Summary Report:

Status of previously satellite-tagged Cook Inlet beluga whales

Prepared by:

Alaska Research Associates, Inc.

2000 West International Airport Road, Suite C1
Anchorage, AK 99502

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Prepared by:

Tamara McGuire and Amber Stephens

LGL Alaska Research Associates, Inc.
2000 West International Airport Road, Suite C1, AK 99502
(907) 562-3339
tmcguire@lgl.com

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Principal Investigator: Dr. Tamara McGuire
Co-Investigator: Amber Stephens

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EXECUTIVE SUMMARY

We conducted a comprehensive review and synthesis of information about satellite-tagged Cook Inlet beluga whales (CIBWs) contained in databases maintained by the *CIBW Photo-id Project* and by NMFS (the Alaska Region; AKR) and the Marine Mammal Laboratory (MML), with the following objectives: 1) review photographic data of CIBWs contained within the photo-id catalog maintained by the CIBW Photo-id Project for information about both confirmed and suspected tagged individuals; 2) review data collected by NMFS during the capture and tagging of CIBWs from 1999-2002; 3) review photographs (from the CIBW Photo-id Project, NMFS, and other sources) of stranded CIBWs to determine if any have scars or markings consistent with satellite tags; 4) compare the three datasets (i.e., photo-id, tagging/capture, stranding) to determine if any of the photographically identified whales (confirmed or suspected as previously tagged individuals) can be associated with a specific capture year or known tagged whale; 5) summarize all the photographic data available about the confirmed and suspected tagged CIBWs; and 6) provide recommendations for data collection in any future capture/tagging efforts that will improve long-term monitoring and tracking success. Photo-analysts with the *CIBW Photo-id Project* reviewed all photographs (ca. 100,500) currently in the 2005-2015 *CIBW Photo-id Project* catalog for images of individuals bearing satellite-tag scars. Analysist also reviewed all photographs and associated data provided by NMFS that were taken of CIBWs during the 1999-2002 capture and tagging events.

Of the 20 CIBWs captured and 18 tagged by NMFS, we matched the photos from tagging to six individual whales in the catalog. We were also able to match one of the captured whales that was not tagged. We classified 14 individuals in the CIBW Photo-id catalog as confirmed satellite-tagged whales. A 15th individual in the catalog was identified as a whale that had been captured but not tagged. Ten of the 15 confirmed captured/tagged whales in the photo-id catalog were resighted as recently as 2015; 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 2015. Photo-id records suggest a fourth whale, tagged in 2002, may have died after its last sighting in 2007. Of the 14 whales identified in the photo-id catalog as satellite tagged whales, four are confirmed females (confirmed via DNA collected during capture) and seven are suspected to be females based on accompaniment by calves. Reproductive histories of these confirmed and suspected females are presented. Five of the 14 confirmed satellite-tagged whales in the photo-id catalog had visible signs of tag-site infection, and eight had signs of concavity of the dorsal crest above the tag site. Two whales showed signs of damage to the left pectoral fins likely caused by flipper bands applied during tagging. All of the 15 confirmed captured/tagged whales in the photo-id catalog were resighted in Upper Cook Inlet's Susitna River Delta, and most were also resighted in Knik Arm and Turnagain Arm.

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INTRODUCTION

Alaska's Cook Inlet beluga whales (CIBWs) are classified as critically endangered by the World Conservation Union, and are listed by the National Marine Fisheries Service (NMFS) as endangered under the Endangered Species Act (NMFS 2008). More information on life history characteristics associated with population growth (i.e., survival, reproduction) and sources of stress and mortality (natural and human-induced) is needed to promote the recovery of the CIBW population (NMFS 2015).

The *Cook Inlet Beluga Whale Photo-identification Project (CIBW Photo-id Project)* has demonstrated that individual CIBWs possess distinct natural marks that persist across years, and that these marks can be effectively identified and re-sighted with digital photography. The photo-id catalog and associated surveys from eleven field seasons (2005-2015) provide information about the distribution, movement patterns, and life-history characteristics of individually identified CIBWs (McGuire et al. 2014 a,b; McGuire and Stephens 2016 a,b).

In 2007, biologists with the *CIBW Photo-id Project* noticed that several identified CIBW had evenly spaced, well-defined holes along their dorsal crests and wondered if these might have been made by satellite tags. We shared photos with biologists with the National Marine Fisheries Service (NMFS), who indicated that these scars were consistent with satellite tags deployed by NMFS. Between 1999 and 2002, NMFS applied satellite tags to 18 CIBWs to study distribution, movements, and habitat use of CIBWs (Ferrero et al. 2000, Litzky et al. 2001, Hobbs et al. 2005, Goetz et al. 2012, and Shelden et al. 2015a, and in prep).

Biologists at LGL and NMFS soon realized that photo-id sighting histories of whales bearing scars from previous satellite tags could provide information about survival, reproduction, and movement/residency of these individuals beyond the tag life, and would allow for the comparison of these parameters between tagged and untagged CIBWs (McGuire et al. 2008). While the number of days individual satellite tags transmitted varied between 1 and 295 days (Shelden et al., in prep), the addition of photographic sighting records from years later extends what can be learned about these individuals and the population. For example, a photograph taken in 2015 of a whale tagged in 1999 provides information about survival 16 years post-tagging.

In 2013, NMFS provided funding to allow for a comprehensive review and synthesis of information about satellite-tagged CIBWs contained in databases maintained by the *CIBW Photo-id Project* and by NMFS (the Alaska Region; AKR) and the Marine Mammal Laboratory (MML), with the following objectives:

1) review photographic data of CIBWs contained within the photo-id catalog maintained by the CIBW Photo-id Project for information about both confirmed and suspected tagged individuals;

2) review data collected by NMFS during the capture and tagging of CIBWs from 1999-2002;

3) review photographs (from the CIBW Photo-id Project, NMFS, and other sources) of stranded CIBWs to determine if any have scars or markings consistent with satellite tags;

4) compare the three datasets (i.e., photo-id, tagging/capture, stranding) to determine if any of the photographically identified whales (confirmed or suspected as previously tagged individuals) can be associated with a specific capture year or known tagged whale;

5) summarize all the photographic data available about the confirmed and suspected tagged CIBWs; and

6) provide recommendations for data collection in any future capture/tagging efforts that will improve long-term monitoring and tracking success.

METHODS

Methods for objective 1: review photographic data of CIBWs contained within the photo-id catalog maintained by the CIBW Photo-id Project for information about both confirmed and suspected tagged individuals

An individual was classified as a "confirmed tagged" individual if the following were visible: 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. 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 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. Natural markings used for photo-id of individual CIBWs consist of tooth rake marks from conspecifics, pigmentation patterns, and scars from injury or disease.

Two experienced photo-analysts reviewed all photographs (ca. 100,500) currently in the *CIBW Photo-id Project* catalog for images of individuals bearing satellite-tag scars. The catalog is divided into a right-side image catalog and a left-side image catalog, and both catalogs were reviewed for photographs of any previously satellite-tagged whales. The right-side catalog encompasses the years 2005 through 2015 and currently contains records for 345 individual whales. The left-side catalog currently contains photos taken 2005-2011 (McGuire et al. 2014b) and records for 298 individual whales. Although the left-side catalog is only complete through 2011, we conducted a preliminary scan of all left-side photographs taken in 2012-2015 for signs of satellite-tag scars, and any photographs of satellite-tagged whales encountered in the scan have been included in the present analysis. If images were available to link a right-side photograph to a left-side photograph, the whale was classified as a dual-side whale.

Methods for objective 2: review data collected by NMFS during the capture and tagging of CIBWs from 1999-2002

We reviewed all photographs and associated data provided by NMFS that were taken of CIBWs during the 1999-2002 capture and tagging events. There were 20 CIBWs captured and 18 instrumented with satellite tags (Ferrero et al. 2000, Litzky et al. 2001, Hobbs et al. 2005, Goetz et al. 2012, and Shelden et al. 2015); see Shelden et al. in prep for details of the capture and tagging methods. Photographs and scans of slides taken at the time of capture and tagging were provided by NMFS' MML and by the NMFS AKR. We obtained additional photographs by searching the published and gray literature, conference presentations, press releases, and the internet for images of CIBWs taken during the tagging efforts, and have included them in our analysis.

Methods for objective 3: review photographs (from the CIBW Photo-id Project, NMFS, and other sources) of stranded CIBWs to determine if any have scars or markings consistent with satellite tags

When informed of dead belugas by the Alaska Marine Mammal Stranding Network and authorized by NMFS, *CIBW Photo-id Project* biologists photographed dead belugas, or relied on other stranding responders to obtain and share photographs of dead belugas. The *CIBW Photo-id Project* developed a protocol for photographing dead belugas for identification marks that was distributed to members of the Alaska Marine Mammal Stranding Network and is posted on the NMFS AKR website https://alaskafisheries.noaa.gov/pr/beluga-research-cook-inlet.

We examined all photographs of stranded (live and dead) CIBWs for signs of tagging scars and matches to the CIBW Photo-id catalog, and classified all stranded individuals as either not satellite tagged, confirmed satellite tagged, or suspected satellite tagged.

Methods for objective 4: compare the three datasets (i.e., photo-id, tagging/capture, stranding) to determine if any of the photographically identified whales (confirmed or suspected as previously tagged individuals) can be associated with a specific capture year or known tagged whale

We first compiled information on tag placement, animal length, color, and sex from field data forms ("level As") provided by NMFS for CIBWs captured and tagged in 2001 and 2002, and from NMFS reports and publications about tagging 1999-2002 (Ferrero et al. 2000, Litzky et al. 2001, Hobbs et al. 2005, Goetz et al. 2012, and Shelden et al. 2015a). We also collaborated with MML in their review of CIBW tag data from their field notebooks, unpublished reports, and publications used to develop the table in Shelden et al. in press and replicated in part in Table 1 of this report. This table includes information on the NMFS-assigned whale identification number, the type of tag(s) applied, capture date and location, number of days of tag transmission, and the length, color, and sex of the tagged whale. The sex of all satellite-tagged whales was determined visually in the field during capture, and later confirmed or revised based on genetic determination made from biopsy samples taken at the time of capture and tagging.

In cases where tagging photographs lacked identifying date stamps and/or whale identification numbers, or when photographs had been mislabeled, we used the information contained in Table 1, as well as visual information contained in the photographs (e.g., whale size, whale color, tag type, field crew composition, landscape markers), to assign all tagging photographs a tagging date and NMFS whale identification number.

To match tagging photos of individual whales with corresponding photo-id resighting photos, we created a matrix consisting of columns representing the 20 captured whales and of rows representing all potential or confirmed satellite-tagged whales identified in the catalog. Two experienced CIBW photo-analysts independently worked

their way through all of the possible pair-wise comparisons of photographs in the matrix. The analysts then compared results and then re-examined photographs together to resolve any disagreements.

Various sets of archived file photos of the 1999-2002 tagging events were made available at different times over the course of the project (some as recently as April 2015) Our review of all available tagging photos revealed that a broad range of tag types had been used and that tag placement locations on the body varied. Thus, we revised and expanded our criteria for classification of possible satellite-tag scars and conducted an additional review of the matching matrix.

Methods for objective 5: summarize all the photographic data available about the confirmed and suspected tagged CIBWs

For each confirmed and suspected tagged whale, we summarized the following information obtained from photo-id records:

- whale photo-id number
- list of years resighted
- maximum number of resightings per year (and which year)
- span of records
- reproductive history (of confirmed/presumed females)
- locations sighted
- tag-site condition
- other (e.g., abnormal body condition, disease, trauma)
- scars from flipper bands
- mortality

The *whale photo-id number* of an individual whale is automatically assigned as its records are entered in the catalog. Right sides and left sides are differentiated with an R or L before the number. The corresponding nickname is to help photo-analysts more-easily remember individuals.

The *years resighted* is a list of all of the years in which an individual was photographed.

The *maximum number of resightings per* year refers to the maximum number of days an individual was photographed within an annual field season.

The *span of records* are the years in which an individual was first and last photographed. For individuals with matches between their tagging photos and resight photos, this starts with the date of their tagging photo and ends with the last date when they were photographed.

Reproductive histories (i.e., dates and locations of sightings with calves) were compiled for confirmed and suspected satellite-tagged whales known or presumed to be reproductive females. Reproductive histories included information on when the mother was photographed with and without a calf, as well as information on the relative size of

the calf. Identified belugas were classified as presumed mothers in photographs if they appeared in a photo-frame with a calf or neonate alongside them. Belugas were classified as calves in photographs if they were dark gray (although light-gray calves were also observed), relatively small (i.e., <2/3 the total length of adult belugas), and photographed alongside a larger beluga. Neonates were distinguished in photographs by visible fetal folds and often a "peanut-shaped" head.

Locations sighted is a summary of the dates and locations where each individual whale was photographed. The CIBW Photo-id catalog contains photographs from dedicated photo-id surveys and opportunistic sampling from small vessels and from shore during the ice-free season. Identification photos came from 404 photo-id surveys conducted between 2005-2015. Surveys were conducted in Upper Cook Inlet (Figure 1), with emphasis on Knik Arm, the Susitna River Delta, Chickaloon Bay, and Turnagain Arm (Figure 2). The geographic scope of the *CIBW Photo-ID Project* was expanded to include the Kenai River Delta 2011-2013 (McGuire et al. 2014 a). Survey schedules varied according to those combinations of season, location, and tide that provided the greatest likelihood of detecting whales. All vessel surveys were conducted under NMFS MMPA/ESA research permits # 14210 and #18016.

Tag-site condition describes what can be seen in photographs of the tag site, such as infection of the tag scar, changes in shape and margins of the tag scars over time, and condition of the area around the tag-attachment site. The presence of infection was inferred from discolored and/or swollen "crusty" looking tissue in or around the tag scars. Photographic records of several confirmed and suspected satellite-tagged CIBWs have been shared with NMFS (AKR, MML, Marine Mammal Health and Stranding Response Program, Permits and Conservation Division of the Office of Protected Resources) and the Alaska Marine Mammal Stranding Network in order to share information and solicit feedback on observations of tag site condition.

The *other* category describes visible signs of abnormal body condition (concavity around head and neck, prominent dorsal ridge), skin disease (other than at the tag site), tooth rake marks, and signs of trauma. It also notes if there is concavity of the dorsal crest over the tag-attachment site.

Scars from *flipper bands* indicates if damage to the pectoral flippers is visible in photographs. Flipper bands were applied to tagged whales in 1999 and in 2002.

If a *mortality* was reported, we reviewed necropsy photos and reports from those individuals classified as confirmed or suspected satellite-tagged whales and incorporated the information on date and location of death (or carcass detection), sex, relative age, body condition, and length at death into the individual sightings records in the catalog. We verified with NMFS and Dr. Greg O'Corry-Crowe of Harbor Branch Oceanographic Institute, Florida Atlantic University (who conducted the genetic analysis of tagged and necropsied CIBWs) that the genetic identification of dead satellite-tagged individuals matched the genetic information from the individuals' tagging samples.

RESULTS

Matching tagged individuals to individuals in the CIBW Photo-id catalog

Of the 20 CIBWs captured and 18 tagged by NMFS, we matched the photos from tagging to six individual whales in the catalog (Table 1). We were also able to match one of the captured whales that was not tagged. Nine other tagged individuals had possible, but ambiguous, matches to whales in the catalog (their tagging photos did not show enough of the areas of the body necessary for photo-id). Four captured whales could not be matched even tentatively to the photo-id catalog: one of these was confirmed by NMFS to have died within a week of tagging; two of these (one tagged and one captured but not tagged) did not appear to have had photographs taken at the time of capture; and one individual had blurry tagging photos that did not allow for identification.

Identification of satellite-tagged whales in the CIBW Photo-id catalog

We classified 14 individuals in the CIBW Photo-id catalog as confirmed satellite-tagged whales. A 15th individual in the catalog was identified as a whale that had been captured but not tagged. Appendices I, II, and III summarize capture/tagging and photographic resighting information for these 15 individuals. An additional eight individual CIBWs in the photo-id catalog were classified as suspected satellite-tagged whales (Appendix IV). They displayed scars similar to those made from satellite tags, but because these scars were ambiguous and other sources of scars could not be ruled out, they were classified as "suspected" rather than "confirmed". Notes were made in the catalog records of these individuals, and any future photographs of these individuals will be examined for evidence of satellite-tag scars.

Survival and mortality of satellite-tagged whales from tagging records and the CIBW Photo-id catalog

Ten of the 15 confirmed captured/tagged whales in the photo-id catalog were resighted as recently as 2015 (Table 2). This represents 50% of the 20 CIBWs originally captured and/or tagged between 1999 and 2002. One of these whales, R103/L493 Strapped, a female, was seen in every year of the 2005-2015 photo-id study. Most of the other tagged whales in the catalog had one to three year-gaps between photo-id resightings. One whale that was tagged in 2002, L2204/R17367, a male, was seen yearly (and multiple times within years) between 2005 and 2007, then was never seen again. Photographic records suggest the tag area was infected and document that the tag scars deteriorated and become concave over time. The condition of the tag area and the lack of resights post 2007, suggests this individual may have died after the last sighting in 2007. Two individuals had sighting records that were too poor (i.e., only one sighting per year in each of the years in which they were sighted) to be able to conclude anything about their survival from their photo-id records (Table 2).

Three satellite-tagged whales were confirmed dead between 2001 and 2015 (Table 3). One of these, NMFS # CI-0204, was found dead within days of tagging in

2002 (Shelden et al. in press). The other two whales, both males tagged in 2002, died in 2014 and 2015, respectively. Copies of the necropsy reports may be requested from the NMFS AKR Stranding Coordinator. As mentioned in the previous paragraph, photo-id records indicate a fourth satellite-tagged whale, L2204/R17367 a male tagged in 2002, may have died at an unknown time after its last sighting in 2007. We compared the lengths of the two confirmed dead satellite-tagged whales necropsied in 2014 and 2015 with their lengths at the time of tagging, and found an increase of 34 cm and 42 cm respectively. Dividing the total increase in length of each whale by the number of years in between tagging and death resulted in growth rates of 2.8 and 3.2 cm/yr (assuming there were no differences in measurement methods used to measure length during tagging and necropsies).

Reproductive histories of satellite-tagged whales from the CIBW Photo-id catalog

Twelve of the 20 captured/tagged whales were genetically determined to be female (Table 1). Of the 14 whales identified in the photo-id catalog as satellite tagged whales, four are confirmed females (confirmed via DNA collected during capture) and seven are suspected to be females based on accompaniment by calves (Table 4). Reproductive histories of these confirmed and suspected females are presented in Table 4. One of the genetically confirmed females, R243/L7861 Scrappy (NMFS CI-01-01) was resighted in 10 different years, but was never seen with a calf. Another whale, R529 Thirdeyeblind/L403Hole, was seen in seven years (including as recently as 2015), but was only seen in one of these years with a calf. One confirmed female, R103/L493 Strapped (NMFS CI-01-06) was seen with a newborn in 2009 and with another newborn six years later (Table 4).

Tag scar healing from the Photo-id catalog

Five of the 14 confirmed satellite-tagged whales in the photo-id catalog had visible signs of tag-site infection, and eight had signs of concavity of the dorsal crest above the tag site (Table 5; Appendices I-IV). Tag site infections and concavity occurred in males and females. Two whales, both tagged in 2002, showed signs of damage to the left pectoral fins likely caused by flipper bands applied during tagging (these whales died in 2014 and 2015). One whale tagged in 2001, R111/L2467 Humperdink (NMFS CI-00-02 "Paul(a)") had only very minor scars at the site of tag attachment, although the peak of the dorsal crest was abraded where the tag had rested (Appendix B; Table B3 and Figures B19-22.

Distribution and movement in Cook Inlet by satellite-tagged whales from tagging records and the Photo-id catalog

All of the 15 confirmed captured/tagged whales in the photo-id catalog were resighted in the Susitna River Delta, and most were also resighted in Knik Arm and Turnagain Arm (Table 6). After dividing the total number of satellite-tagged whales photographed in each area by the total number of photo-id surveys conducted in each area to account for unequal survey effort among areas, there was little difference in sighting

rates among areas, with the exception of the Kenai River Delta, where only one satellite-tagged individual was photographed (Table 6).

DISCUSSION

The ability to identify previously tagged whales using the CIBW Photo-id catalog has allowed us to track the survival, healing, reproduction, and movements of fourteen individuals for as many as 16 years post-tagging. We determined that at least 10 of the 20 CIBWs originally captured/tagged were still alive in 2015, and that at least nine of the 12 captured females had reproduced post-tagging.

In addition to extending the span of records for satellite-tagged CIBWs, matching tagging records to photo-id records has filled gaps in the photo-id catalog. The information gathered by NMFS on the sex, length, and age-class of the individual CIBWs at the time of capture is valuable for augmenting the individual life-history information for identified CIBWs in the CIBW Photo-id catalog, as this information is only otherwise available from necropsy of these individuals when they die. Without information on length/age-class from capture or necropsy, we can only infer the age-class from the relative length of a CIBW photographed at the surface of the turbid waters of Cook Inlet. With the exception of a few whales first photographed as young-of-the-year calves, the ages of most of the whales in the photo-id catalog are unknown; therefore, the sighting histories of these previously tagged whales that were known to be adults or sub adults at the time of tagging provide information on the approximate age of these identified whales. Linking tagging and resighting histories allowed us to obtain growth rates for two identified individuals.

Knowing the sex of the satellite-tagged whales at the time of capture has allowed us to confirm some of the assumptions that were otherwise made from photographs alone in the photo-id catalog. We infer that an individual was a reproductive female based on the close accompaniment of a calf in photographs, which carries the risk that a male with a calf swimming nearby might be misclassified as a female. Matching the photo-id records and tagging records of individuals allowed us to assign a known sex to these individuals in the photo-id catalog and to test the accuracy of the reproductive status we had previously assigned based solely on inference. All but one of these females had been correctly classified as presumed mothers in the catalog. One known female had not been classified as a mother, as she had never been photographed with a calf and so would have been presumed to be male. One of the males had been incorrectly classified as a presumed mother in the photo-id catalog. However, this was based on a single day in which he was photographed with a calf nearby. When we then modified our classification of a confirmed mother in the catalog to only include individuals that were accompanied by a calf on more than one occasion. When we tested this new definition on photographic records of known dead stranded whales of known sex (from tagging and from necropsies); males and females were correctly classified.

We compared the incidence of tag infection, size of scars, and confirmed and presumed death rates, to the sex and length of individuals at the time of tagging, as well as to the year of tagging (tagging years varied according to the type of tag and size of

pins/methods of attachment). The sample sizes for photo-id resights of whales from known tagging years were too small to be able to definitively link tagging year and infection rates. Two whales tagged in 2001 were positively identified in the photo-id catalog: one had signs of tag scar infections and one did not. Three whales tagged in 2002 were identified in the photo-id catalog; two of these individuals had signs of tag site infection and one did not. The whale with the cleanest-healing tag scars was tagged in 2000, and it is possible that the smaller pins used for tagging that year and/or the relatively young age (inferred from total length and gray color) of this whale contributed to its healing. In terms of size and conspicuousness of tag scars by year of tagging, belugas tagged in 2000 healed the best, belugas tagged in 2001 were intermediate, and those tagged in 2002 had the largest and most conspicuous tag scars (photos of tagging in 1999 could not be matched to photo-id records). Tagging year 2002 had the highest death rate associated with it, although it should be noted that three of the six confirmed or suspected deaths of CIBWs tagged in 2002 died 5 to 13 years post tagging. In the two cases where we were able to photographically document evidence of flipper bands on identified whales, the damaged caused to the pectoral fins by the bands used in 2002 was apparent.

An additional three whales (one tagged in 2001 and two tagged in 2002) may have died soon after tagging based on tag transmission records ((NMFS unpublished data, pers com Rod Hobbs, pers comm Sally Mizroch), but these deaths have not been confirmed and the possibility of tag failure rather than whale death has been proposed. We never received tagging photos of the 2001 whale. We have possible photo-id resights of the two 2002 whales, but their tagging photos were poor (marks obscured by shadow, photos taken at oblique angles, photos not taken of side profiles) and definitive matches cannot be made; therefore photo-id records cannot offer evidence as to whether these whales survived tagging or not. It may be only coincidence, but we mention it here for consideration that the four whales suspected or confirmed to have died during tagging were all females, while the three whales suspected or confirmed to have died 5 to13 years post-tagging were all males.

Patterns of distribution and movement of satellite-tagged whales in the photo-id catalog closely resemble those of untagged whales in the photo-id catalog, in that the majority of identified individuals have been seen in Susitna River Delta, and most have also been seen in Knik Arm, or Turnagain Arm (McGuire et al. 2014 a). We have previously assumed that all CIBWS used all areas of Upper Cook Inlet, and that lack of resights in an area was an artifact of photo-id sampling methods rather than lack of use of an area by an individual. However, combined tagging and photo-id records have indicated at least one exception: the tagged whale, R11/L2467 Humperdink/NMFS CI-00-02 “Paul(a)”, a young female at the time of capture, has never been seen in Turnagain Arm. Her tagging records show that she moved throughout Knik Arm, the Susitna River Delta, along the west side of the upper and middle inlet to around the west forelands, and Chickaloon Bay (Shelden et al. in prep) but never entered Turnagain Arm. Likewise, she was photographed 2005-2015 in the Susitna River Delta and Knik Arm, but not in Turnagain Arm. The likelihood of photo-identifying an individual whale depends in part on the location in which it was photographed because average distance between photographer and whale varies by location (McGuire et al. 2014a). Also, there is evidence that whales with larger more conspicuous marks will have a higher resight rate

than those with subtle marks in land-based survey locations such a Turnagain Arm where distances between whale and photographer are relatively large. Based on photo-id records alone, it would be reasonable to suspect that this individual's lack of sightings in Turnagain Arm were an artifact of the sampling method and her relatively subtle marks; however, the satellite-tracking records corroborate the photo-id resight history, and tagging data and photo-id data together indicate this whale doesn't use Turnagain Arm. Therefore, photo-id results may be more conclusive that originally thought regarding CIBW distribution and movement among sampling areas.

Future Work

The *CIBW Photo-id Project* is currently working on a summary and synthesis of results of all photo-id surveys of Cook Inlet conducted from 2005-2015, including all belugas identified in the 2005-2015 right-side and 2005-2011 left-side catalogs. In this comprehensive report, scheduled to be released in December 2016, comparisons between previously tagged and untagged whales in the photo-id catalog will be made with respect to resighting histories, survival, reproduction, and body condition.

Objective #6: Recommendations for data collection in any future capture/tagging efforts that will improve long-term monitoring and tracking success.

If future capture and/or tagging studies of CIBWs are conducted, we recommend the following:

- Photographers on the field team should review the photo-id protocol prior to going to the field. This is available on the NMFS Alaska Region website https://alaskafisheries.noaa.gov/pr/beluga-research-cook-inlet.

- A member of the CIBW Photo-id Project team should be present on-site to photograph CIBWs in a manner most consistent with other photos in the photo-id catalog.

- Photographers should ensure all photos include the areas of the body highlighted in Figure 3, which are the areas used for photo-identification.

- Photographs should be taken of captured whales prior to tagging, during tagging, post-tagging, pre-release, and immediately post-release, if possible. The post-release photographs are to show the position of marks exposed above water when the whale is swimming, which is what will be visible in most of the photo-id photos collected of free-swimming whales.

- Photographs of each individual should be dorsolateral-of the right and left sides, as well as over the dorsal of the individual to link both sides.

- Photographers should use the time and date stamp option on digital photographs and should verify the accuracy of the information prior to taking photographs.

- Photograph any unique identifying features of the satellite tag while visible on the animal (such as the tag serial number).

- Photograph flipper bands or additional tags, including suction cup tags.

- If a biopsy sample is taken, the biopsy site should be photographed, pre-and post-sample collection.

- Photograph any misplaced pins that were later removed so that these scars may be used for identification.

- Photograph any obvious natural scars or pigment marks.

- All photographs should be duplicated and archived in two physically separate locations.

- Photographs should be inventoried and entered into the chain of custody, as with other samples collected under permitted research.

- Dedicated photo-id surveys of tagged animals should be conducted weeks to months post-capture in order to monitor tag attachment, tag site healing, and body condition, ideally with real-time or near real-time locations from transmitters provided to the photo-id team in order to increase the odds of finding and photographing tagged whales.

- An alternative to flipper bands should be used to identify tagged whales, as photo-id and necropsy records indicate these bands cause extensive damage to the flippers.

- When the suspected satellite-tagged CIBWs die and if their bodies are recovered and necropsied, we recommend that their genetic samples taken during necropsy be compared to those of taken from satellite-tagged whales at the time of capture. With 14 confirmed and eight suspected satellite-tagged whales in the photo-id catalog, we have more than the 18 actually tagged, and need genetic confirmation to help eliminate untagged individuals from the suspected tagged list.

- Prior to re-initiating any CIBW tagging efforts, refer to the photographic resighting information contained in this report and Shelden et al (in prep) to evaluate the 1999-2002 tagging operations to determine future best practices for the pin size, number of pins, type of attachment, and whale handling methods.

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TABLES

Table 1. Summary of CIBWs captured and satellite-tagged between 1999 and 2002, and matches to individuals in the CIBW Photo-id Catalog.

NMFS CIBW ID Tagging Number	Capture Location	Capture Date	Sex	Color (assigned during capture)	Length (cm)	CIBW Photo-id Catalog Number
no number (captured, not tagged)	Little Susitna	31-May-99	F	gray	230	L2191
CI-9901	Little Susitna	31-May-99	M	White	370	possible match
no number (captured, not tagged)	Knik Arm	8-Sep-02	F	light gray	274	no match (no tagging photos to examine)
CI-0001	Knik Arm	13-Sep-00	M	White	413	possible match
CI-0002	Knik Arm	13-Sep-00	F	White/gray	272	R111/L2467 Humperdink
CI-0101	Little Susitna	10-Aug-01	F	Gray	257	R243/L7861 Scrappy
CI-0102	Knik Arm	11-Aug-01	M	White	323	possible match
CI-0103	Knik Arm	12-Aug-01	F	White	312	possible match
CI-0104	Knik Arm	13-Aug-01	F	White	340	no match (no tagging photos to examine)
CI-0105	Knik Arm	13-Aug-01	F	White	357	possible match
CI-0106	Knik Arm	15-Aug-01	F	White	401	R103/L 493 Strapped
CI-0107	Knik Arm	20-Aug-01	M	White	442	no matches (blurry tagging photos)
CI-0201	Little Susitna	29-Jul-02	M	White	412	possible match
CI-0202	Little Susitna	30-Jul-02	F	White/gray	340	possible match
CI-0203	Knik Arm	31-Jul-02	F	White	366	possible match
CI-0204	Little Susitna	1-Aug-02	F	White	379	No matches (died pre-photo-id study)
CI-0205	Knik Arm	2-Aug-02	M	White/gray	386	L2303/R17366 Sash
CI-0206	Knik Arm	3-Aug-02	M	White/gray	353	L2204/R17367 Jabbathehut
CI-0207	Knik Arm	3-Aug-02	F	White	374	possible match
CI-0208	Knik Arm	4-Aug-02	M	White/gray	376	L2579/R115 Sashtoo

Table 2. Sighting records of satellite-tagged individuals identified in the 2005-2015 CIBW Photo-id catalog, according to year photographed (P=photographed; X=not photographed).

			Annual Number of Surveys												
			51	40	23	34	40	39	48	54	30	22	23		
		Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Maximum Period without Resights (# Years)	Comments
CIBW Photo-id Catalog Number	NMFS CIBW ID Tagging Number	Sex													
L2191*	none (capured, not tagged)	female	x	x	P	x	x	x	x	x	x	x	x	8	sighting record too poor to presume dead or not
R103/L 493 Strapped	CI-01-06	female	P	P	P	P	P	P	P	P	P	P	P	0	
L2303/R17366 Sash	CI-02-05	male	x	P	P	P	P	P	P	P	P	P	confirmed dead	1	
R111/L2467 Humperdink	CI-00-02 "Paul(a)"	female	P	x	P	P	P	P	P	P	x	P	P	1	
L2579/R115 Sashtoo	CI-02-08	male	P	P	P	P	P	P	P	P	x	confirmed dead	n/a	1	
L2204/R17367 Jabbathehut	CI-02-06	male	P	P	P	x	x	x	x	x	x	x	x	8	presumed dead based on drop off in sightings
R243/L7861 Scrappy	CI-01-01	female	P	x	P	P	P	P	P	P	P	P	P	1	
L480 Dimples-L/R49 Dimples -R	unableto match	suspected female	P	P	x	P	x	P	P	P	x	P	P	1	
R549/L1936 Tagger	unableto match	suspected female	P	P	x	x	P	x	P	x	x	P	P	2	
R6 Bullet	unableto match	suspected female	P	P	x	x	P	P	x	P	x	P	P	2	
L17368 notsash L	unableto match	suspected female	x	x	x	P	x	P	P	x	x	x	x	4	sighting record too poor to presume dead or not
L2193 exitwound/R dark dimple	unableto match	suspected male	P	x	P	P	P	P	P	P	x	P	P	1	
R529 Thirdeyeblind/L403Hole	unableto match	suspected female	P	P	x	P	P	P	P	x	x	x	P	3	
R75 Blackhole/L2021 Dimple	unableto match	suspected female	P	P	P	P	P	P	P	x	P	P	P	1	
R5319 Dent PCW /L7709	unableto match	suspected female	x	x	P	x	P	P	P	P	P	P	P	2	
#tagged/captured CIBW seen in year			**11**	**9**	**10**	**10**	**11**	**12**	**12**	**9**	**5**	**10**	**10**		
resight index (# tagged/captured CIBW seen/# surveys)			**0.2**	**0.2**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.5**	**0.4**		

Table 3. Summary of confirmed dead and possibly dead satellite-tagged CIBWs, based on necropsy records and sighting histories in the 2005-2015 CIBW Photo-id catalog.

NMFS CIBW ID Tagging Number	Capture Date	Sex	Length at Tagging (cm)	Length at Death (cm)	CIBW Photo-id Catalog Number	Dead?	Number of Years between Tagging and Death	Growth (diffence between lengths at death and capture) cm	Growth Rate (cm/yr.)
CI-0104	13-Aug-01	F	340	unknown	no tagging photos to examine	possibly dead 2001 post tagging	0		
CI-0202	30-Jul-02	F	340	unknown	possible match	possibly dead 2002 post tagging	0		
CI-0204	1-Aug-02	F	379	unknown	No matches (died pre-photo-id study)	confirmed dead post tagging 8/9/2002	0		
CI-0207	3-Aug-02	F	374	unknown	possible match	possibly dead 2002 post tagging	0		
CI-0206	3-Aug-02	M	353	unknown	L2204/R17367 Jabbathehut	photo-id evidence may have died after 2007	5		
CI-0208	4-Aug-02	M	376	410	L2579/R115 Sashtoo	confirmed dead 5/26/2014	12	34	2.8
CI-0205	2-Aug-02	M	386	428	L2303/R17366 Sash	confirmed dead 6/12/2015	13	42	3.2

Table 4. Yearly sighting records of individual satellite-tagged CIBWs photographically resighted 2005-2015 in Upper and Middle Cook Inlet, Alaska. (P=photographed without a calf; X=not photographed; C=photographed with a calf; CBD=could not be determined).

				Number of Surveys												
				51	40	23	34	40	39	48	54	30	22	23		
			Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		
CIBW Photo-id Catalog Number	**NMFS CIBW ID Tagging Number**	**Sex**	**Length at Capture (cm)**												**Calf Age Information Inferred from Individuals seen with Calves in Multiple Years**	**Years between Calves**
R103/L 493 Strapped	CI-01-06	female (detemined at capture)	401	P	P	P	C	P	C	C	P	P	P	P	CBD if maturing 2008-2010; maturing 2010 to 2011	?
R111/L2467 Humperdink	CI-00-02 "Paul(a)"	female (detemined at capture)	272	P	x	P	P	C	P	P	P	x	C	C	larger in 2014 than 2009 (neonate in 2009); neonate in 2015	6 between neonates
R243/L7861 Scrappy	CI-01-01	female (detemined at capture)	257	P	x	P	P	P	P	P	P	P	P	P	never seen with calf	x
L2191 (captured, not tagged)	none (capured, not tagged)	female (detemined at capture)	230	x	x	P	x	x	x	x	x	x	x	x	only resighed once	x
R6 Bullet	unable to match	suspected female	unable to match	P	P	x	x	C	C	x	P	x	P	C	2010 could be larger calf from 2009; neonate in 2015	5 between large and smaller
R549/L1936 Tagger	unable to match	suspected female	unable to match	P	C	x	x	C	x	P	x	x	C	P	2009 maturing from 2006; smaller calf in 2014	5 between large and smaller
L17368 notsash L	unable to match	suspected female	unable to match	x	x	x	P	x	C	P	x	x	x	x		x
R529 Thirdeyeblind/L403Hole	unable to match	suspected female	unable to match	P	C	x	P	P	P	P	x	x	x	P	seen with calf in multiple photos in 2006, but no other years	x
R5319 Dent PCW /L7709	unable to match	suspected female	unable to match	x	x	P	x	P	C	C	P	P	C	P	smaller calf 2011 than 2010; 2014 may be larger than 2011 but can't see enough to tell	1 between large and smaller
R75 Blackhole/L2021 Dimple	unable to match	suspected female	unable to match	P	C	P	P	C	P	c	x	P	P	P	don't see size difference between 2006 and 2008; assumed at 3 years later is is a new calf; calf in 2011 is smaller than 2009	2 between large and smaller
L480 Dimples-L/R49 Dimples -R	unable to match	suspected female	unable to match	P	P	x	C	x	P	C	P	x	P	P	2008 and 2011 calves may be the same	x

Table 5. Summary of tag healing and flipper band damage for satellite-tagged CIBWs, based on photographic records in the 2005-2015 CIBW Photo-id catalog.

CIBW Photo-id Catalog Number	NMFS CIBW ID Tagging Number	Sex	Infection Seen at Tag Site?	Concavity of Dorsal Crest above Tag Site?	Visible Flipper Damage?	Comments	Mortality
R103/L 493 Strapped	CI-01-06	female	no	no	not used in 2001		
L2303/R17366 Sash	CI-02-05	male	yes	yes	yes		died
R111/L2467 Humperdink	CI-00-02 "Paul(a)"	female	no	no	not used in 2000	abraded peak of dorsal crest	
L2579/R115 Sashtoo	CI-02-08	male	no	yes (slight)	yes		died
L2204/R17367 Jabbathehut	CI-02-06	male	yes	yes	flipper not visible in photo-id photos		presumed dead
R243/L7861 Scrappy	CI-01-01	female	yes	no	not used in 2001		
L480 Dimples-L/R49 Dimples -R	unable to match	suspected female	no	yes	flipper not visible in photo-id photos		
R549/L1936 Tagger	unable to match	suspected female	no	yes (slight)	flipper not visible in photo-id photos		
R6 Bullet	unable to match	suspected female	unknown, deteriorating edges of scars	no	flipper not visible in photo-id photos		
L17368 notsash L	unable to match	suspected female	yes	yes	flipper not visible in photo-id photos		
L2193 exitwound/R dark dimple	unable to match	suspected male	no	yes	flipper not visible in photo-id photos		
R529 Thirdeyeblind/L403Hole	unable to match	suspected female	no	yes	flipper not visible in photo-id photos		
R75 Blackhole/L2021 Dimple	unable to match	suspected female	yes	yes	flipper not visible in photo-id photos		
R5319 Dent PCW /L7709	unable to match	suspected female	no	no	flipper not visible in photo-id photos		

Table 6. Sighting records of satellite-tagged individuals identified in the 2005-2015 CIBW Photo-id catalog, according to location photographed (P=photographed; X=not photographed).

				Number of Surveys				
				120	131	114	16	23
				Susitna River Delta	Knik Arm	Turnagain Arm	Chickaloon Bay/Fire Island	Kenai River Delta
CIBW Photo-id Catalog Number	NMFS CIBW ID Tagging Number	Capture Location	Sex					
L2191*	none (capured, not tagged)	Little Susitna River	female	P	x	x	x	x
R103/L 493 Strapped	CI-01-06	Knik Arm	female	P	P	P	x	x
L2303/R17366 Sash	CI-02-05	Knik Arm	male	P	P	P	x	x
R111/L2467 Humperdink	CI-00-02 "Paul(a)"	Knik Arm	female	P	P	x	x	x
L2579/R115 Sashtoo	CI-02-08	Knik Arm	male	P	P	P	P	x
L2204/R17367 Jabbathehut	CI-02-06	Knik Arm	male	P	P	P	x	x
R243/L7861 Scrappy	CI-01-01	Little Susitna River	female	P	P	P	P	x
L480 Dimples-L/R49 Dimples -R	unableto match	unableto match	suspected female	P	P	P	x	x
R549/L1936 Tagger	unableto match	unableto match	suspected female	P	P	P	x	x
R6 Bullet	unableto match	unableto match	suspected female	P	P	x	x	x
L17368 notsash L	unableto match	unableto match	suspected female	P	x	P	x	x
L2193 exitwound/R dark dimple	unableto match	unableto match	suspected male	P	P	P	x	P
R529 Thirdeyeblind/L403Hole	unableto match	unableto match	suspected female	P	P	x	x	x
R75 Blackhole/L2021 Dimple	unableto match	unableto match	suspected female	P	P	P	x	x
R5319 Dent PCW /L7709	unableto match	unableto match	suspected female	P	P	P	x	x
# tagged/captured CIBW photographed in area				**15**	**13**	**11**	**2**	**1**
resight index(# tagged/captured CIBW seen/# surveys)				**0.1**	**0.1**	**0.1**	**0.1**	**0.0**

FIGURES

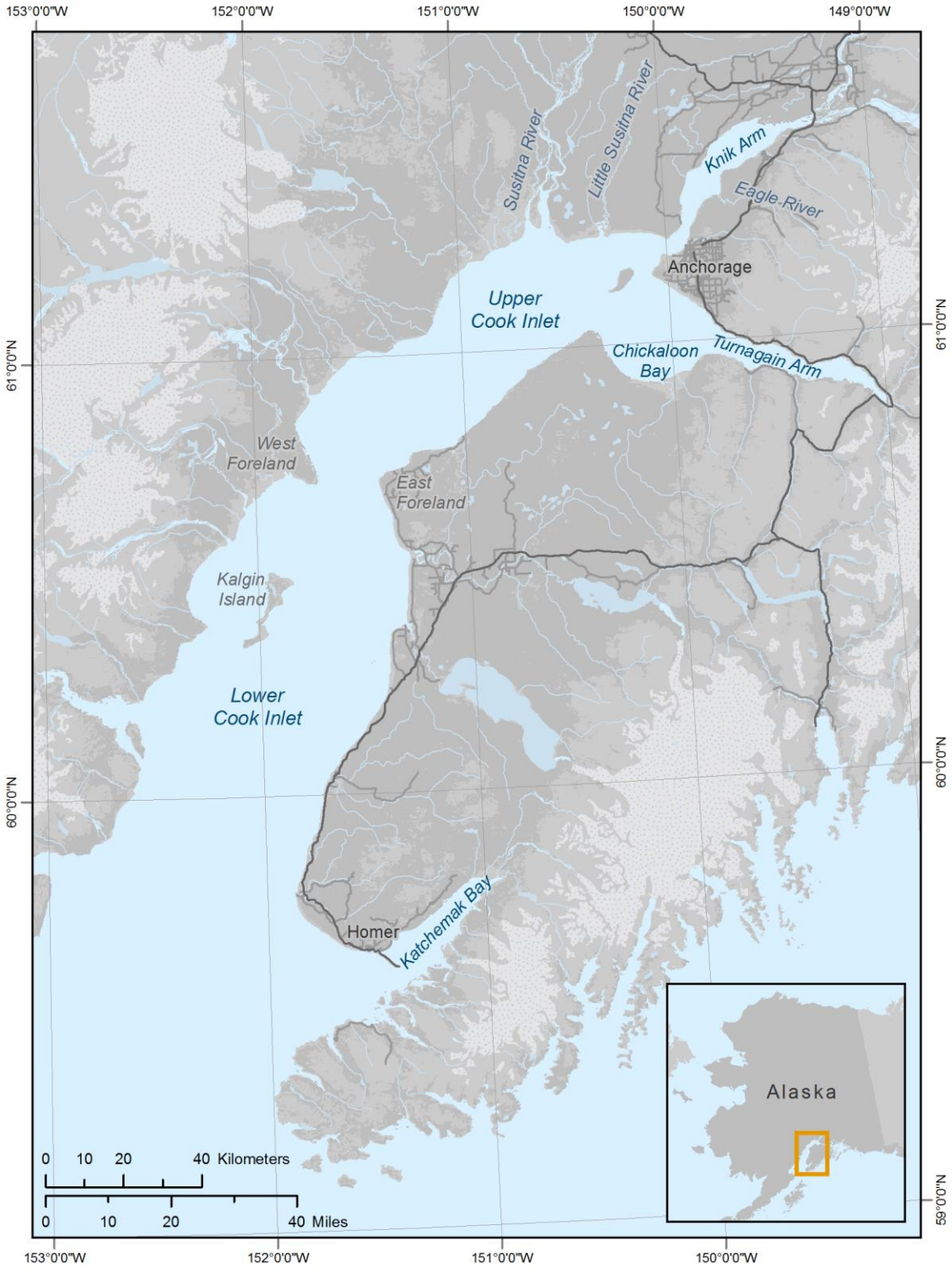

Figure 1. Map of Cook Inlet, Alaska, showing major features discussed in text.

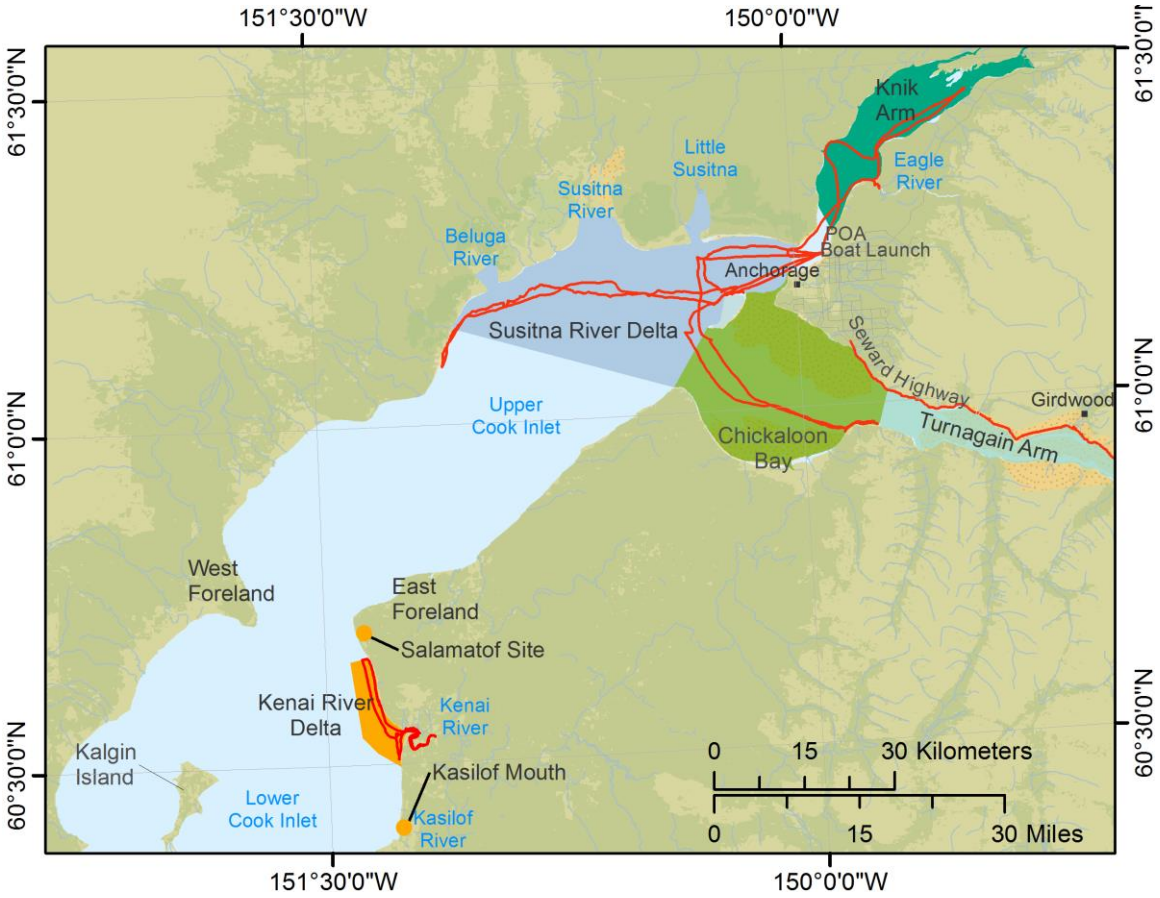

Figure 2. Map of Middle and Upper Cook Inlet, Alaska, showing shaded boundaries of sub-areas within the study area and the general survey routes used 2005–2015. The Kenai River Delta study area was included 2011-2013.

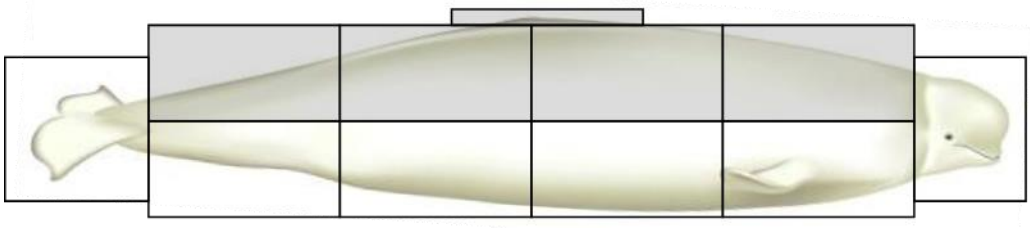

Figure 3. Diagram showing the various body segments used when cataloging. The five shaded areas are the critical sections used in photo-identification. Beluga illustration courtesy of Uko Gorter.

APPENDICES

Appendix A. Match between photos of individual at capture and in photo-id catalog (whale captured, not tagged)

Appendix B. Match between photos of individuals during tagging and in photo-id catalog

Appendix C. Confirmed satellite-tagged individuals in the photo-id catalog unmatched to individuals during tagging.

Appendix D. Individuals in the photo-id catalog with possible, but unconfirmed, satellite-tag scars.

APPENDIX A

MATCH BETWEEN PHOTOS OF INDIVIDUAL BELUGA AT CAPTURE AND PHOTO-ID CATALOG (WHALE CAPTURED, NOT TAGGED)

Table A1. Capture and resight data for match between NMFS captured whale and photo-id whale L2191 (whale captured but not tagged).

Capture/Tagging Data	
NMFS CIBW ID Number	None Described in Ferrero et al. 2000
Date captured/tagged	31 May 1999
Capture location	2 km up the Little Susitna River
Sex (visual/genetics at capture)	female
Color recorded at capture	gray
Length at capture (cm)	230
Photo-ID Resight Data	
Photo-ID number	L2191*
Years resighted	2007
Number of years resighted	1
Maximum number of resightings per year (and year)	1 in 2007
Span of records (photo-id and/or tagging)	1999-2007
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta
Tag-site condition (infections, margins)	Not tagged
Other (e.g., abnormal body condition, disease, trauma)	large white patches- skin infection?
Flipper bands?	No record of use during tagging/flippers not seen in tagging or photo-id photos

*not an individual in the catalog- classified as “temporary folder” because only seen one day and profile does not meet criteria to be considered an individual in the catalog

Figure A4. Left-side photo of untagged female whale captured on May 31, 1999. Photo courtesy of NMFS.

Figure A5. Left-side photo of whale L2191 in 2007.

APPENDIX B

MATCH BETWEEN PHOTOS OF INDIVIDUAL BELUGAS DURING TAGGING AND PHOTO-ID CATALOG

Table B1. Capture and resight data for match between NMFS captured whale CI-01-06 and photo-id whale R103/L493 Strapped.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-01-06
Date captured/tagged	15 August 2001
Capture location	Knik Arm
Sex (visual/genetics at capture)	female
Color recorded at capture	white
Length at capture (cm)	401
Photo-ID Resight Data	
Photo-ID number	R103/L493 Strapped
Years resighted	All years 2005-2015
Number of years resighted	11
Maximum number of resightings per year (and year)	12 in 2008
Span of records (photo-id and/or tagging)	2001-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Tag scars and biopsy scars conspicuous but clean margins and no signs of infections
Other (e.g., abnormal body condition, disease, trauma)	New scar in 2015- right side- possible tooth rake marks
Flipper bands?	Not used in 2001 tagging

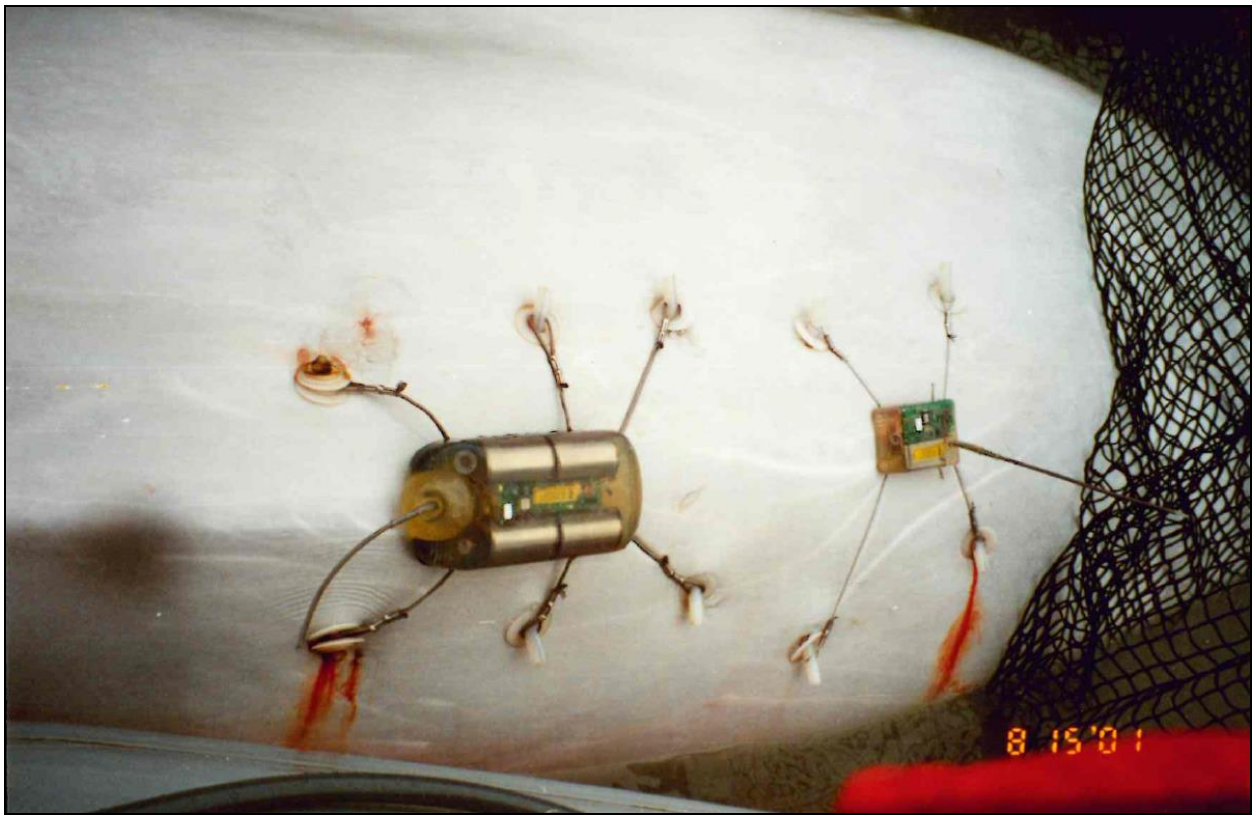

Figure B1. Dual-side photo of female whale CI-01-06 captured and tagged on August15, 2001. Photo courtesy of NMFS.

Figure B2. Left-side photo of whale R103/L493 Strapped in 2006. This photo shows five pin scars plus one biopsy scar.

Figure B3. Left-side photo of whale R103/L493 Strapped in 2014.

Figure B4. Right-side photo of whale R103/L493 Strapped in 2005.

Figure B5. Dual-side photo of whale R103/L493 Strapped in 2013.

Figure B6. Right-side photo of R103/L493 Strapped in 2015.

Table B2. Capture and resight data for match between NMFS captured whale CI-02-05 and photo-id whale L2303/R17366 Sash.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-02-05
Date captured/tagged	2 August 2002
Capture location	Knik Arm
Sex (visual/genetics at capture)	male
Color recorded at capture	white/gray
Length at capture (cm)	386
Photo-ID Resight Data	
Photo-ID number	L2303/R17366 Sash
Years resighted	all years 2006-2015
Number of years of resightings	10
Maximum number of resightings per year (and year)	4 (2007, 2011, 2014)
Span of records (photo-id and/or tagging)	2002-2015
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Infection of tag scar first noted 2006, deteriorated each year
Other (e.g., abnormal body condition, disease, trauma)	Concavity of dorsal area around tagging site, first noted 2006
Flipper bands?	Yes, damage to flipper in resight photos
Mortality	Dead 12 June 2015
Match confirmed by genetics?	yes
Other	Necropsy report available from NMFS upon request

Figure B7. Right-side photo of CI-02-05 captured and tagged on August 2, 2002. Photo courtesy of NMFS.

Figure 6. Left-side photo of CI-02-05 captured and tagged on August 2, 2002. Photo courtesy of NMFS.

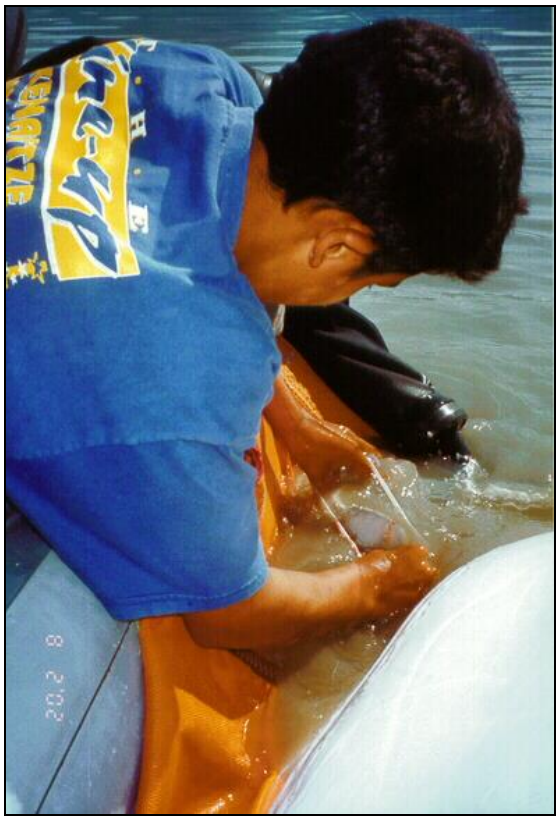

Figure B9. Flipper band placement on left pectoral flipper of C1-02-05. Photo courtesy of NMFS.

Figure B10. Right-side photo of L2303/R17366 Sash in 2006.

Figure B11. Right-side photo of L2303/R17366 Sash in 2007.

Figure B12. Right-side photo of L2303/R17366 Sash in 2009. Note yellow coloration around deteriorating tag site.

Figure B13. Right-side photo of L2303/R17366 Sash in 2013.

Figure B14. Right-side photo of L2303/R17366 Sash in 2014.

Figure B15. Left-side photo of L2303/R17366 Sash in 2007. Note the concave profile.

Figure B16. Left-side photo of L2303/R17366 Sash in 2011. Note visible tag site deterioration.

Figure B17. Left-side necropsy photo of L2303/R17366 Sash on June 12, 2015.
Note left pectoral fin damage and concave tag site. Photo courtesy of Kathy Burek.

Figure B18. Left-side necropsy photo of L2303/R17366 Sash on June 12, 2015. Note concave tag site. Photo courtesy of Kathy Burek.

Table B3. Capture and resight data for match between NMFS captured whale CI-00-02 and photo-id whale R111/L2467 Humperdink.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-00-02 “Paul(a)”
Date captured/tagged	13 September 2000
Capture location	Knik Arm
Sex (visual/genetics at capture)	female
Color recorded at capture	white/gray
Length at capture (cm)	272
Photo-ID Resight Data	
Photo-ID number	R111/L2467 Humperdink
Years resighted	2005, 2007, 2008, 2009, 2010, 2011, 2012, 2014, 2015
Number of years resighted	9
Maximum number of resightings per year (and year)	10 in 2005
Span of records (photo-id and/or tagging)	2000-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm,
Tag-site condition (infections, margins)	cleanest, least-conspicuous tag scars observed of all resighted tagged CIBW. Peak of dorsal crest abraded. Field notebook from tagging indicates 4th pin inserted too high then removed, healed scar visible in photos right side
Other (e.g., abnormal body condition, disease, trauma)	Skin infection, tooth rake marks present at time of tagging
Flipper bands?	not used in 2000

Figure 7. Left-side photo of CI-00-02 captured and tagged on September 13, 2000. Photo courtesy of NMFS.

Figure B20. Left-side photo of R111/L2467 Humperdink in 2005. Note pin placement holes.

Figure B21. Left-side photo of R111/L2467 Humperdink in 2010. Note abraded peak of dorsal crest.

Figure B22. Right-side photo of R111/L2467 Humperdink in 2005.

Table B4. Capture and resight data for match between NMFS captured whale CI-02-08 and photo-id whale L2579/R115 Sashtoo.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-02-08
Date captured/tagged	4 August 2002
Capture location	Knik Arm
Sex (visual/genetics at capture)	male
Color recorded at capture	white/gray
Length at capture (cm)	376
Photo-ID Resight Data	
Photo-ID number	L2579/R115 Sashtoo
Years resighted	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2014
Number of years resighted	9
Maximum number of resightings per year (and year)	14 in 2011
Span of records (photo-id and/or tagging)	2002-2014
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Tag scars conspicuous but clean margins and no signs of infections
Other (e.g., abnormal body condition, disease, trauma)	neck abrasions
Flipper bands?	Flipper-band damage seen on dead whale
Information on death?	Dead 26 May 2014 Kincaid Park, Turnagain Arm, Anchorage
Match confirmed by genetics?	yes
Other	Necropsy report available from NMFS upon request

Figure B23. Dual-side photo of CI-02-08 captured and tagged on August 4, 2002. Photo courtesy of NMFS.

Figure B24. Left-side photo of dead L2579/R115 Sashtoo on May 27, 2014. Note damaged left pectoral fin. Photo courtesy of Bill Streever.

Figure B25. Left-side photo of dead L2579/R115 Sashtoo on May 27, 2014. Photo courtesy of Bill Streever.

Figure B26. Left-side necropsy photo of tag scars on L2579/R115 Sashtoo. Photo courtesy of Russ Andrews, Alaska SeaLife Center.

Figure B27. Right-side necropsy photo of tag scars on L2579/R115 Sashtoo. Photo courtesy of Russ Andrews, Alaska SeaLife Center.

Figure B28. Right-side photo of L2579/R115 Sashtoo in 2006.

Figure B29. Left-side photo of L2579/R115 Sashtoo side swimming in 2007. Note flipper band embedded in left pectoral fin. Photo courtesy of Chris Garner, JBER DOD.

Figure B30. Dual-side photo of L2579/R115 Sashtoo in 2008.

Figure B31. Right-side photo of L2579/R115 Sashtoo in 2012.

Table B5. Capture and resight data for match between NMFS captured whale CI-02-06 and photo-id whale L2204/R17367 Jabbathehut.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-02-06
Date captured/tagged	3 August 2002
Capture location	Knik Arm
Sex (visual/genetics at capture)	male
Color recorded at capture	white/gray
Length at capture (cm)	353
Photo-ID Resight Data	
Photo-ID number	L2204/R17367 Jabbathehut
Years resighted	2005, 2006, 2007
Number of years resighted	3
Maximum number of resightings per year (and year)	5 in 2005
Span of records (photo-id and/or tagging)	2002-2007
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Extreme tag scarring/tag site deterioration
Other (e.g., abnormal body condition, disease, trauma)	Concavity of dorsal ridge around tagging site
Flipper bands?	Applied during tagging; flippers not seen in photo-id resight photos
Information on death?	Not seen after 2007, suspected to have died, based on lack of photo-id resights

Figure B32. Right-side photo of CI-02-06 captured and tagged on August 3, 2002. Photo courtesy of NMFS.

Figure B33. Right-side photo of L2204/R17367 Jabbathehut in 2005.

Figure B34. Left-side photo of L2204/R17367 Jabbathehut in 2006. Note concave profile and tag site deterioration.

Figure B35. Left-side photo of L2204/R17367 Jabbathehut in 2007.

Figure B36. Right-side photo of L2204/R17367 Jabbathehut in 2007. Note concave profile and tag site deterioration.

Table B6. Capture and resight data for match between NMFS captured whale CI-01-01 and photo-id whale R243/L7861 Scrappy.

Capture/Tagging Data	
NMFS CIBW ID Number	CI-01-01
Date captured/tagged	10 August 2001
Capture location	Little Susitna River
Sex (visual/genetics at capture)	female
Color recorded at capture	gray
Length at capture (cm)	257
Photo-ID Resight Data	
Photo-ID number	R243/L7861 Scrappy
Years resighted	2005, 2007 ,2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015
Number of years resighted	10
Maximum number of resightings per year (and year)	4 in 2010
Span of records (photo-id and/or tagging)	2001-2015
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Appeared to be healing well in 2005, some infection visible 2011-2015
Other (e.g., abnormal body condition, disease, trauma)	skin infection at time of tagging and throughout sighting history
Flipper bands?	Not used in 2001 tagging

Figure B37. Left-side photo of CI-01-01 captured and tagged on August 10, 2001. Photo courtesy of NMFS.

Figure B38. Left-side photo of R243/L7861 Scrappy in 2011. Possible infection of left tag scars.

Figure B39. Right-side photo of R243/L7861 Scrappy in 2005.

Figure B40. Right-side photo of R243/L7861 Scrappy in 2009.

Figure B41. Right-side photo of R243/L7861 Scrappy in 2013. There appears to be some infection in tag holes.

Figure B42. Right-side photo of R243/L7861 Scrappy in 2014.

Figure B43. Dual-side photo of R243/L7861 Scrappy in 2015.

APPENDIX C

CONFIRMED SATELLITE-TAGGED INDIVIDUALS IN THE PHOTO-ID CATALOG UNMATCHED TO INDIVIDUALS DURING TAGGING.

Table C1. Resight data for satellite tagged whale L480 Dimples-L/R49 Dimples-R unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	L480 Dimples-L/R49 Dimples-R
Years resighted	2005, 2006, 2008, 2010, 2011, 2012, 2014, 2015
Number of years resighted	8
Maximum number of resightings per year (and year)	10 in 2011
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Am
Tag-site condition (infections, margins)	Only one tag scar visible, and appears to heal cleanly then close
Other (body condition, infections, trauma)	site around tag scar concave, some concavity of dorsal crest over tag site

Figure C1. Left-side photo of L480 Dimples-L/R49 Dimples-R in 2005.

Figure C2. Dual-side photo of L480 Dimples-L/R49 Dimples-R in 2008.

Figure C3. Left-side photo of L480 Dimples-L/R49 Dimples-R in 2015.

Figure C4. Right-side photo of L480 Dimples-L/R49 Dimples-R in 2008.

Figure C5. Right-side photo of L480 Dimples-L/R49 Dimples-R in 2011 with an accompanying calf.

Figure C6. Right-side photo of L480 Dimples-L/R49 Dimples-R in 2014.

Table C2. Resight data for satellite tagged whale R549/L1936 Tagger unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	R549/L1936 Tagger
Years resighted	2005, 2006, 2009, 2011, 2014, 2015
Number of years resighted	6
Maximum number of resightings per year (and year)	5 in 2006
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Tag scars conspicuous but healed
Other (e.g., abnormal body condition, disease, trauma)	Slightly concavity along dorsal crest between tag scars

Figure C7. Right-side photo of R549/L1936 Tagger in 2006 with an accompanying calf.

Figure C8. Right-side photo of R549/L1936 Tagger in 2014.

Figure C9. Left-side photo of R549/L1936 Tagger in 2006.

Figure C10. Left-side photo of R549/L1936 Tagger in 2006 with an accompanying calf.

Figure C11. Left-side photo of R549/L1936 Tagger in 2011 with an accompanying calf.

Table 2. Resight data for satellite tagged whale R6 Bullet unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	R6 Bullet
Years resighted	2005, 2006, 2009, 2010, 2012, 2014, 2015
Number of years resighted	7
Maximum number of resightings per year (and year)	5 in 2009
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm
Tag-site condition (infections, margins)	Deteriorating margins of tag scars
Other (e.g., abnormal body condition, disease, trauma)	skin infection 2015

Figure C12. Right-side photo of R6 Bullet in 2005.

Figure C13. Right-side photo of R6 Bullet in 2009.

Figure C14. Right-side photo of R6 Bullet in 2015.

Table C4. Resight data for satellite tagged whale L17368 notsash L unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	L17368 notsash L
Years resighted	2008, 2010, 2011
Number of years resighted	3
Maximum number of resightings per year (and year)	1 each year seen
Span of records (photo-id and/or tagging)	2008-2011
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Turnagain Arm
Tag-site condition (infections, margins)	Rough edges tag scar 2010, infected tag scars 2011
Other (e.g., abnormal body condition, disease, trauma)	concave dorsal ridge above tag scars beginning in 2010

Figure C15. Left-side photo of L17368 notsash L in 2008.

Figure C16. Left-side photo of L17368 notsash L in 2010.

Figure C17. Left-side photo of L17368 notsash L in 2011. Note tag site infection.

Figure C18. Left-side photo of L17368 notsash L in 2012.

Table C5. Resight data for satellite tagged whale L2193 exitwound/R dark dimple unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	L2193 exitwound/R dark dimple
Years resighted	2005, 2007, 2008, 2009, 2010, 2011, 2012, 2014, 2015
Number of years resighted	9
Maximum number of resightings per year (and year)	7 (in 2015)
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	no
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm, Kenai River Delta
Tag-site condition (infections, margins)	Tags scars closed, but conspicuous divots/indentations
Other (e.g., abnormal body condition, disease, trauma)	concave dorsal crest above tag scars beginning in 2007

Figure C19. Left-side photo of L2193 exitwound/R dark dimple in 2007.

Figure C20. Left-side photo of L2193 exitwound/R dark dimple in 2010.

Figure C21. Left-side photo of L2193 exitwound/R dark dimple in 2011.

Figure C22. Left-side photo of L2193 exitwound/R dark dimple in 2015. Photo courtesy of Marc Webber.

Figure C23. Right-side photo of L2193 exitwound/R dark dimple in 2009. Photo courtesy of Chris Garner, JBER DOD.

Figure C24. Right-side photo of L2193 exitwound/R dark dimple in 2015.

Table C6. Resight data for satellite tagged whale R529 Thirdeyeblind/L403Hole unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	R529 Thirdeyeblind/L403Hole
Years resighted	2005, 2006, 2008, 2009, 2010, 2011, 2015
Number of years resighted	7
Maximum number of resightings per year (and year)	7 in 2005
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm
Tag-site condition (infections, margins)	conspicuous divots/indentations; scar tissue or abrasions around tag site left side?
Other (e.g., abnormal body condition, disease, trauma)	Rough skin around neck

Figure C25. Right-side photo of R529 Thirdeyeblind/L403Hole in 2006 with an accompanying calf.

Figure C26. Right-side photo of R529 Thirdeyeblind/L403Hole in 2015.

Figure C27. Left-side photo of R529 Thirdeyeblind/L403Hole in 2006 with an accompanying calf.

Figure C28. Left-side photo of R529 Thirdeyeblind/L403Hole in 2011.

Table C7. Resight data for satellite tagged whale R75 Blackhole/L2021 Dimple unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	R75 Blackhole/L2021 Dimple
Years resighted	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2013, 2014, 2015
Number of years resighted	10
Maximum number of resightings per year (and year)	5 in 2011
Span of records (photo-id and/or tagging)	2005-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Left-side scar extensive, infection in 2014 and 2015; right side relatively well-healed, only one tag scar visible, concavity around tag scar
Other (e.g., abnormal body condition, disease, trauma)	Concavity above tag site

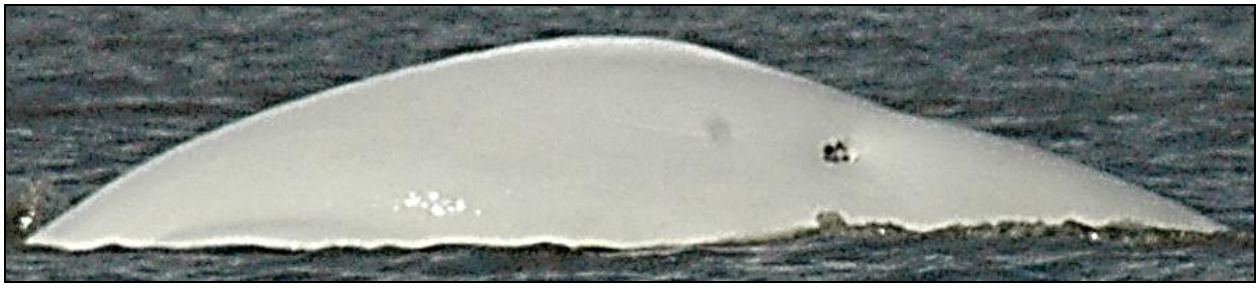

Figure C29. Left-side photo of R75 Blackhole/L2021 Dimple in 2005.

Figure C30. Left-side photo of R75 Blackhole/L2021 Dimple in 2008.

Figure C31. Left-side photo of R75 Blackhole/L2021 Dimple in 2011.

Figure C32. Left-side photo of R75 Blackhole/L2021 Dimple in 2011 with an accompanying calf.

Figure C33. Right-side photo of R75 Blackhole/L2021 Dimple in 2005.

Figure C34. Right-side photo of R75 Blackhole/L2021 Dimple in 2006 with an accompanying calf.

Figure C35. Right-side photo of R75 Blackhole/L2021 Dimple in 2011.

Figure C36. Right-side photo of R75 Blackhole/L2021 Dimple in 2014.

Figure C37. Right-side photo of R75 Blackhole/L2021 Dimple in 2015.

Table C8. Resight data for satellite tagged whale R5319 Dent PCW /L7709 unable to be matched to NMFS captured whale photographs.

Capture/Tagging Data	
NMFS CIBW ID Number	Unable to match
Photo-ID Resight Data	
Photo-ID number	R5319 Dent PCW /L7709
Years resighted	2007, 2009, 2010, 2011, 2012, 2013, 2014, 2015
Number of years resighted	8
Maximum number of resightings per year (and year)	6 in 2010
Span of records (photo-id and/or tagging)	2007-2015
Presumed mother (seen with calves?)	yes
Locations sighted	Susitna River Delta, Knik Arm, Turnagain Arm
Tag-site condition (infections, margins)	Healed, minor indentation from one tag scar
Other (e.g., abnormal body condition, disease, trauma)	Nothing of note

Figure C38. Left-side photo of R5319 Dent PCW /L7709 in 2009.

Figure C39. Left-side photo of R5319 Dent PCW /L7709 in 2010.

Figure C40. Left-side photo of R5319 Dent PCW /L7709 in 2011 with an accompanying calf.

Figure C41. Right-side photo of R5319 Dent PCW /L7709 in 2012.

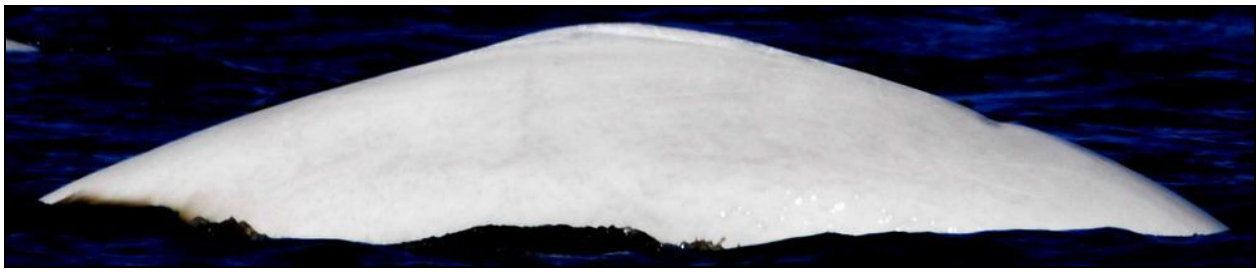

Figure C42. Right-side photo of R5319 Dent PCW /L7709 in 2015.

APPENDIX D

INDIVIDUALS IN THE PHOTO-ID CATALOG WITH POSSIBLE, BUT UNCONFIRMED, SATELLITE-TAG SCARS.

Figure D1. Right-side photo of R516blacktriangle/L1662Shallowdent, an unconfirmed satellite-tagged whale.

Figure D2. Left-side photo of R516blacktriangle/L1662Shallow dent, an unconfirmed satellite-tagged whale.

Figure D3. Right-side photo of R1368 whitenotch, an unconfirmed satellite-tagged whale.

Figure D4. Left-side photo of L2327 tagmaybe, an unconfirmed satellite-tagged whale.

Figure D5. Right-side photo of R3293 tagsaddle/L3024 rear dent left, an unconfirmed satellite-tagged whale.

Figure D6. Left-side photo of R3293 tagsaddle/L3024 rear dent left, an unconfirmed satellite-tagged whale.

Figure D7. Right-side photo of L2295 Saddle-L/R107 Saddle-R, an unconfirmed satellite-tagged whale.

Figure D8. Left-side photo of L2295 Saddle-L/R107 Saddle-R, an unconfirmed satellite-tagged whale.

Figure D9. Right-side photo of R3203 BigXwhitetop, an unconfirmed satellite-tagged whale.

Figure D10. Right-side photo of R11506 percentage, an unconfirmed satellite-tagged whale.

Figure D11. Left-side photo of L2041 gray center dent, an unconfirmed satellite-tagged whale.