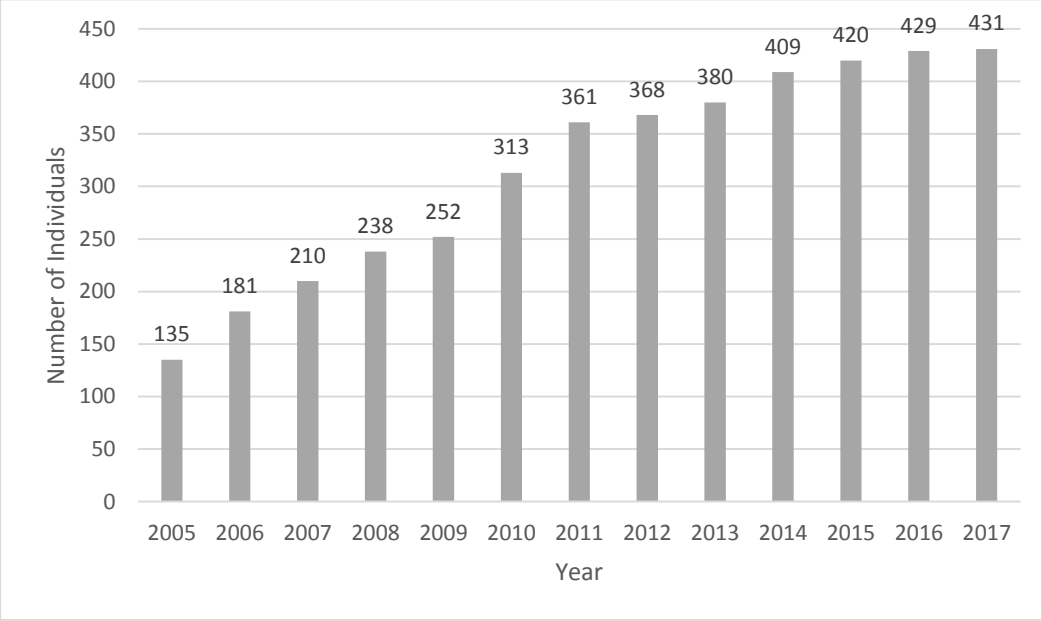


Figure 13. Location of groups with and without observations of feeding behavior (suspected or confirmed) during photo-id surveys conducted 2005-2017.



A.



B.

Figure 14. The number of identified individual whales in the right-side catalog (A), and left side catalog (B), according to the year in which an individual was first photographed by study.

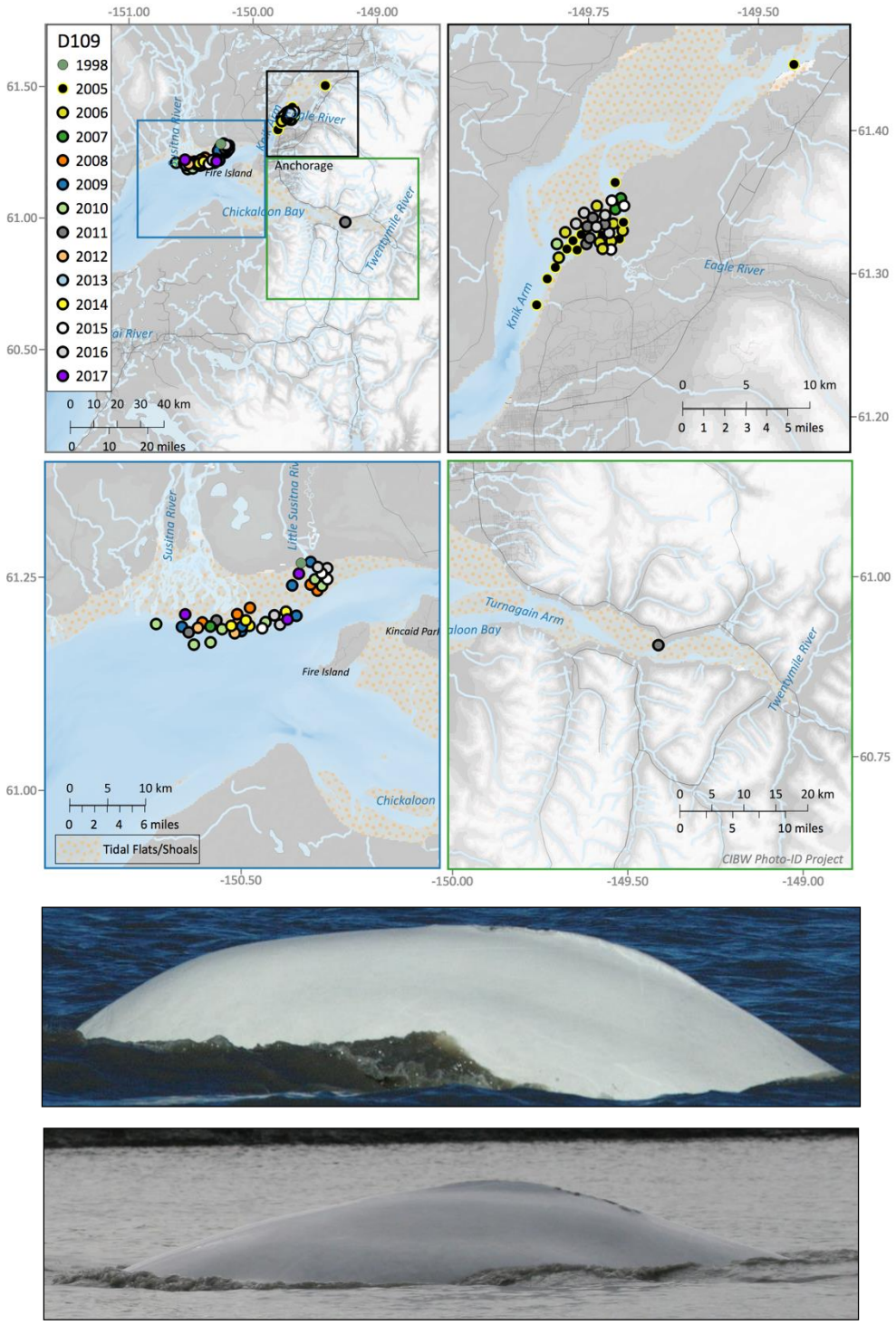


Figure 15. Sighting history of beluga D109. This whale was first photographed in 1998 by NMFS, indicating it was at least 20 years old when it was last photographed in 2017. This whale is a presumed mother based on photos with an accompanying calf. (Top photo is of the right side; bottom photo is of the left side).

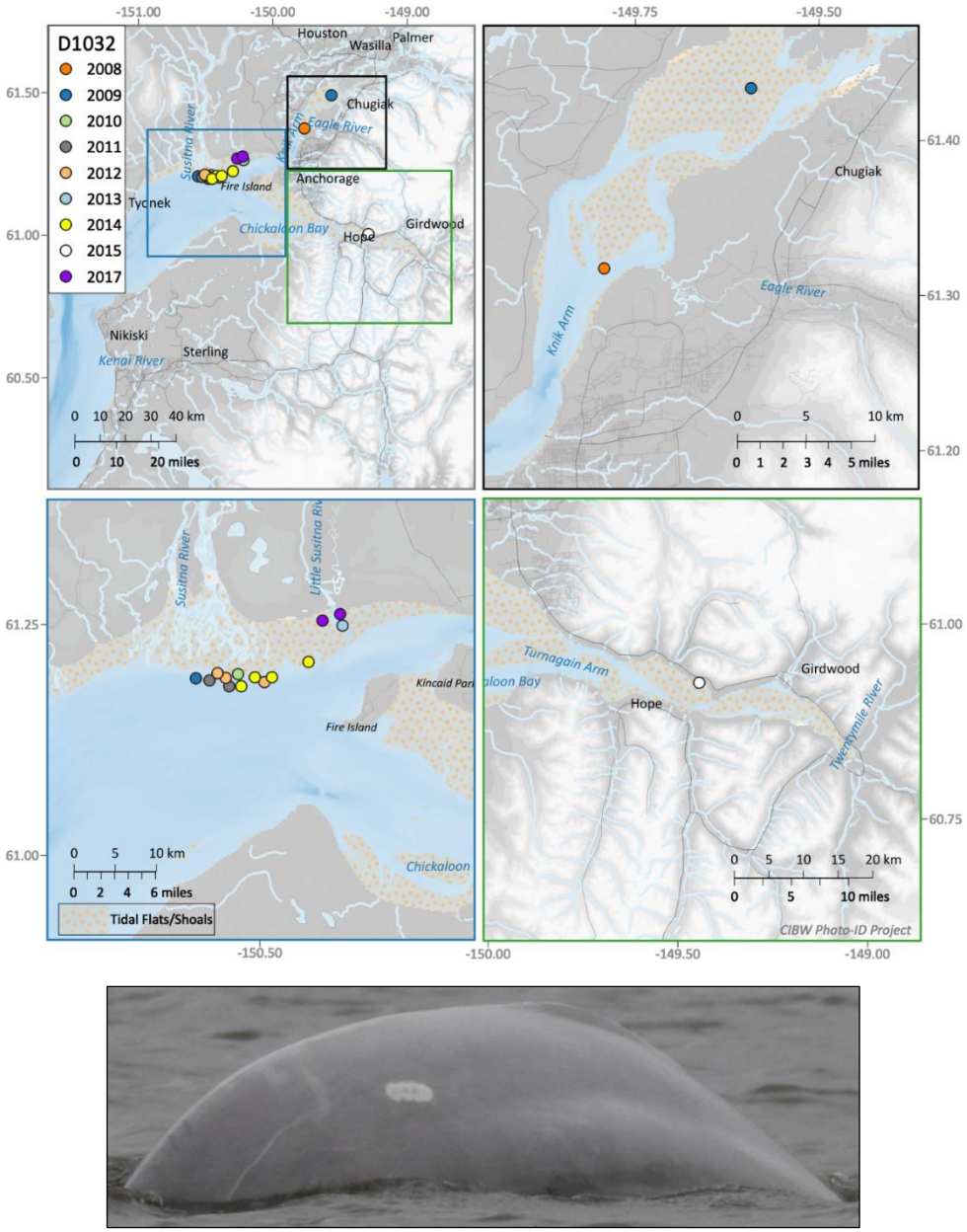


Figure 16. Sighting history of beluga D1032. This beluga was a live stranding on the mudflats with a calf in Turnagain Arm in 2015. (This photo is of the right side).

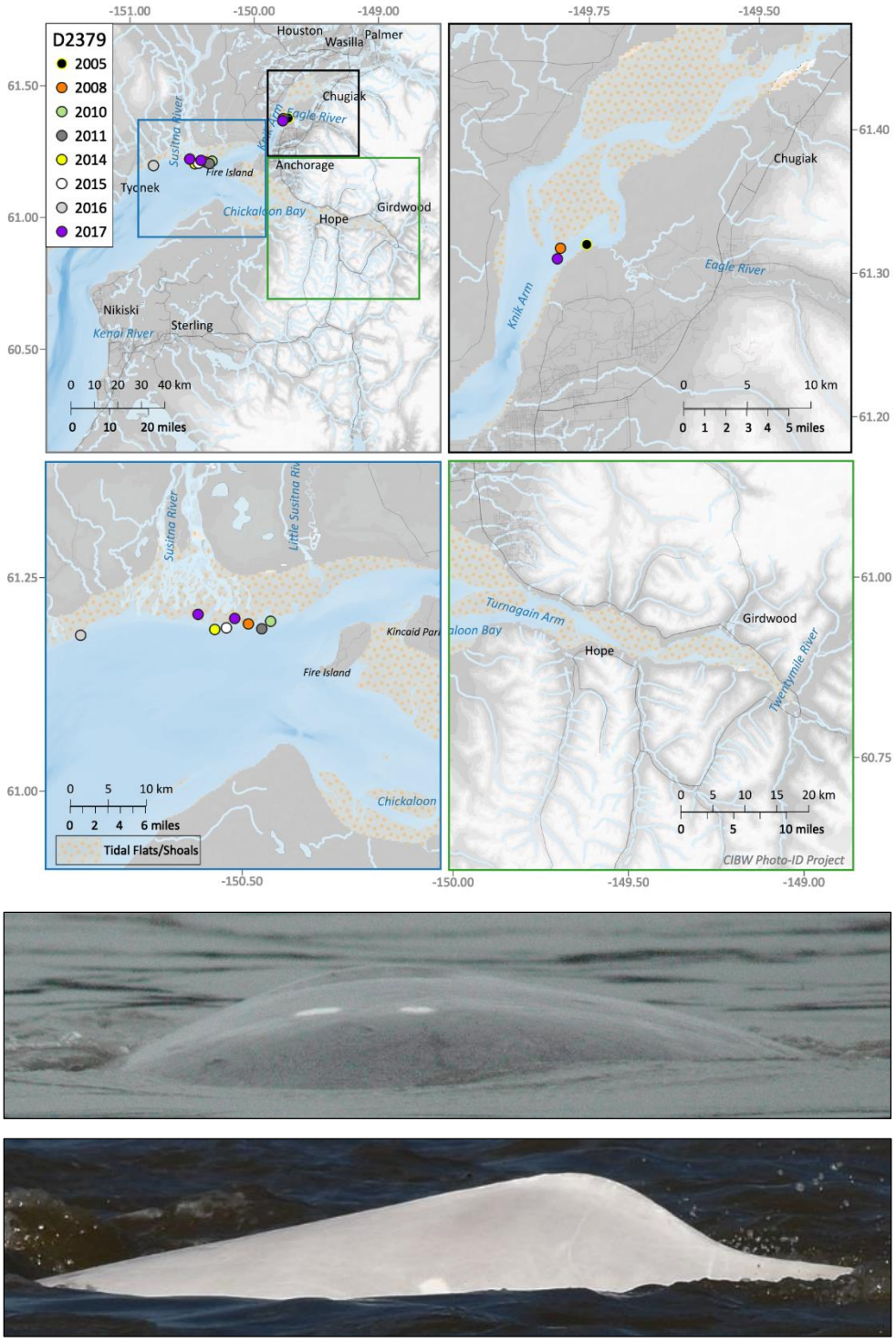


Figure 17. Sighting history of beluga D2379. Photographs are of the left side of the whale, note the concavity behind the dorsal crest in 2017 that was not present in 2005. (Top photo is of the left side in 2005; bottom photo is of the left side in 2017).

APPENDICES

Appendix A. Daily Survey Routes and Groups Encountered in 2017

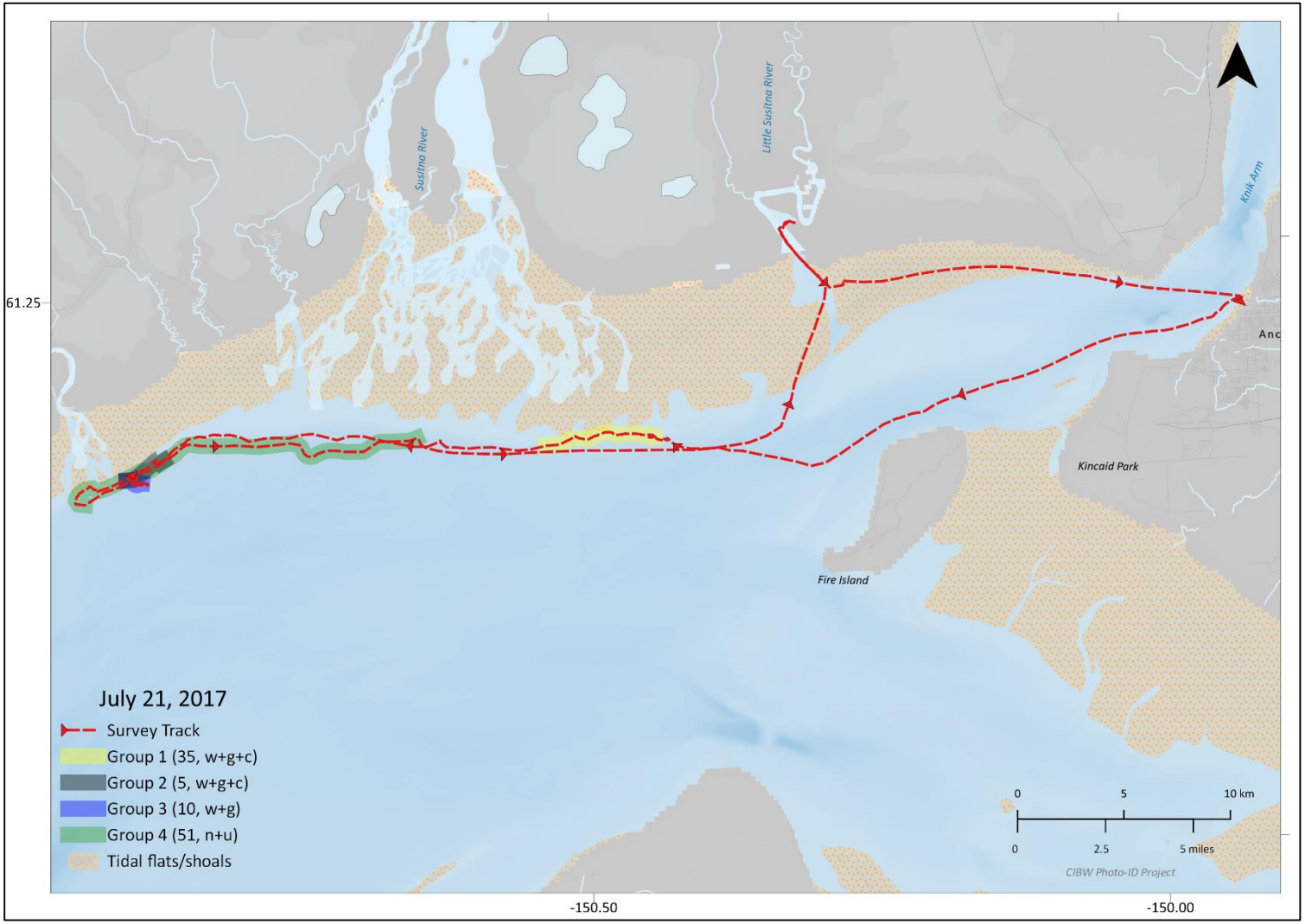


Figure A1. Route and beluga whale groups encountered during the July 21, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

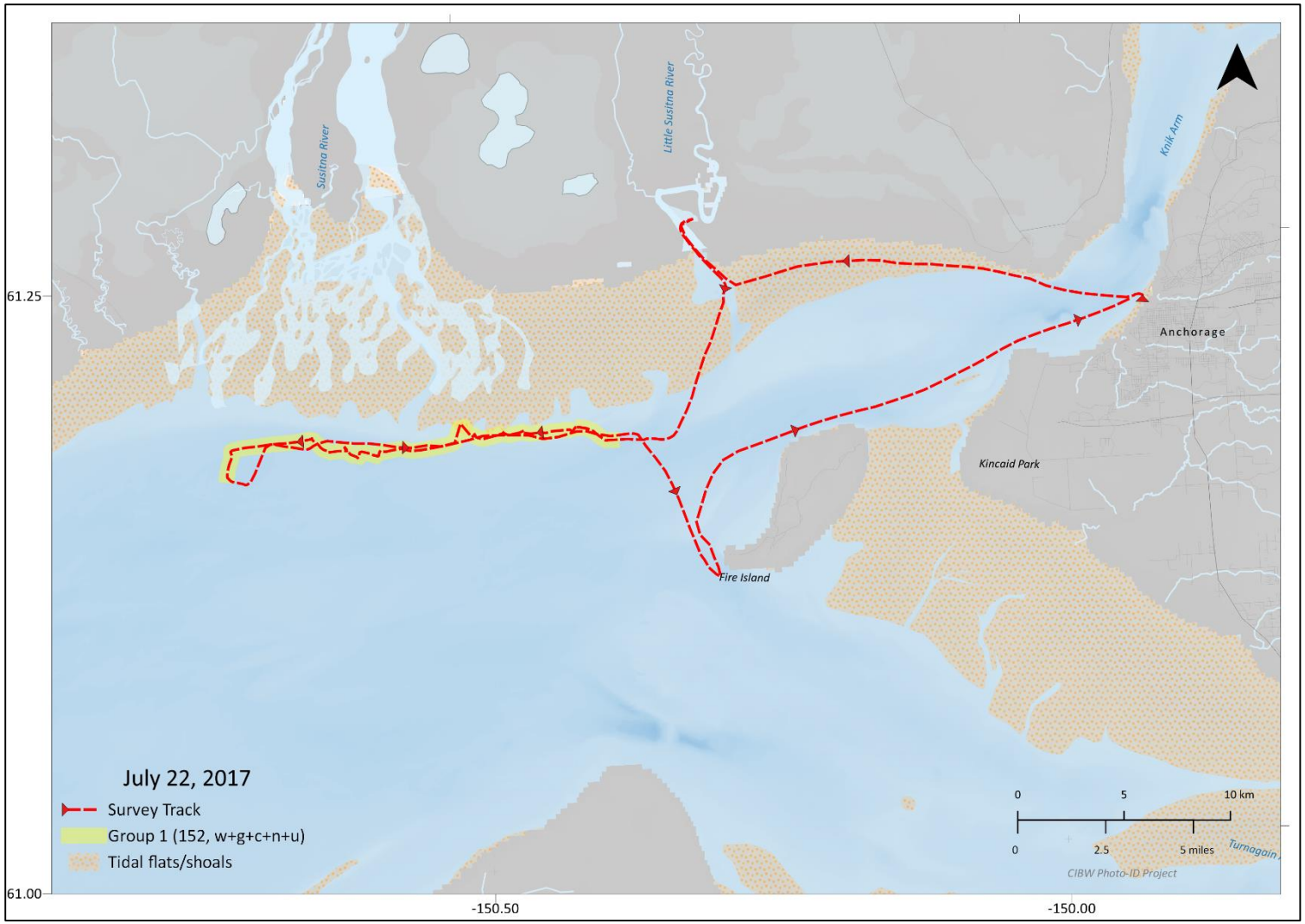


Figure A2. Route and beluga whale group encountered during the July 22, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

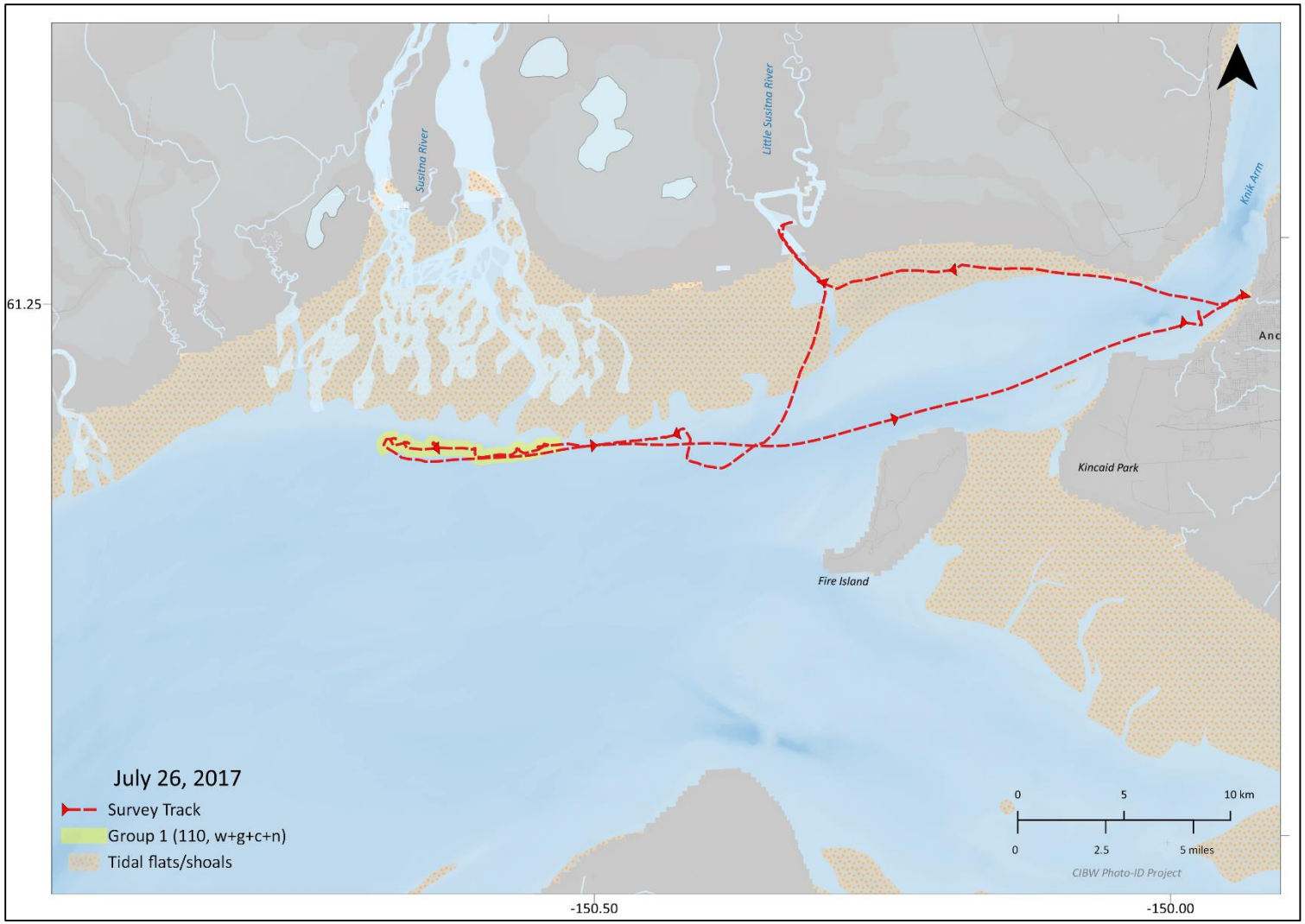


Figure A3. Route and beluga whale group encountered during the July 26, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

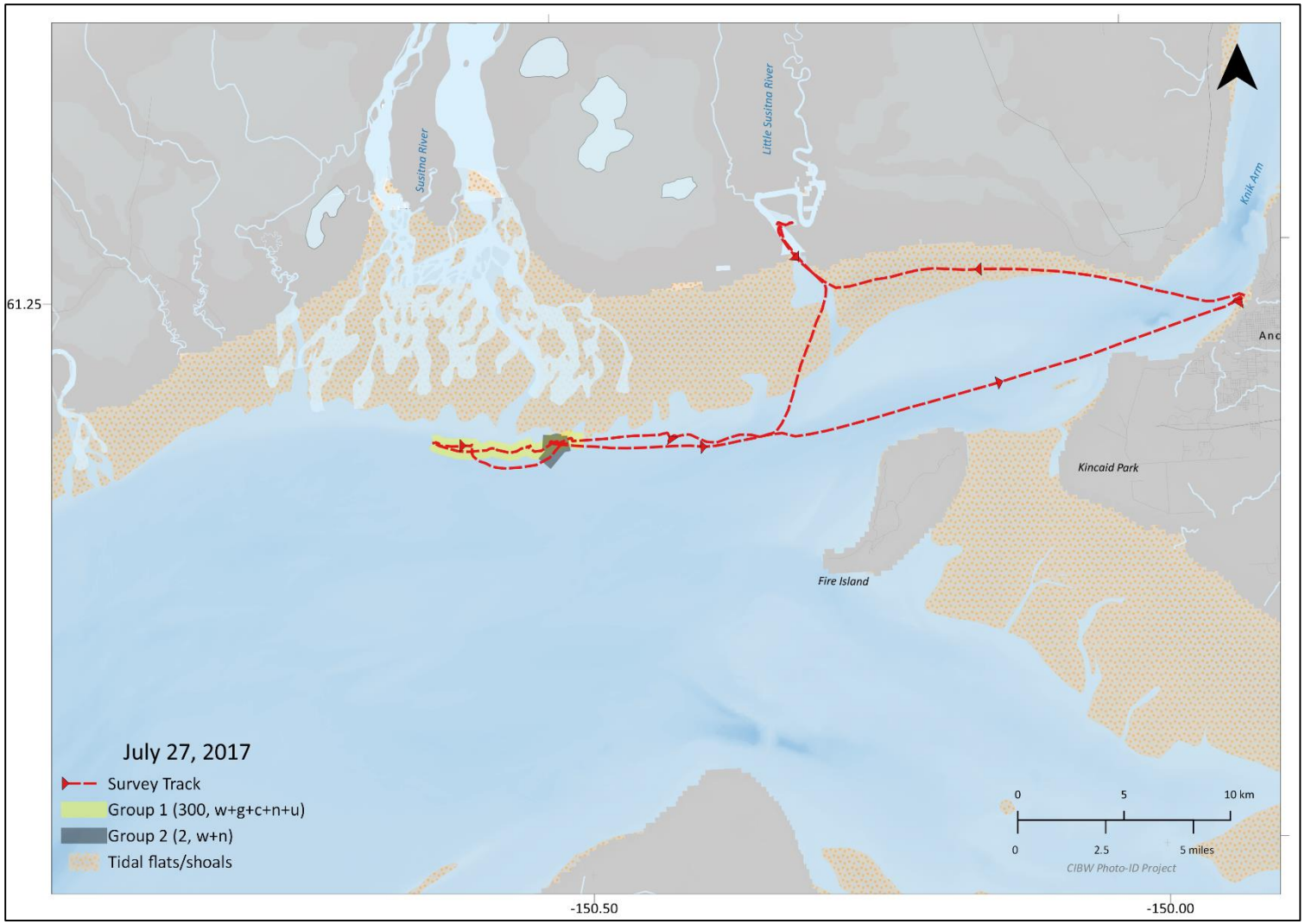


Figure A4. Route and beluga whale groups encountered during the July 27, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

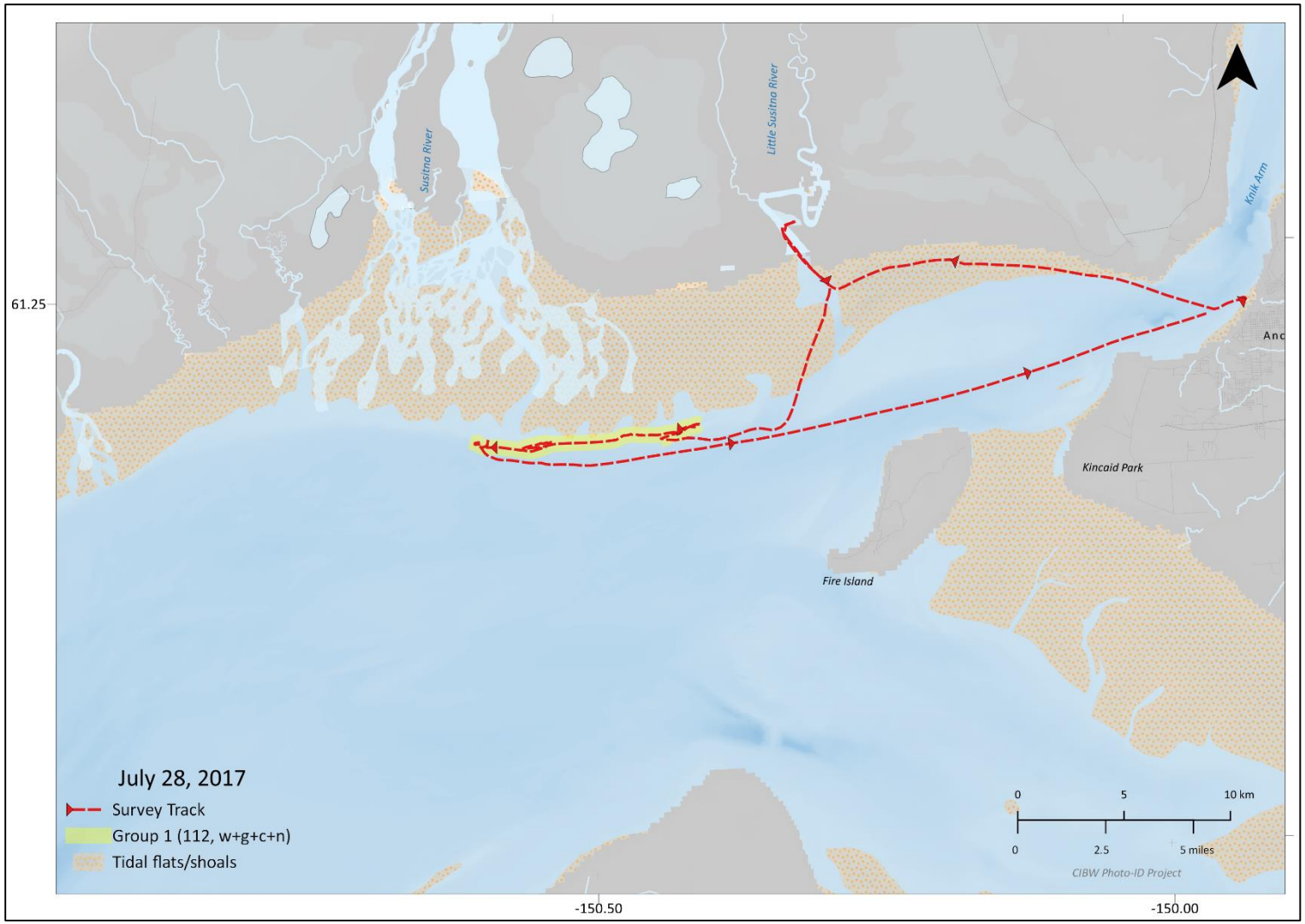


Figure A5. Route and beluga whale group encountered during the July 28, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

Figure A6. Route and beluga whale groups encountered during the August 3, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

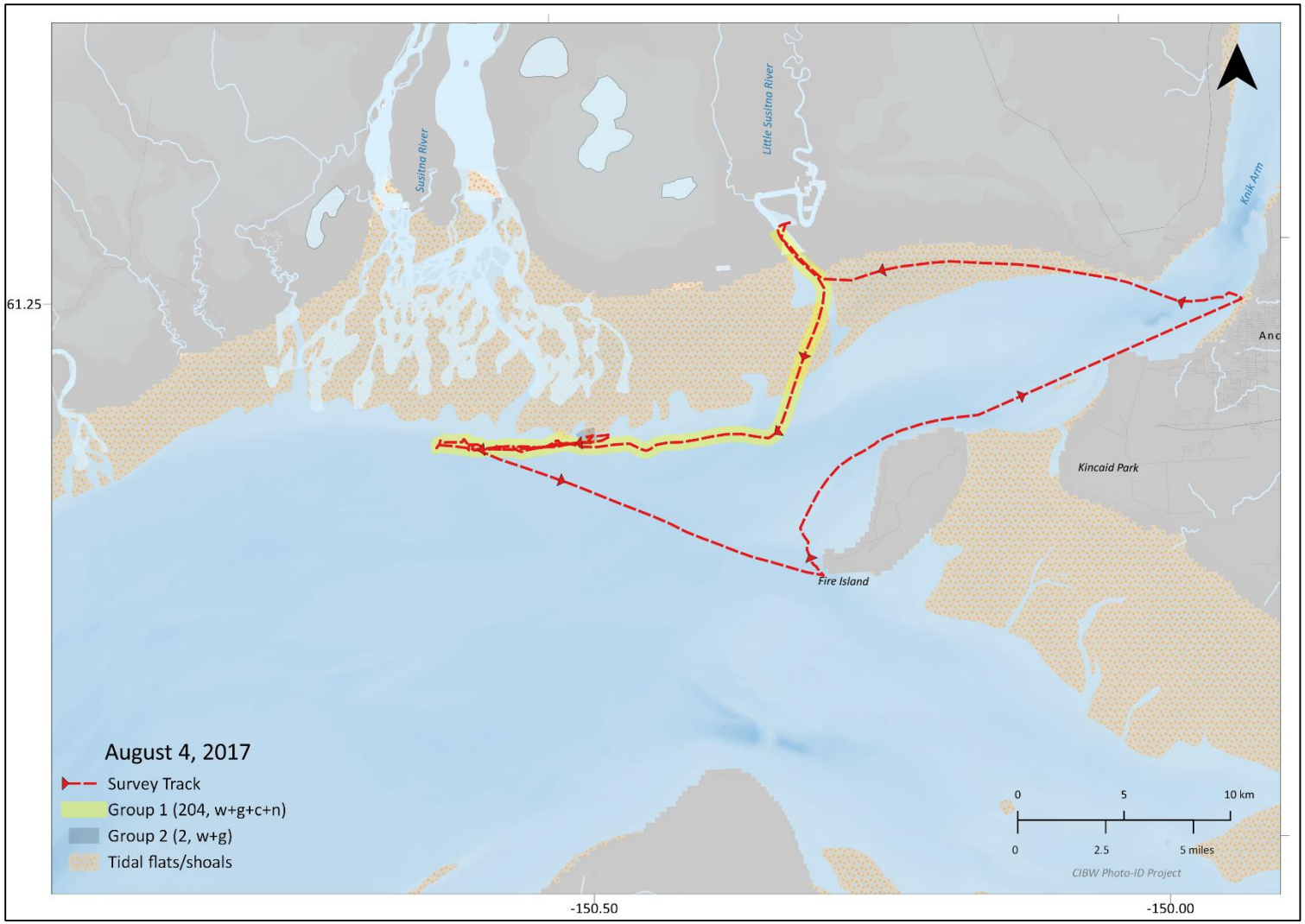


Figure A7. Route and beluga whale groups encountered during the August 4, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

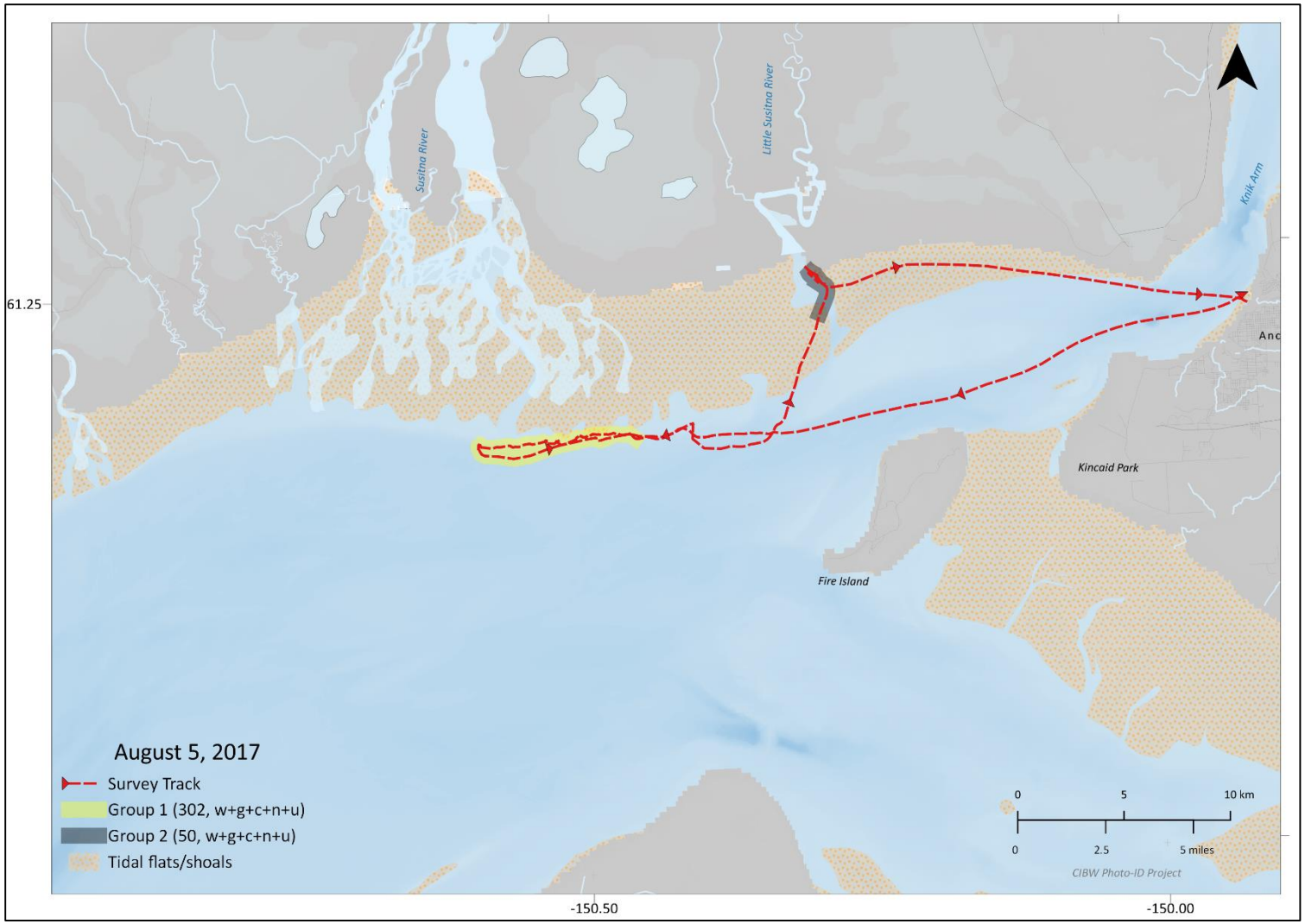


Figure A8. Route and beluga whale groups encountered during the August 5, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

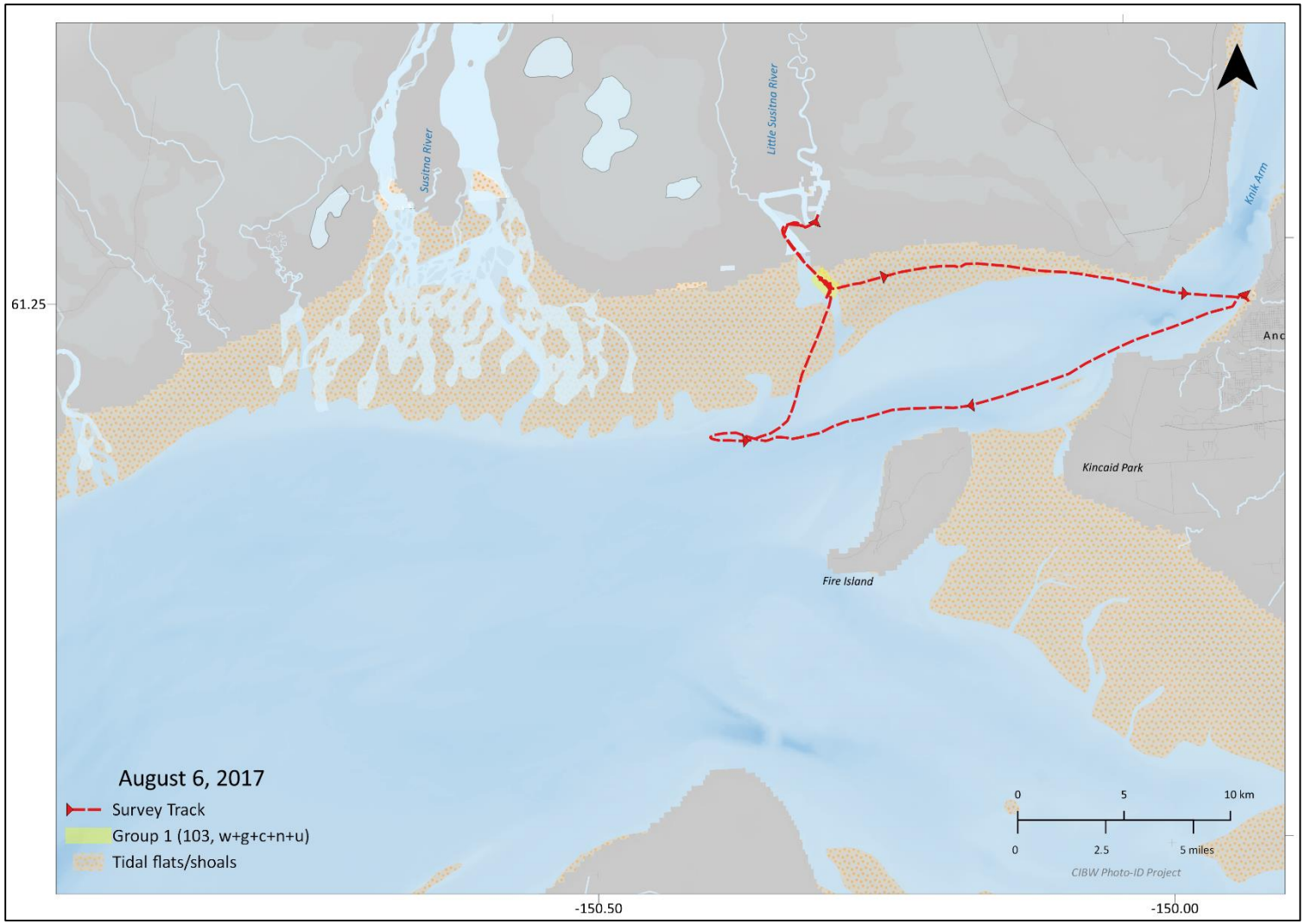


Figure A9. Route and beluga whale group encountered during the August 6, 2017 vessel-based survey in the Susitna River Delta, Upper Cook Inlet, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

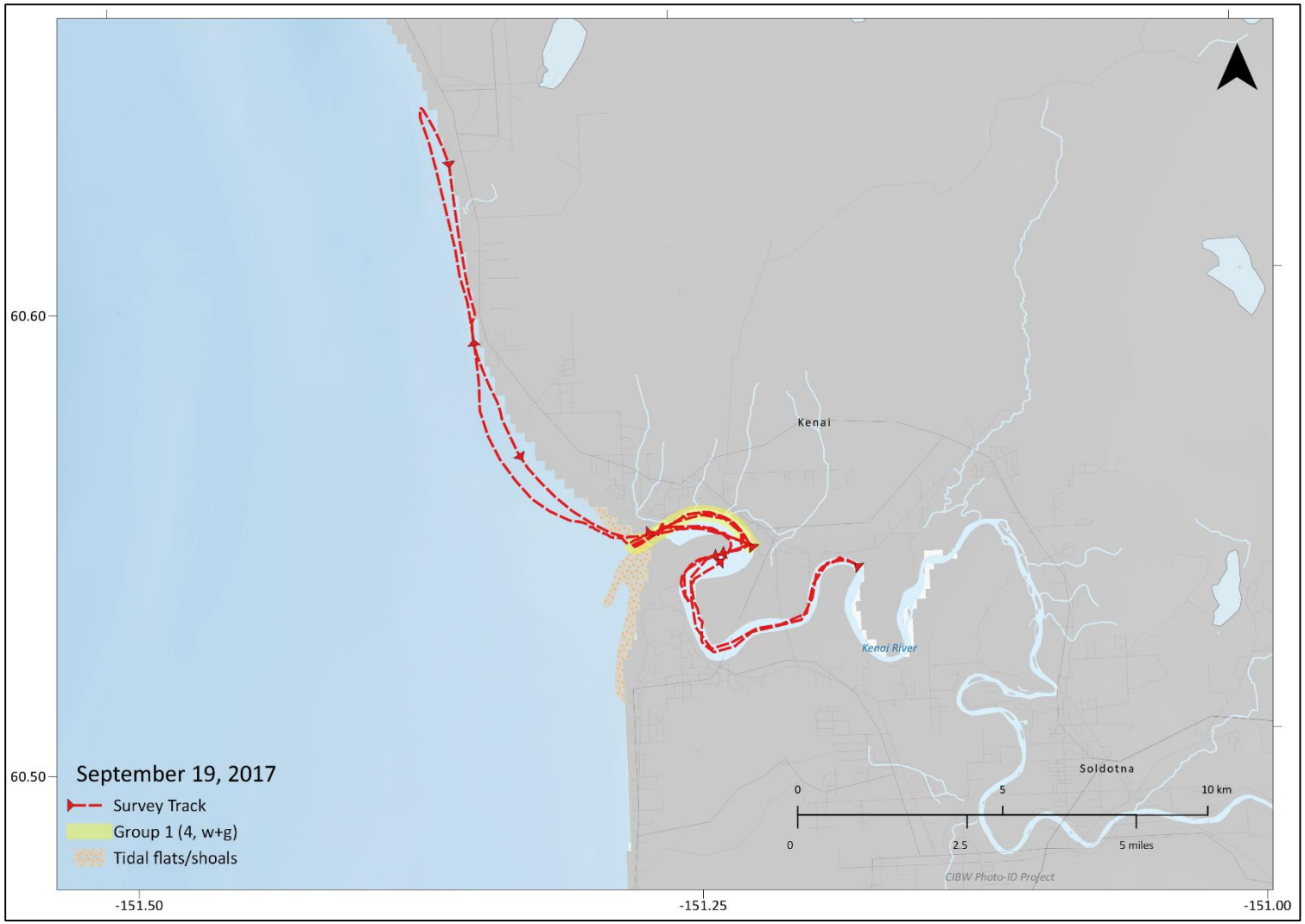


Figure A10. Route and beluga whale group encountered during the September 19, 2017 vessel-based survey in the Kenai River Delta, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

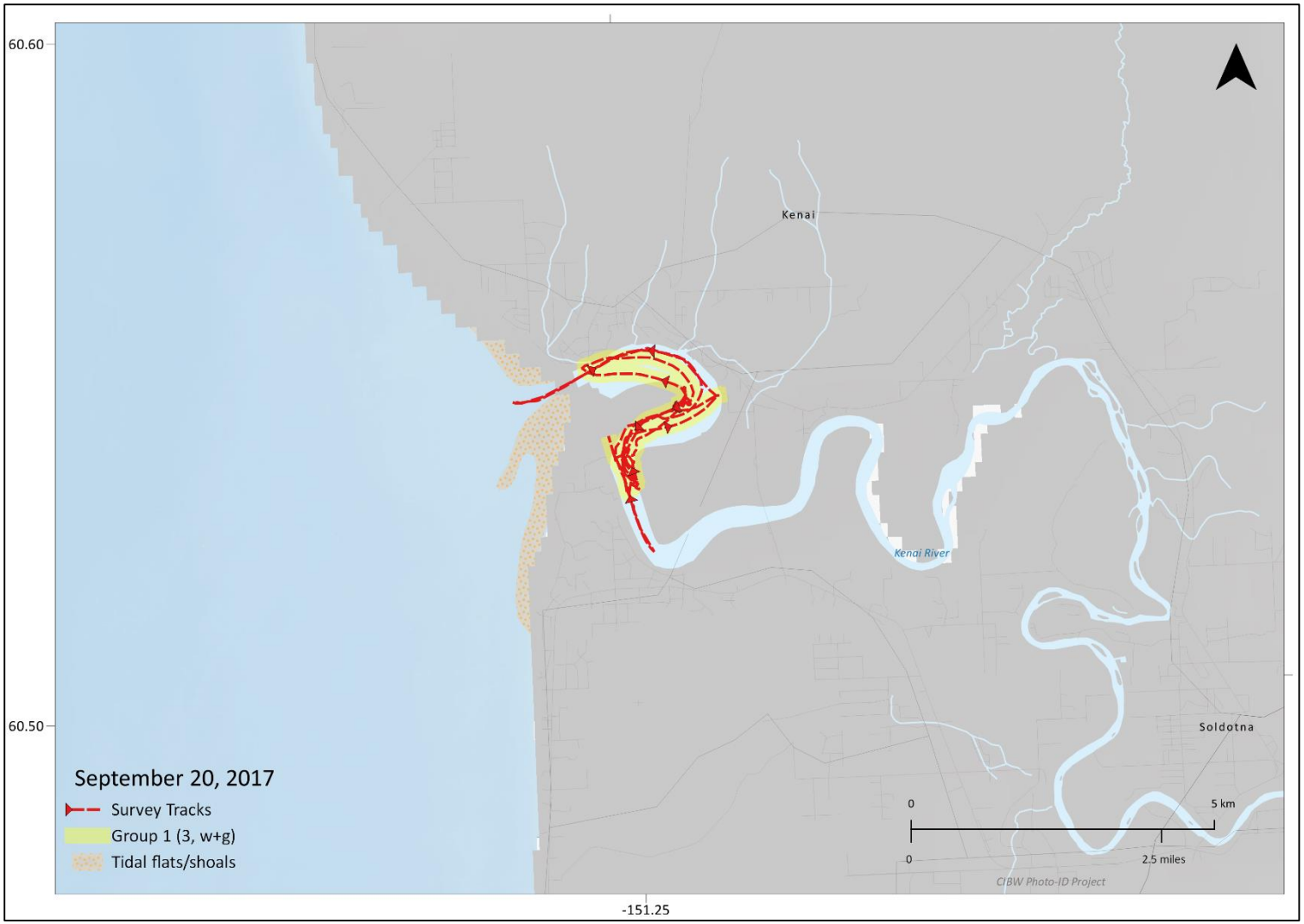


Figure A11. Route and beluga whale group encountered during the September 20, 2017 vessel-based survey in the Kenai River Delta, Alaska. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

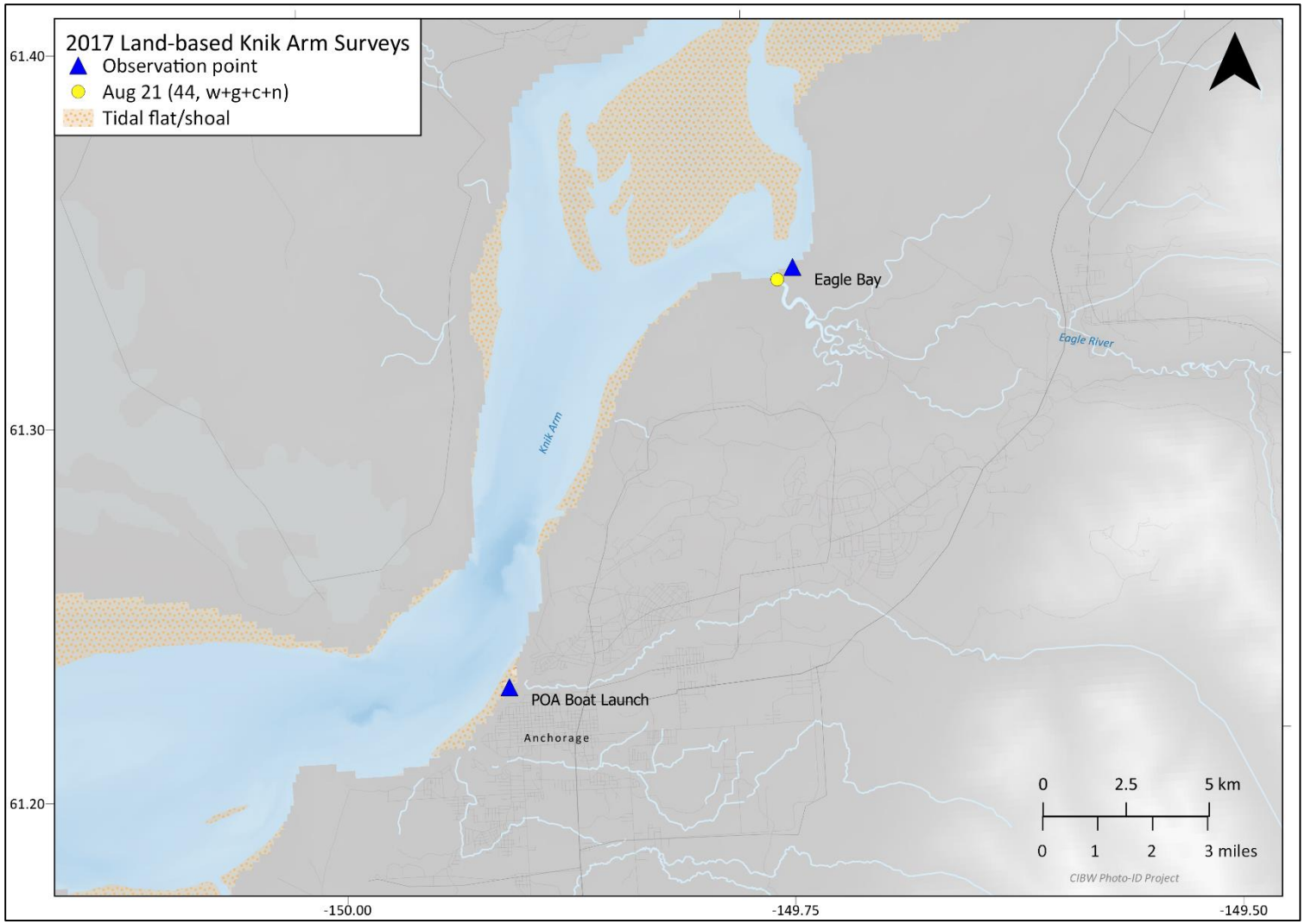


Figure A12. Beluga whale groups encountered during land-based photo-identification surveys of Knik Arm, Upper Cook Inlet, Alaska in 2017. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

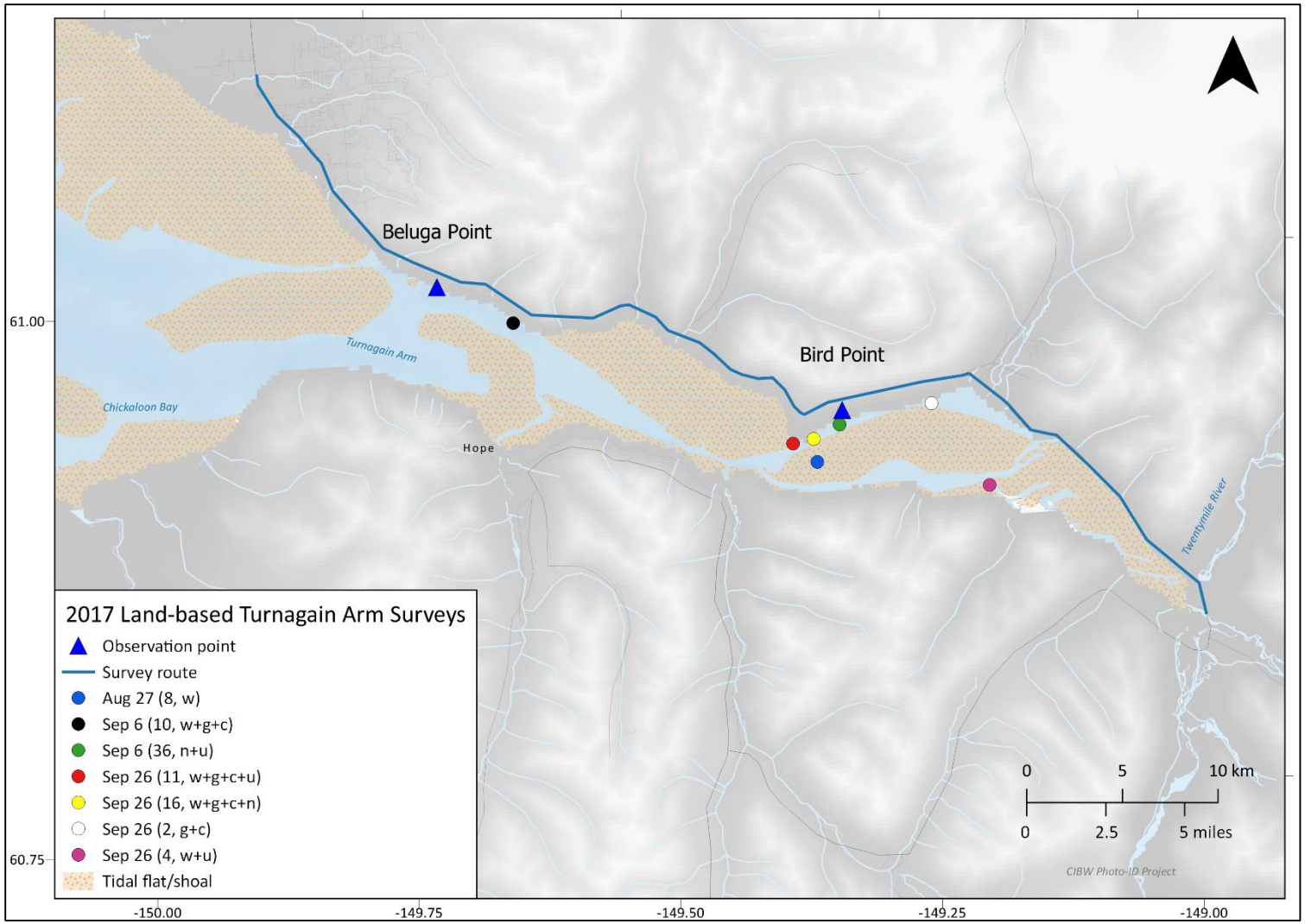


Figure A13. Beluga whale groups encountered during land-based photo-identification surveys of Turnagain Arm, Upper Cook Inlet, Alaska in 2017. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

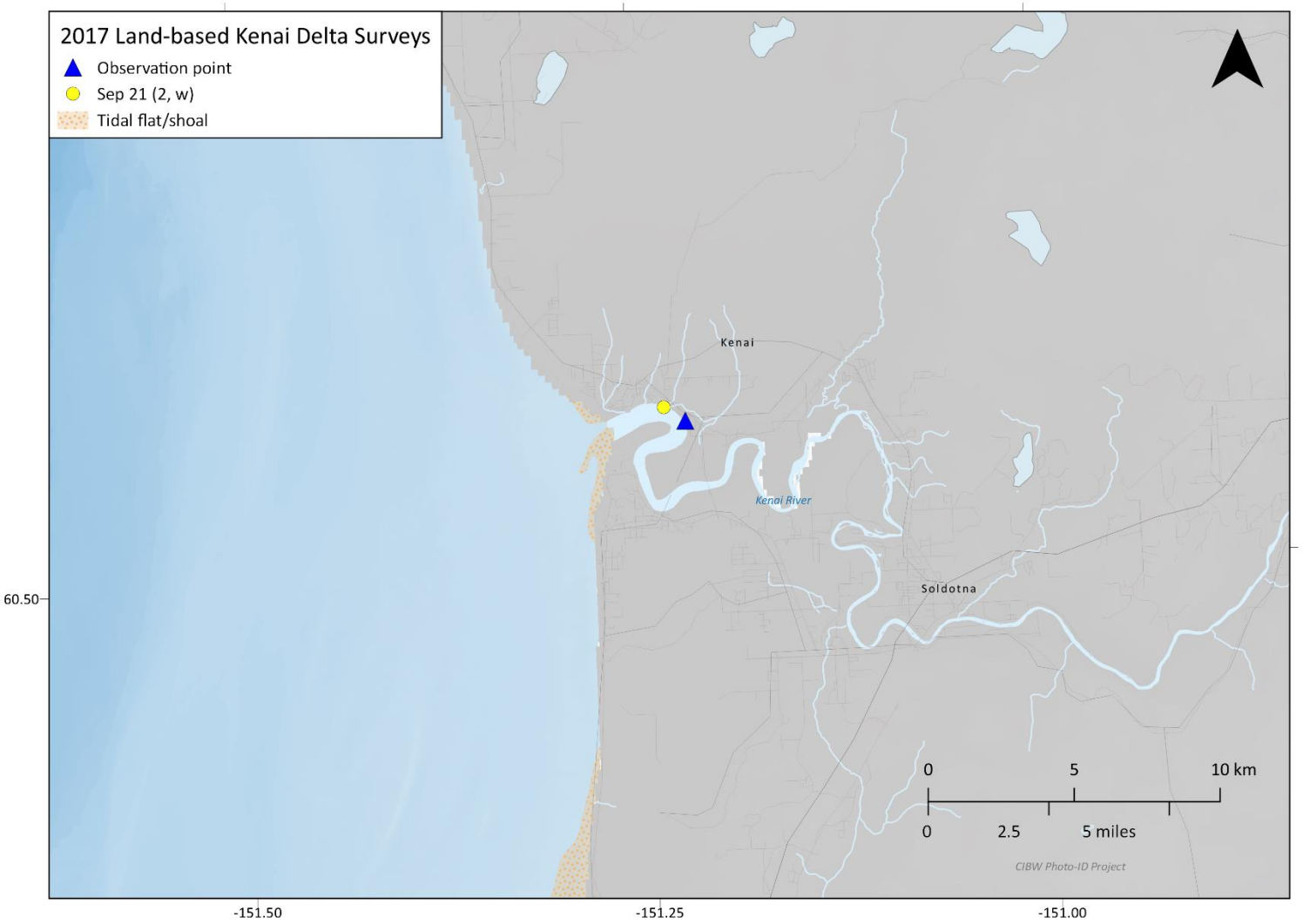


Figure A14. Beluga whale groups encountered during land-based photo-identification surveys of the Kenai River Delta, Alaska in 2017. (letters refer to color/age classes present: w=white, g=gray, c=calf, n=neonate, u=unknown)

Appendix B: Outreach Activities for the Cook Inlet Beluga Whale Photo-ID Project, 2017

Presentations about Cook Inlet Beluga Whales and the Photo-ID Project

- Alaska Marine Science Symposium, Anchorage, AK, January 2017, 2018, posters (Figures B1, B2).
- Beluga Whale Alliance Public Outreach event, Girdwood, AK, February 2017
- CIBW Research and Coordination Meeting, Anchorage, AK, April 2018
- NMFS Workshop on Invasive Research Methods for CIBW, Anchorage, AK, November 2017
- Interview to NOAA Communications Office, Turnagain Arm, September 2017.
- Interview to Film Student with American University for documentary on CIBWs, May and August 2017
- Interview with contractor for NMFS AKR for virtual reality documentary on CIBWs, September 2017.
- Interview with Peninsula Clarion about belugas and photo-id work, September 2017. https://www.peninsulaclarion.com/news/beluga-research-looks-at-failure-to-rebound/

Presentations at Festivals/Events

- Provided information and materials to NOAA Office of Law Enforcement's booth at "Great Alaska Gathering" Aviation Show, Ted Stevens International Airport, and 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. Anchorage, AK, May 2017.
- Belugas Count! 2017: Staffed a beluga counting station for the public at Bird Point, staffed an information booth at the festival at the Alaska Zoo, and gave a public presentation on CIBW Photo-ID Project. Anchorage, Alaska, September 2017.

Factsheets Produced and Distributed

- Informational pamphlet
- Guide for how to photograph free-swimming and stranded CIBWs
- Business card-sized handout with information on how and where to report live and dead CIBWs.

Pamphlets and cards were distributed during fieldwork and at all public outreach events. Distribution during fieldwork included to fisher folk, recreational boat users, and hunters at the Anchorage Small Boat Launch and Kenai City Dock; and to tourists and residents as they beluga-watched along the Seward Highway along Turnagain Arm.

Website

The CIBW Photo-ID project website (www.cookinletbelugas.org or www.cookinletbelugas.com) describes the project, gives background information about CIBWs and the project, and contains a

page for members of the public to report beluga sightings and share photos with the project, as well as a sightings map to view reported sightings. The website address is distributed via the project bumper sticker (below), project pamphlets, and wallet-cards. All sighting reports are shared with NMFS.

Project Results

All CIBW Photo-ID Project reports are publicly available on the project website (www.cookinletbelulgas.org), and many are also available on https://alaskafisheries.noaa.gov/pr/beluga-research-cook-inlet. In addition, the CIBW Photo-ID Project has provided their survey dataset to the "NMFS Cook Inlet Beluga Whale Scientific Sightings Mapper"; these data are a layer in the publicly available and free-of-charge Alaska Ocean Observing System's (AOOS) Cook Inlet Beluga Whale Ecosystem Portal http://portal.aoos.org/cibw.php.

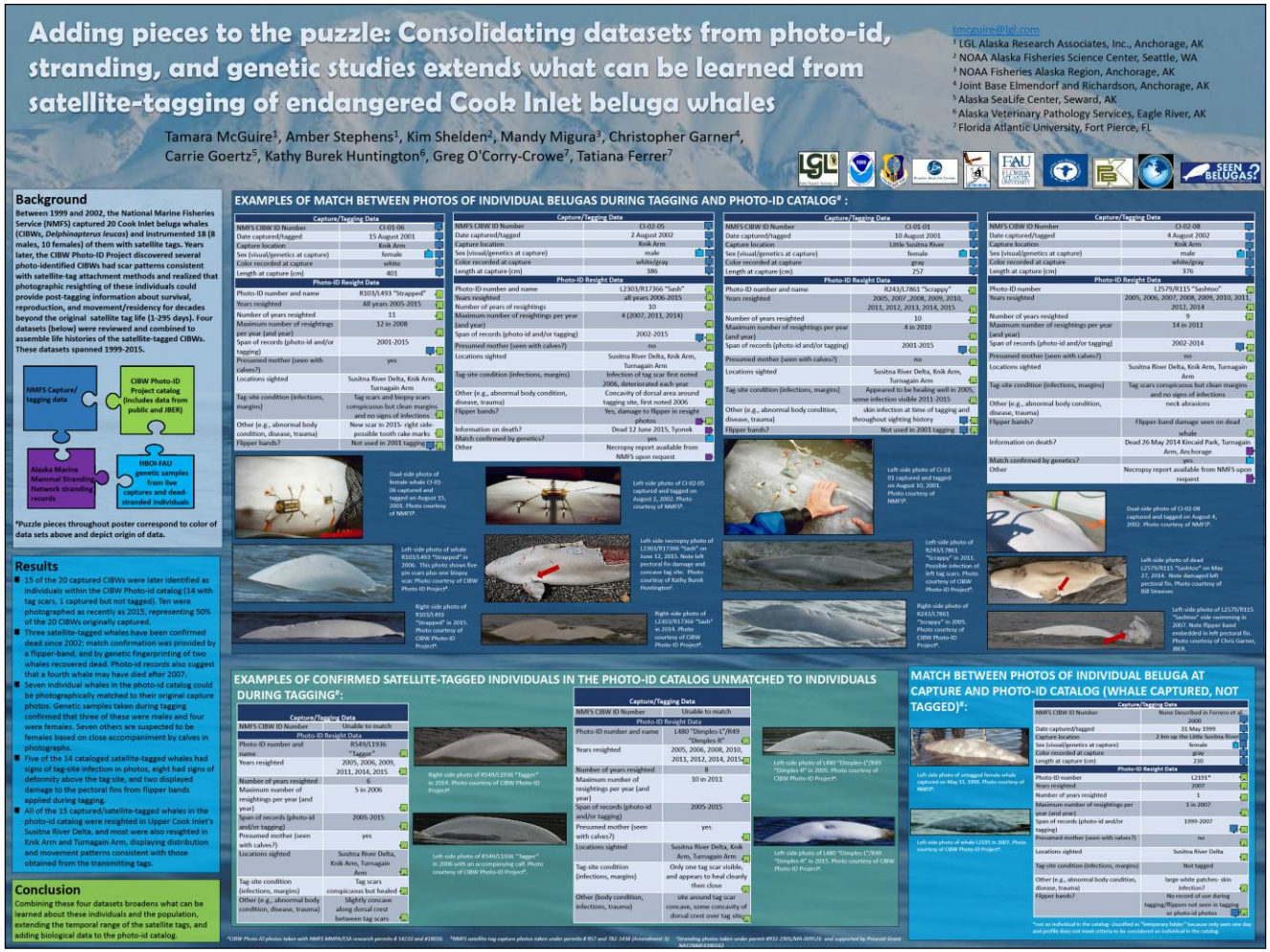


Figure B1. CIBW Photo-Id Project poster presented at the January 2017 Alaska Marine Science Symposium in Anchorage, Alaska.

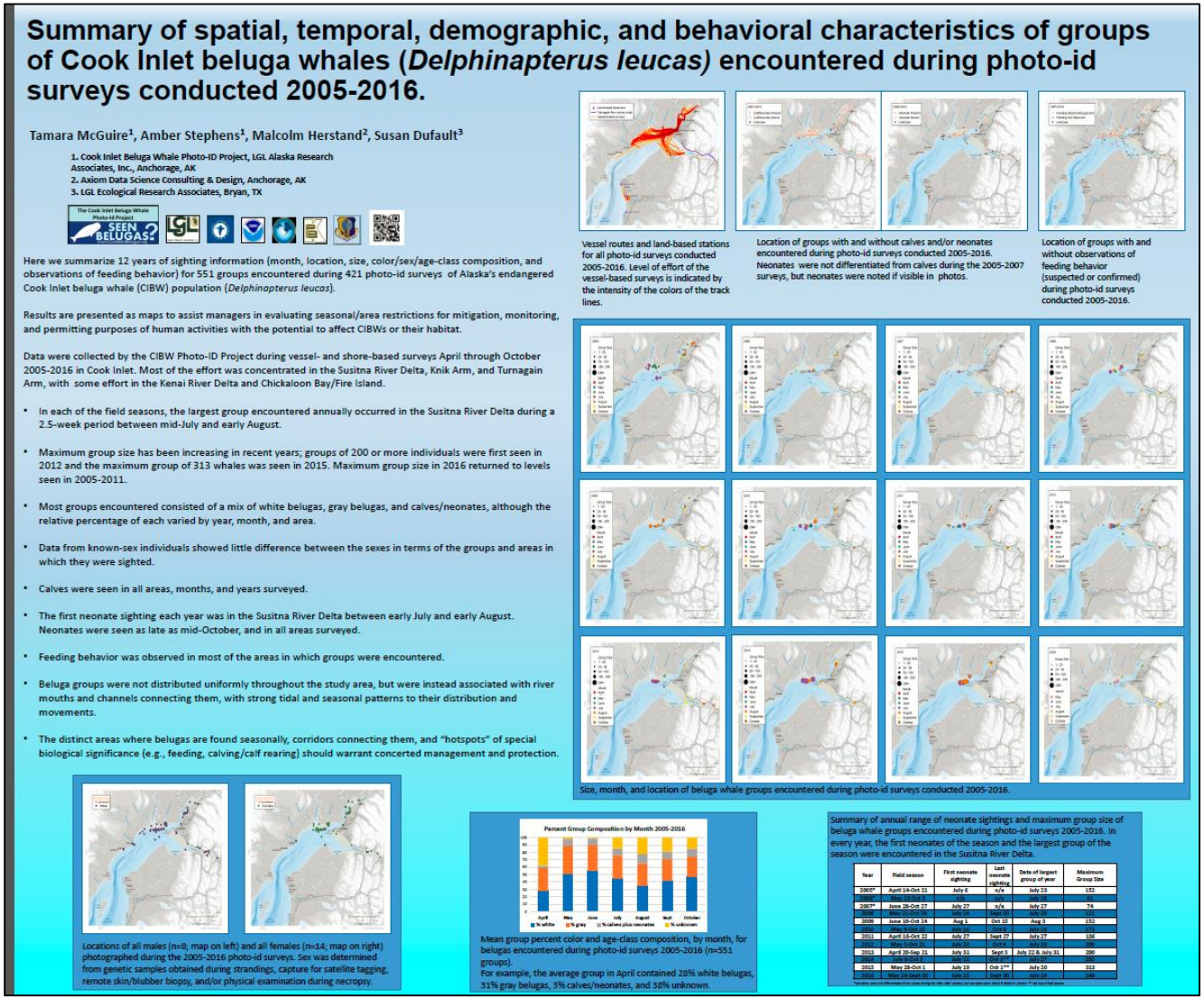


Figure B2. CIBW Photo-Id Project poster presented at the January 2018 Alaska Marine Science Symposium in Anchorage, Alaska.