Beluga Whale
Cook Inlet DPS
(Delphinapterus leucas)

5-Year Review:
Summary and Evaluation

National Marine Fisheries Service
Alaska Fisheries Science Center
Marine Mammal Laboratory
Seattle, Washington

February 2017

5-YEAR REVIEW

Species reviewed: Beluga whale, Cook Inlet DPS (*Delphinapterus leucas*)

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Beluga whale (Cook Inlet DPS)/*Delphinapterus leucas*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Science Center:
Alaska Fisheries Science Center (AFSC) - Kim Shelden, Marine Mammal Laboratory (MML), Cetacean Assessment and Ecology Program, 206-526-6275

Cooperating Regional or Headquarters Offices:
Alaska Regional Office (AKR), Anchorage – Mandy Migura, Protected Resources Division, 907-271-1332

1.2 Methodology used to complete the review:

The first draft of the 5-year review was completed at the Marine Mammal Laboratory (MML), referencing criteria and recovery actions provided in the 2015 *Draft Recovery Plan for the Cook Inlet Beluga Whale (Delphinapterus leucas),* and papers published since release of the Draft Recovery Plan in May 2015. Upon finalization of the Recovery Plan in December 2016, this document was updated to reflect recovery criteria and recovery actions identified in the final recovery plan (NMFS 2016). Reviews were completed by Kim Shelden and Rod Hobbs (MML), Mandy Migura and Greg Balogh (AKR).

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

NMFS requested public information and comments about the status of the endangered Cook Inlet beluga whale DPS twice via notices in the Federal Register as part of the review of the status of the species in association with the development of the recovery plan for Cook Inlet beluga whales, which was published December 2016. Information collected during the recovery planning process was incorporated into this 5-year status review document.

75 FR 4528, January 28, 2010 (notice of intent to prepare a recovery plan and solicitation of information from the public about the species)

80 FR 27925, May 15, 2015 (publication of draft recovery plan and request for comments)

1.3.2 Listing history

<u>Original Listing</u>

Federal Register notice: 73 FR 62919
Date listed: October 22, 2008
Entity listed: Beluga whale (*Delphinapterus leucas*), Cook Inlet Distinct Population Segment (DPS)
Classification: Endangered

1.3.3 Associated rulemakings

DPS determination
Federal Register notice: 65 FR 38778; June 22, 2000.

Critical Habitat designation
Federal Register notice: 76 FR 20180; April 11, 2011.

1.3.4 Review History:

This is the first, formal Status Review for the Cook Inlet beluga whale DPS since listing. Prior to the endangered listing decision in 2008, Cook Inlet belugas were listed as a Candidate Species under the ESA. Previous reviews of the status of this population were undertaken in 1988, 1992, 1999, 2006, and 2008.

Hazard, K. 1988. Beluga whale, *Delphinapterus leucas*, p. 195-235. In J. W. Lentfer (editor), Selected marine mammals of Alaska: Species accounts with research and management recommendations. Mar. Mammal Comm., Washington, D.C. (Note: *this review provided the basis for the listing of Cook Inlet belugas on the 1988 List of Candidate Vertebrate and Invertebrate Marine Species*: 53 FR 33516, August 31, 1988)

NMFS (National Marine Fisheries Service). 1992. Status report on Cook Inlet belugas (*Delphinapterus leucas*). Unpublished report prepared by the Alaska Region, NMFS, 222 W 7th Ave., Box 43, Anchorage, AK 99513. Available at: http://alaskafisheries.noaa.gov/sites/default/files/status1992.pdf (Note: *the abundance estimate for 1991 provided in this report was revised in Shelden and Mahoney (2016)* Available at*:* http://www.afsc.noaa.gov/Publications/ProcRpt/PR2016-02.pdf)

Moore, S., D. Rugh, K. Shelden, B. Mahoney, and R. Hobbs. 1999. Synthesis of available information on the Cook Inlet stock of beluga whales. AFSC Processed Rep. 99-06, 22 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR1999-06.pdf (Note: *the journal Marine Fisheries Review, Volume 62, Issue 3: special issue on beluga whales published in July 2000 includes peer-reviewed papers based on a number of the abstracts presented herein.* Available at: http://spo.nwr.noaa.gov/mfr623/mfr623.htm)

Hobbs, R. C., K. E. W. Shelden, D. J. Vos, K. T. Goetz, and D. J. Rugh. 2006. Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2006-16, 74 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR%202006-16.pdf

Hobbs, R. C., K. E. W. Shelden, D. J. Rugh, and S.A. Norman. 2008. Status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2008-02, 116 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR%202008-02.pdf

Hobbs, R. C., and K. E. W. Shelden. 2008. 2008 supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*). AFSC Processed Rep. 2008-08, 94 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2008-08.pdf

1.3.5 Species' Recovery Priority Number at start of 5-year review:

"1" – source: http://www.nmfs.noaa.gov/pr/PR3/biennial.html ESA Biennial Report 2012-2014. Based on criteria in the Recovery Priority Guidelines (as defined under 55 FR 24296, June 15, 1990): *magnitude of threat* is **high** (meaning extinction is almost certain in the immediate future because of a rapid population decline or habitat destruction); *recovery potential* is **high** (meaning the limiting factors and threats to the species are well understood and the needed management actions are known and have a high probability of success), and *conflict* exists (indicating recovery priority be given to species in conflict with construction or other development projects or other forms of economic activity in terms of recovery plan development).

1.3.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the Cook Inlet Beluga Whale (*Delphinapterus leucas*)
Date issued: December 2016
Dates of previous revisions, if applicable: N/A

The Endangered Species Act requires that NMFS develop and implement recovery plans for the conservation and survival of threatened and endangered species under its jurisdiction, unless it is determined that such plans would not promote the conservation of the species. A draft recovery plan was published in 2015 (80 FR 27925) and public and peer reviewer comments were solicited. Prior to finalization of the plan in December 2016, it was revised as appropriate based upon the public and peer reviewer comments.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__X__ **Yes**, *go to section 2.1.2*
______ **No**, *go to section 2.2*

2.1.2 Is the species under review listed as a DPS?

__X__ **Yes**, *go to section 2.1.3*
______ **No**, *go to section 2.1.4*

2.1.3 Was the DPS listed prior to 1996?

_____ **Yes**, *give date and go to section 2.1.3.1*
__X__ **No**, *go to section 2.1.4*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

______ **Yes**, *provide citation and got to section 2.1.4*
______ **No**, *go to section 2.1.3.2*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 policy standards?

______ **Yes**, *discuss how it meets the DPS policy and got to section 2.1.4*
______ **No**, *discuss how it is not consistent with the DPS policy and consider the 5-year review completed. Go to section 2.4 Synthesis.*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

_____ **Yes**, *provide citation(s) and a brief summary of the new information; explain how this new information affects our understanding of the species and/or the need to list as DPSs. This may be reflected in section 4.0 Recommendations for Future Actions. If the DPS listing remains valid, go to section 2.2 Recovery Criteria. If the new information indicates the DPS listing is no longer valid, consider the 5-year review completed, and go to section 2.4 Synthesis.*
__X__ **No**, *go to section 2.2 Recovery Criteria*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan[1] containing objective, measurable criteria?

__X[1]__ **Yes**, *continue to section 2.2.2*
______ **No,** *consider recommending development of a recovery plan or recovery criteria in section 4.0 Recommendations for Future Actions and go to section 2.3 Updated Information and Current Species Status*

[1] Although the guidance generally directs the reviewer to consider criteria from final approved recovery plans, criteria in published draft recovery plans may be considered at the reviewer's discretion

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

__X__ **Yes,** *go to section 2.2.2.2*
______ **No,** *go to section 2.2.3 and note why these criteria do not reflect the best available information. Consider developing recommendations for revising recovery criteria in section 4.0*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? *(Note: if it can be clearly articulated how recovery criteria address all current threats to the species, evaluating whether recovery and /or downlisting criteria have been met in section 2.2.3 may be sufficient to evaluate the species listing classification and no further analysis may be necessary)*

__X__ **Yes,** *go to section 2.2.3*
______ **No,** *go to section 2.2.3 and note which factors do not have corresponding criteria. Consider developing recommendations for revising recover criteria in section 4.0*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information: *(for threats-related recovery criteria please note which of the 5 listing factors are addressed by the criterion. If any of the 5 listing factors are not relevant to this species, please note that here)*

If you answered yes to both 2.2.2.1 and 2.2.2.2, evaluating whether recovery and/or downlisting criteria have been met in section 2.2.3 may be sufficient to evaluate the species listing classification and no further analysis may be necessary; *go to section 2.4 Synthesis.*

Criteria for Considering Reclassification (from endangered to threatened, or from threatened to not listed) for Cook Inlet Beluga Whales (source: NMFS, 2016).

Status	Demographic Criteria		Threats-based Criteria
Reclassified from Endangered to Threatened (i.e., downlisted)	The abundance estimate for the CI belugas is greater than or equal to 520 individuals, and there is 95% or greater probability that the most recent 25-year population abundance trend (where 25 years represents one full generation) is positive.	AND	The 10 downlisting threats-based criteria are satisfied.

Reclassified to Recovered (i.e., delisted)	The abundance estimate for the CI belugas is greater than or equal to 780 individuals, and there is 95% or greater probability that the most recent 25-year population abundance trend (where 25 years represents of one full generation) is positive.	AND	The 10 downlisting and 9 delisting threats-based criteria are satisfied

In the 2008 listing decision, NMFS' review of the five factors identified the following threats to survival of the Cook Inlet beluga DPS: 1) development and pollutants (Factor A), 2) subsistence hunting (Factor B), 3) killer whale predation (Factor C), 4) lack of subsistence hunting regulations (Factor D), and 5) stranding (Factor E). The Recovery Plan identifies 10 potential threats linked to the relevant ESA Factor(s) and includes a determination of "relative concern" (presented in the following table).

Potential Threats, ESA Factors, and Determination of Relative Concern for Cook Inlet Belugas (source: NMFS, 2016).

Threat Type	ESA § 4(a)(1) factor	Major effect	Extent	Frequency	Trend	Prob-ability	Magnitude	Relative concern
Catastrophic events (e.g., natural disasters; spills; mass strandings)	A, D, E	Mortality, compromised health, reduced fitness, reduced carrying capacity	Localized	Intermittent & Seasonal	Stable	Medium to High	Variable Potentially High	High
Cumulative effects	C ,D, E	Chronic stress; reduced resilience	Range wide	Continuous	Increasing	High	Unknown Potentially High	High
Noise	A, D, E	Compromised communication & echolocation, physiological damage, habitat degradation	Localized & Range wide	Continuous, Intermittent, & Seasonal	Increasing	High	Unknown Potentially High	High
Disease agents (e.g., pathogens; parasites; harmful algal blooms)	C	Compromised health, reduced reproduction	Range wide	Intermittent	Unknown	Medium to High	Variable	Medium
Habitat loss or degradation	A	Reduced carrying capacity, reduced reproduction	Localized & Range wide	Continuous & Seasonal	Increasing	High	Medium	Medium
Reduction in prey	A, D, E	Reduced fitness (reproduction and/or survival); reduced carrying capacity	Localized & Range wide	Continuous, Intermittent, & Seasonal	Unknown	Unknown	Unknown	Medium

Threat Type	ESA § 4(a)(1) factor	Major effect	Extent	Frequency	Trend	Prob-ability	Magnitude	Relative concern
Unauthorized take	A, E	Behavior modification, displacement, injury or mortality	Range wide, localized hotspots	Seasonal	Unknown	Medium	Variable	Medium
Pollution	A	Compromised health	Localized & Range wide	Continuous, Intermittent, & Seasonal	Increasing	High	Low	Low
Predation	C	Injury or mortality	Range wide	Intermittent	Stable	Medium	Low	Low
Subsistence hunting	B, D	Injury or mortality	Localized	Intermittent	Stable or Decreasing	Low	Low	Low

In the Recovery Plan, NMFS linked each threat of high or medium concern to a recovery goal, objective, and specific downlisting and delisting criteria under each ESA Factor. These include 10 threats-based downlisting criteria (2 under Factor A, 1 under Factor B, 6 under Factor D, and 1 under Factor E), and 9 delisting criteria (2 under Factor A, 1 under Factor B, 1 under Factor C, 2 under Factor D, and 3 under Factor E). Recovery actions within the Recovery Plan are subdivided into two categories: Population Monitoring, Recovery Plan Implementation, and Education/Outreach actions (n = 12), and Threats Management actions (n = 52).

As of June 2014, the estimated abundance of the Cook Inlet beluga population was 340 whales (CV = 0.08) with the trend since the hunting quota (1999-2014) showing a rate of decline of 1.3% (SE = 0.7%, *P* (<0.0) = 97%) per year (Shelden et al. 2015). Therefore, the DPS does not meet the minimum demographic criteria for reclassification from endangered to threatened.

Shelden, K. E. W., C. L. Sims, L. Vate Brattström, K. T. Goetz, and R. C. Hobbs. 2015. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2014. AFSC Proc. Rep. 2015-03, 55 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-03.pdf

2.3 Updated Information and Current Species Status

The Recovery Plan includes the best available information on Cook Inlet beluga biology, habitat, and threats. Since release of the Draft Recovery Plan for public comment in May 2015 and prior to publication of the final Recovery Plan in December 2016, additional papers were peer-reviewed and published. Several are listed below and summarized under each category. This information increases our knowledge but does not change our understanding of the status of the Cook Inlet DPS or the relative concern levels of the threats presented in the 2016 Recovery Plan.

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Between 1998 and 2013, 38 necropsies were performed on beluga carcasses (23% of the known stranded carcasses reported in Cook Inlet (Fig. 1) during this time period) (Burek et al. 2015). The sample included adults (n = 25), juveniles (n = 6), calves (n = 3), and aborted fetuses (n = 4). When possible, a primary cause of death was noted along with contributing factors. Of these, 29% (n = 11) were unknown. Others were attributed to trauma (18%, n = 7), perinatal mortality (13%, n = 5), mass stranding (13%, n = 5), single stranding (11%, n = 4), malnutrition (8%, n = 3), or disease (8%, n = 3). Multiple animals had mild to moderate pneumonia, kidney disease, and stomach ulcers that likely contributed to death (Burek et al. 2015).

Figure 1. Study area and place names mentioned in the text.

Apparent mating behavior was photo-documented on two occasions in Cook Inlet during the spring of 2014 (Lomac-McNair et al. 2015). The timing of these observations, in April and May, corresponds with similar behaviors observed between captive belugas and aligns with peaks in ovulation, testes size, and calving periods of other wild populations.

Calving and nursery areas (defined by the presence of newborns) were documented over the course of 11 field seasons (2005-2015) during a photo-identification study conducted in Cook Inlet waters from late spring to early fall (McGuire et al. 2016). In all years, newborns were detected during a calving period that began in mid-July and ended in mid-October. Newborns were observed in every region surveyed over the course of the study season including the Susitna delta (between the Beluga River and Little Susitna River), Knik Arm, Turnagain Arm, Chickaloon Bay, and the Kenai River.

A review and analysis of stomach contents collected from beluga carcasses from all five stocks found in Alaska was published in 2015 (Quakenbush et al. 2015). A total of 53 stomachs were analyzed from Cook Inlet separated across two time periods due to how contents were examined and quantified. Twenty-four stomachs from the earlier time period (1992–2001) were collected between April and October; 7 (29%) were empty. Eulachon (*Thaleichthys pacificus*) and Chinook salmon (*Oncorhynchus tshawytscha*) were the only prey identified to species and no invertebrates were reported (though these remains may have been missed by visual inspectors). Empty stomachs occurred in summer and fall. Almost half of the stomachs sampled during this time period (n = 16) were from belugas taken during the Native subsistence hunt. Twenty-eight stomachs for the period 2002–12 were collected between March and November. Ten (36%) were empty (June n = 1, Aug. n = 2, Sept. n = 2, Oct. n = 4, Nov. n = 1). Of the remainder, 17 (94%) contained fish remains and 9 (50%) contained invertebrates. Most of the stomachs sampled during this time period were collected from dead stranded belugas (n = 24). The fish remains from the 2002-12 sample included at least 12 species representing 7 families: salmon (67% FO: frequency of occurrence in individual stomachs), cod (39% FO), smelt (11% FO), and flounder (11% FO) were most prevalent. Salmon (*Oncorhynchus* sp.) that could be identified to species included Coho (28% FO, 21% N: % of total fish prey in stomachs), chum (17% FO, 8% N), and Chinook (11% FO, 2% N). Cod species included saffron cod (22% FO, 26% N), walleye pollock (17% FO, 10% N), and Pacific cod, *Gadus macrochephalus* (6% FO, 1% N). Eulachon (11% FO 12% N) was the only smelt identified, and yellowfin sole, *Limanda aspera* (11% FO, 2% N) and starry flounder, *Platichthys stellatus* (6% FO, 1% N) were the only flounders. One longnose sucker, *Catostomus catostomus*, was the only freshwater fish found. Shrimp, polychaetes, and amphipods made up the bulk of the invertebrate prey. Eight species of invertebrates were identified, predominantly shrimp (39% FO), followed by polychaetes and amphipods, each represented at 11% FO. Crustaceans and cod were consumed by at least one whale in each month represented in this sample (March, July, August, September and October). Almost all whales had consumed salmon and/or smelt in addition to other prey items with the exception of four whales (July (1), August (1), October (2)) that had consumed crustaceans, sculpins, and/or cod. Either stomachs were empty (e.g., June and November) or carcasses were not found (December-February, April-May) during the latter sampling period.

Unfortunately, we still do not have stomach samples for the period November-February.

Rouse et al. (in review) examined a male beluga in October 2013 that stranded in Turnagain Arm after asphyxiating on a starry flounder. Due to this beluga's excellent body condition, and both chronic and acute wounds in the larynx, this may have been a repeated behavior for this particular animal that ended fatally in this instance. Starry flounder may have been the preferred prey of this individual whale during the fall (when it died) following the end of anadromous fish runs in the inlet. Starry flounder and yellowfin sole were also among the prey species consumed by an adult male beluga that died in Turnagain Arm in October 2003 (Hobbs et al. 2008). Fay (1971) included flounder among the preferred prey for western Arctic belugas in the spring, summer, and fall. While Rouse et al. (in review) did not consider this to be a probable contributing factor to the decline of the Cook Inlet beluga population, it is nonetheless noteworthy and may speak to potential reduced prey type availability or prey item shifts by Cook Inlet beluga whales.

Determining when and where whales are feeding has been a difficult undertaking. Castellote et al. (2011) noted changes in echolocation and calling in belugas when feeding, finding when whales appeared to be feeding echolocation tended to occur in train packets often followed by a terminal buzz, and that social calls were absent. These acoustic characteristics were detected almost exclusively in river mouths. The authors noted that this behavior can be acoustically monitored remotely and has the potential to be used as an indirect indicator of foraging behavior.

Burek-Huntington, K.A., J. Dushane, C.E.C. Goertz, L. Measures, C. Romero, and S. Raverty. 2015. Morbidity and mortality in stranded Cook Inlet beluga whales (*Delphinapterus leucas*). Dis. Aquat. Organ. 114(1):45-60. DOI:10.3354/dao02839

Castellote, M., T. McGuire, C. McKee, and M. Lammers. 2011. Can we hear Cook Inlet beluga whales feeding? Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote01_hear-belugas-feeding.pdf

Lomac-McNair, K.S., M.A. Smultea, M.P. Cotter, C. Thissen, and L. Parker. 2015. Socio-sexual and probable mating behavior of Cook Inlet beluga whales, *Delphinapterus leucas*, observed from an aircraft. Mar. Fish. Rev. 77(2):32-39. doi: dx.doi.org/10.7755/MFR.77.2.2

McGuire, T., A. Stephens, and B. Goetz. 2016. The Susitna River Delta as a calving ground: Evidence from observation of a Cook Inlet beluga birth and the 2005-2015 seasonal and geographic patterns of neonate occurrence in Upper Cook Inlet. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK https://alaskafisheries.noaa.gov/sites/default/files/2016finalamssposter.pdf

Quakenbush, L.T., R.S. Suydam, A. L. Bryan, L.F. Lowry, K.J. Frost, and B.A. Mahoney. 2015. Diet of beluga whales, *Delphinapterus leucas*, in Alaska from stomach contents, March–November. Mar. Fish. Rev. 77(1):70–84. (doi: 10.7755/MFR.77.1.7)

Rouse, N., K. Burek-Huntington, and K. Shelden. In review. Asphyxiation of an endangered Cook Inlet beluga whale, *Delphinapterus leucas*. Marine Fisheries Review.

2.3.1.2 Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Since publication of Hobbs et al. (2000a,b), 13 abundance surveys (Hobbs et al. 2015a, Shelden et al. 2015) and 8 calf index aerial surveys (Hobbs et al. 2015b) have been conducted in Cook Inlet. The most recent abundance estimate of 340 whales (CV = 0.08, 95% CI = [291, 398], Nmin = 318) in June 2014 (Shelden et al. 2015a) falls within the range of abundance estimates from the last 10 survey years (278 – 375 whales). The 10-year trend (2004-2014) was -0.4% per year with a SE of 1.3% (i.e., a declining trend: *P* (< 0.0) = 62%). During the period since management of the Alaska Native subsistence hunt began (1999-2014), the trend was -1.3% per year with a SE of 0.7% (i.e., a declining trend: *P* (< 0.0) = 97%).

Hobbs et al. (2015a) reanalyzed the abundance time series for the period when annual surveys occurred (1994-2012), after which a biennial survey schedule was adopted (Hobbs 2013). The reanalysis included revising coefficients of variation (CVs) for each abundance estimate and revisiting the sector analysis used prior to 2004. The revised estimates of variance yielded CV values that, in all cases, were less than those calculated by the equation of Hobbs et al. (2000b), and in some cases, were reduced nearly by half by explicitly accounting for the variation in beluga diving behavior (albeit from limited data, i.e., one tagged whale).

Changes in survey methodology introduced in 2004 (i.e., increasing the number of survey days and no longer splitting the upper inlet into separate sectors) addressed the concern that beluga groups moving between sectors could bias the estimate. Hobbs et al. (2015a) found abundance estimates from each 1-week period were not significantly different from the estimate that included both weeks and did not split the upper inlet (n = 9 (2004–2012), T-test = 2.12; p = 0.52 (Week 1 vs. Abundance without sectors), p = 0.61 (Week 2 vs. Abundance without sectors), p = 0.48 (Weeks averaged vs. Abundance without sectors)). Trend analysis using the “weeks averaged” estimates yielded an average annual rate of decline of -1.50% (SE = 0.86%). The possible trends when week 1 and week 2 were analyzed in all 512 possible combinations by year ranged from -2.56% to -0.56% with an average annual growth rate of -1.57%. All of these fell within the 95% confidence interval of the original trend (-3.24%, +0.01%). Overall, the trend in growth remained negative regardless of the choice of weeks, averaging the weeks, or applying sector analysis (Hobbs et al. 2015a).

Throughout each abundance survey, beluga whales were seen near the coast and within river mouths in all years, and after 2000, nearly all of the sightings occurred in the northernmost portions of the inlet (Hobbs et al. 2015a, Shelden et al. 2015a). Belugas were found in the Susitna delta region (defined as the area between Point MacKenzie and the Beluga River) throughout the survey time series. Whales were also seen in large numbers in Knik Arm from 1997 to 2003, with a few observations continuing until 2007, after which none were found in this region during the June surveys (Fig. 2). From 2004 to 2007, more whales were observed in the Chickaloon Bay–Turnagain Arm region, coincident with the lower numbers seen in Knik Arm. Smaller numbers of belugas (group sizes ranging from 1 to 27 whales) have been observed in areas south of North Foreland and Point Possession (Fig. 3), but not consistently.

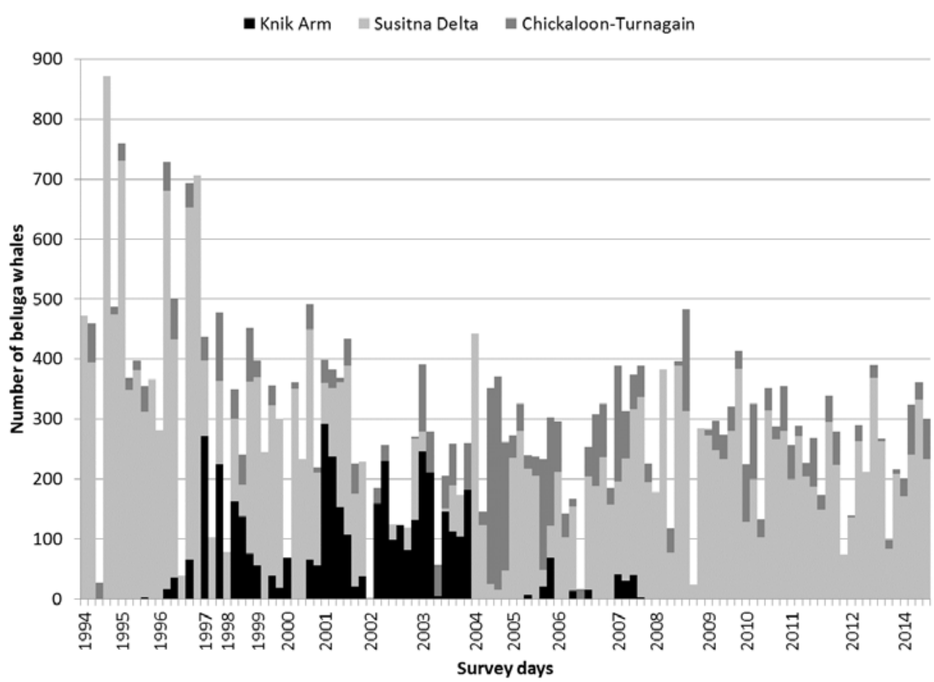

Figure 2. Regions occupied by beluga whales in upper Cook Inlet, Alaska, north of North Foreland and Point Possession: Knik Arm, Chickaloon Bay–Turnagain Arm, and the Susitna delta (defined as the area between Beluga River and Point MacKenzie) from 1994 to 2014. Each survey day is represented as a single bar above and following the year indicated on the x-axis. (Originally published in Hobbs et al. 2015a for the period 1994-2012).

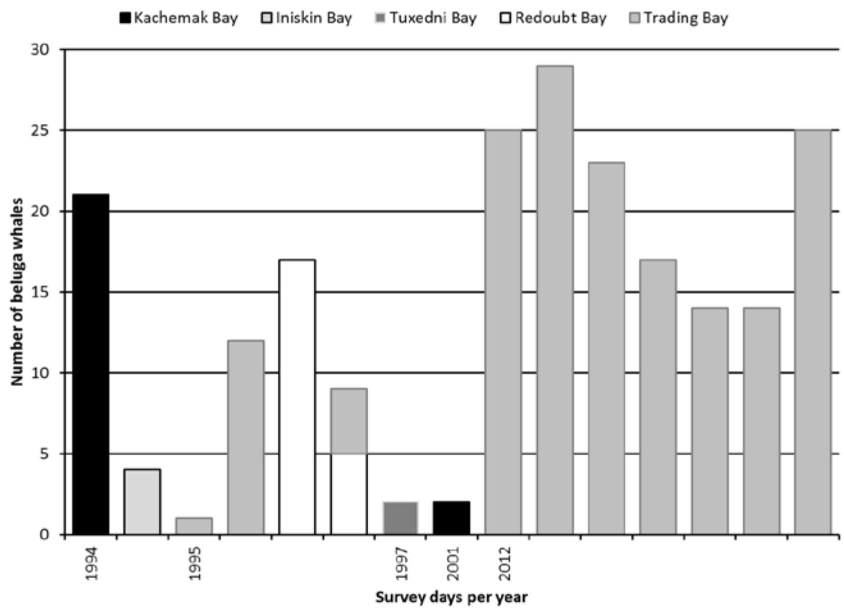

Figure 3. Regions occupied by beluga whales in Cook Inlet, Alaska, south of North Foreland and Point Possession: Kachemak Bay, Iniskin Bay, Tuxedni Bay, Trading Bay, and Redoubt Bay, from 1994 to 2014. Each survey day is represented as a single bar above and following the year indicated on the x-axis. (Originally published in Hobbs et al. 2015a for the period 1994-2012).

A population viability analysis (PVA) model was developed to evaluate this population's risk of extinction and decline over 50 and 100 years (Hobbs et al. 2015b). Model assumptions and parameter sensitivity were tested by varying survival and fecundity rates, frequency of catastrophic events, predation level, and group mortality events and carrying capacity. While the different model scenarios showed considerable variation in extinction risk within 50 years (0–18%), and 100 years (0–38%), and probability of decline (1–71%), only the assumption of an intrinsic rate of growth greater than 2%, among the least likely scenarios (Models A, C–E), reduced the risk of further decline to 1–2%.

Almost all model scenarios that included unusual mortality events (Models G–L) had probabilities of extinction within 50 years (2–18%, with the exception of Model G = 0%) unlike scenarios without (0–1%). Both predation and group mortality events were shown to create thresholds below which the population could not recover. Models including threshold effects had probabilities of extinction as much as 25% higher than similar models without. In Model B, with no threshold effects, and with no subsistence hunt after 2014, the population declines in 53% of the cases, with a probability of recovery in 100 years of 14%.

The model scenarios that best fit the existing Cook Inlet beluga whale data (Models B, F, M–O) included a per capita mechanism increasing mortality (Models B, F, O), mortality from killer whale, *Orcinus orca*, predation (Models F, N, O), or a reduction in Cook Inlet carrying capacity (Models M–O). To the five most likely models we add Model K to account for the risk of catastrophic events. Model scenarios B, F, K, M–O were used to estimate the range of the probability of extinction: these had a probability of decline between 42% and 71%, and a probability of extinction between 0% and 14% in 100 years. In 2008, Hobbs and

Shelden (2008) estimated the range of extinction risk to be between 1% and 27% in 100 years from a similar set of models. In the current analysis (Hobbs et al. 2015b), Models B, F, and K correspond to Models a, d, and h in Hobbs and Shelden (2008), respectively. There are no equivalents for Models M, N, and O in Hobbs and Shelden (2008) and the current analysis includes no equivalents for their Models c, e, and g. Models a, d, and h in Hobbs and Shelden (2008) had extinction risks of 1%, 12%, and 26% in 100 years, respectively; consequently, they spanned the range of extinction risks (i.e., 1–27%) in that paper, but are roughly twice the values for the corresponding models in the Hobbs et al. (2015b) analysis.

There are several reasons for these changes. First, the analyses in Hobbs et al. (2015b) have 20 abundance estimates, up from the 15 estimates used in the earlier analysis. These additional data supported the selection of annual growth rates close to zero; consequently, there is a more precise estimation of the growth rate parameter with fewer outliers that would be low and trend towards extinction. Second, the mean growth rate for Model B is 0.1%/yr with 53% of cases declining, while the corresponding Model a in Hobbs and Shelden (2008) had a mean growth rate of -0.4%/yr and 62% of cases declining, which supported this slightly improved outlook. In other words, with more data the recent trend of the population has been estimated more precisely and it has been found to be roughly stable or slowly declining. Thus, although the population is not increasing as expected, the data indicate the population is not declining precipitously, and, therefore, the probability of extinction is lower than in the previous analyses (i.e., Hobbs and Shelden 2008).

The NMFS ESA listing decision in 2008 (73 Fed. Reg. 62919, 62923) was based in part upon a 26% chance of extinction within 100 years (Model h from Hobbs and Shelden 2008). Model K in Hobbs et al. 2015b (14% probability of extinction within 100 years) most closely corresponds to the earlier Model h. Models K and h were not identical in that in Model h of Hobbs and Shelden (2008) the mortality rate was fixed at 20% and the probability of an event was fixed at 5%; consequently, the expected mortality was 1%/yr. In Model K these percentages were allowed to vary with the mortality rate chosen from between 10% and 50%, and the probability selected so that the expected mortality per year met a value selected by the model for that case. Model K also included per capita mortality and predation mortality, so the three were competing. In Model K, the average values of the probability of an event was 3.1% and the expected annual mortality from catastrophic events was 0.7%; therefore, Model K selected fewer events with a lower expected mortality rate than in Model h, which resulted in a decreased risk of extinction. Thus the effect of catastrophic mortality events was reduced in Model K compared to model h in Hobbs and Shelden (2008). The performance of Models B, F, and M–O relative to existing population data indicates that the observed decline of the population is likely due to reduced carrying capacity or a per capita or chronic decrease in survival or reproduction.

Hobbs et al. (2015c) further explored the possibility of a reduced calving rate. Systematic aerial surveys were conducted in August covering primary habitat in upper Cook Inlet and were compared to similar surveys conducted in

June. Calves were identified in video images and assigned a proximity number (1-5) in relation to adults visible in the same video clip (with 1 being a calf next to an adult, progressing through greater distances from an adult (2-4), with 5 being the calf alone in the field of view). Two indices were created for the analyses: Index 1 that presumed all young-of-the-year calves in the Proximity 1 category, and Index 1-5 that included all dependent calves (young-of-the-year to pre-weaning) and proximity codes such that Index 1 was nested within Index 1-5.

The average relative size of apparent calves within each proximity category was estimated for June and August for each year (2006-2012) and overall. The June calves tended to be relatively larger overall compared to those observed in August, consistent with the assumption that most calves are not born until later in the summer. The calves in the June sample would be 10 to 12 months old while the calves in August would be zero to 2 months old. In August, this difference was particularly evident in the proximity 1 category (i.e., calf touching adult) which represented 40% of the calf sample (compared to 25% of the June calf sample) which is consistent with observations by Krasnova et al. (2006) during which calves younger than 2 months were nearly always in contact with their mother.

For both months, the proximity 1 category produced the smallest (i.e. youngest) calves, while the other categories (excluding August proximity 5) included larger (older) calves. These results are consistent with the analysis in Suydam (2009) which showed that animals estimated to be 1 year old or older (based on size) spend less time in close proximity to an adult than smaller calves (<1 year old). The August proximity 5 calves (alone in field of view) may also include young-of-the-year based on relative size. Young-of-the-year calves are known to surface more frequently than the accompanying adult (Krasnova et al. 2006, Suydam 2009), and given the turbid waters of Cook Inlet, the mother was likely present but submerged.

Beluga groups were found in greater numbers in the Susitna area in both June and August (Hobbs et al. 2015c). This was not surprising as the Susitna area has always been an area of high occupancy even as this population has declined in numbers (Rugh et al. 2010, Shelden et al. 2015b). Calves were smaller in August than June within this area. Similar to the annual averages, the proximity 1 category included the youngest calves while the other categories (excluding August proximity 5) were represented by older calves. After 2007, belugas were no longer found in Knik Arm in June but continued to be present in this area in August in all years but 2007 during the aerial surveys. Relative sizes of calves within this area were similar in June and August with most being smaller and thus likely young-of-the-year. This suggests the Knik area may be an important nursery area. The Turnagain area has been consistently occupied in June, but whales were not present in 2009 and 2011 in August during the aerial surveys. Few calves were found in the Turnagain area and almost all relative sizes were much larger than those in Knik Arm suggesting that these calves were older than a yearling in both June and August.

In June, indices were similar across years with Index 1 calves representing 0.4% to 1.5% of the population and Index 1–5 calves between 1.5% and 5.7%

((Hobbs et al. 2015c). The 7-yr (2006–12) average for Index 1 in June was about 1.2% (SD = 0.5%). The consistent low numbers for Index 1 suggest that the young-of-the-year calves, which by June would be 10–12 months old, no longer maintained close contact with the mother and instead behaved more like yearlings and older calves. August was significantly different from June. In August 2006, young-of-the-year calves made up 12% of the population (Index 1) and both indices were fairly close, suggesting that it was a relatively good year for new calves. The large percentage of calves in 2006 would be encouraging for the health of the population and could be a highly sustainable level if it occurred in all years. The 7-yr (2006–12) average was 3.3% (SD = 3.8%). However, rates from 2007 to 2012 were between 0.5% and 3.5%, with a 6-yr average of 1.9%. The large number of young-of-the-year calves in August 2006 would be expected to show up in Index 1-5 in June 2007, and although it was the largest for the June time series at about 6% of the population, no large increases or declines occurred in subsequent years as occurred in August. The low percentage in August 2010 was not reflected in either of the June 2011 indices. Therefore, a retrospective analysis of video data from earlier June surveys (1995–2005) would not be useful for estimating a calf index given this lack of correspondence (Hobbs et al. 2015c).

The 7-yr average per capita calving rate in August, assuming that Index 1 is unbiased, was 3.5% (SD = 4.3%). With this average per capita birth rate, the average annual mortality would have to be less than 3.5% for the population to increase (Fig. 9). A minimum value of 2% (SD = 1.2%) for the period 2006–12 can be estimated from the number of carcasses discovered each year (which was likely an underreporting of total mortalities given the difficulty of detecting carcasses in Cook Inlet). When the 6-yr period following 2006 (2007–12) was considered, the average per capita birth rate was 1.9% (SD = 1.1%, 2007–12)) compared to a minimum mortality rate of 1.9% (SD = 1.2%, 2007–12). This suggests that the birth rate was probably at or below the replacement level in those years. Although the biases in the indices have not been estimated, the range indicates that birth rates per adult female were probably low in most years and the average of the estimated per capita birth rates for the years 2007–12 was about 15% of the level in 2006. Assuming that adult females make up about 30% of the population, then 44% of adult females gave birth in 2006, and in an average year (2006–12), 12% gave birth which was one-third the maximum rate estimated for other Alaska beluga populations (Burns and Seaman 1986). In Cook Inlet, it was likely that the birth rate per adult female was lower than the maximum rate but this cannot be confirmed without an estimate of percent mature females within this population (Hobbs et al. 2015c).

Burns, J.J., and G.A. Seaman. 1986. Investigations of belukha whales in the coastal waters of western and northern Alaska: II. Biology and ecology. U.S. Dep. Commer., NOAA, Natl. Ocean Serv., Anchorage, Alaska, Final Rep., Res. Unit 612, 129 p.

Hobbs, R.C. 2013. Detecting changes in population trends for Cook Inlet beluga whales (*Delphinapterus leucas*) using alternative schedules for aerial surveys. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-252, 25p.

Hobbs, R.C., J.M. Waite, and D.J. Rugh. 2000a. Beluga, *Delphinapterus leucas*, group sizes in Cook Inlet, Alaska, based on observer counts and aerial video. Mar. Fish. Rev. 62(3):46–59.

Hobbs, R.C., D.J. Rugh, and D.P. DeMaster. 2000b. Abundance of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2000. Mar. Fish. Rev. 62(3):37–45.

Hobbs, R.C., K.E.W. Shelden, D.J. Rugh, C.L. Sims, and J.M. Waite. 2015a. Estimated abundance and trend in aerial counts of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2012. Mar. Fish. Rev. 77(1):11–31. (doi: 10.7755/MFR.77.1.2)

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, L. Vate Brattström, and D.J. Rugh. 2015b. Annual calf indices for beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 2006-12. Mar. Fish. Rev. 77(2): 40–58. (doi:10.7755/MFR.77.2.3)

Hobbs, R.C., P.R. Wade, and K.E.W. Shelden. 2015c. Viability of a small, geographically-isolated population of beluga whales, *Delphinapterus leucas*: effects of hunting, predation, and mortality events in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):59-88. doi: dx.doi.org/10.7755/MFR.77.2.4

Krasnova, V.V., V.M. Bel'kovich, and A.D. Chernetsky. 2006. Mother-infant spatial relations in wild beluga (*Delphinapterus leucas*) during postnatal development under natural conditions. Biol. Bull. 33(1):53–58. (doi:10.1134/S1062359006010079).

Rugh, D.J., K.E.W. Shelden, and R.C. Hobbs. 2010. Range contraction in a beluga whale population. End. Species Res. 12:69–75. (doi:10.3354/esr00293).

Shelden, K.E.W., C.L. Sims, L. Vate Brattström, K.T. Goetz, and R.C. Hobbs. 2015a. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2014. AFSC Proc. Rep. 2015-03, 55 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-03.pdf

Shelden, K.E.W., K.T. Goetz, D.J. Rugh, D.G. Calkins, B.A. Mahoney, and R.C. Hobbs. 2015b. Spatio-temporal changes in beluga whale, *Delphinapterus leucas*, distribution: results from aerial surveys (1977–2014), opportunistic sightings (1975–2014), and satellite tagging (1999–2003) in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):1–31. (doi:10.7755/MFR.77.2.1).

Suydam, R.S. 2009. Age, growth, reproduction, and movements of beluga whales (*Delphinapterus leucas*) from the eastern Chukchi Sea. Ph.D. dissert., Univ. Wash., Seattle, 169p.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

A small number of beluga whales (fewer than 20 animals) are regularly observed in Yakutat Bay. Although not included in the Cook Inlet DPS, NMFS regulations under the Marine Mammal Protection Act (MMPA) (50 CFR 216.15) include the beluga whales occupying Yakutat Bay as part of the depleted Cook Inlet stock (75 FR 12498, 16 March 2010). Based on genetic analyses, TEK spanning 80 years, and observations reported year-round, the Yakutat beluga whales likely represent a small, resident group that is reproductively separated from Cook Inlet (Lucey et al. 2015, O'Corry-Crowe et al. 2015). Furthermore, this group appears to be showing signs of inbreeding and low diversity due to their isolation and small numbers (O'Corry-Crowe et al. 2015). Notice-and-comment rulemaking procedures would be required to change this NMFS regulatory definition under the MMPA or ESA. Until such procedures are completed, Yakutat Bay belugas remain designated as depleted and part of the Cook Inlet stock under the MMPA, but are not part of the Cook Inlet DPS under the ESA.

O'Corry-Crowe, G., W. Lucey, F.I. Archer, and B. Mahoney. 2015. The genetic ecology and population origins of the beluga whales, *Delphinapterus leucas*, of Yakutat Bay. Mar. Fish. Rev. 77(1):47–58. doi: dx.doi.org/10.7755/MFR.77.1.5.

Lucey, W., H.E. Abraham, G. O'Corry-Crowe, K.M. Stafford, and M. Castellote. 2015. Traditional knowledge and historical and opportunistic sightings of beluga whales, *Delphinapterus leucas*, in Yakutat Bay, Alaska. Mar. Fish. Rev. 77(1):41–46. doi: dx.doi.org/10.7755/MFR.77.1.4

2.3.1.4 Taxonomic classification or changes in nomenclature:

No additional information is available.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Review of beluga presence data from aerial surveys, satellite-tagging, and opportunistic sightings collected in Cook Inlet from the late 1970s to 2014 show their range has contracted remarkably since the 1970s (Shelden et al. 2015). Almost the entire population is found in northern Cook Inlet waters from late spring through the summer and into the fall. This differs markedly from surveys in the 1970s when whales were found in, or would disperse to, lower Cook Inlet by midsummer.

Since 2008, on average 83 percent of the total population occupied the Susitna delta in early June during the aerial survey period, compared to roughly 50 percent in the past (1978-79, 1993-97, 1998-2008) (Fig. 4). The 2009-14 range was estimated to be only 25% of the range observed in 1978-79 (Shelden et al. 2015). Rugh et al. (2000) first noted that whales had not dispersed to the lower inlet in July during surveys in the mid-1990s. This was also evident during aerial surveys conducted in July 2001 (Rugh et al. 2004). Whales transmitting locations from satellite tags during July in 1999 and 2002 also remained in the northern reaches of the upper inlet (Shelden et al. 2015). During surveys in the 1970s, large numbers of whales were scattered throughout the lower inlet in August (Shelden et al. 2015). This was not the case in 2001, when counts in the upper inlet were similar to those reported that June and July (Rugh et al. 2004). Only two of ten tagged whales spent time in offshore waters and the lower inlet in August (Shelden et al. 2015). Numbers of whales observed during August calf index surveys conducted from 2005 to 2012 were also within the range of counts reported during the June surveys (Hobbs et al. 2015, Shelden et al. 2015).

This contraction in range appears to have continued into late summer. While surveys were not conducted in September during the 1970s and 1980s, aerial surveys in 1993 suggest some dispersal into lower inlet waters by late September (Shelden et al. 2015). However, surveys in September and October of 2001 resulted in counts that were within the range of counts made in June that same year (Rugh et al. 2004). With the exception of three whales that spent brief periods of time in the lower inlet in September and/or October, most whales transmitting locations in 1999, 2000, 2001, and 2002 remained in the upper inlet north of East and West Foreland (Shelden et al. 2015). Counts during aerial surveys in September 2008 were also within the range of counts obtained during surveys in June (Shelden et al. 2015). The population appears to now be consolidated into habitat in the upper-most reaches of Cook Inlet for much longer periods of time, habitat that is most prone to effects of anthropogenic development (e.g., Kendall and Cornick 2015, Norman et al. 2015).

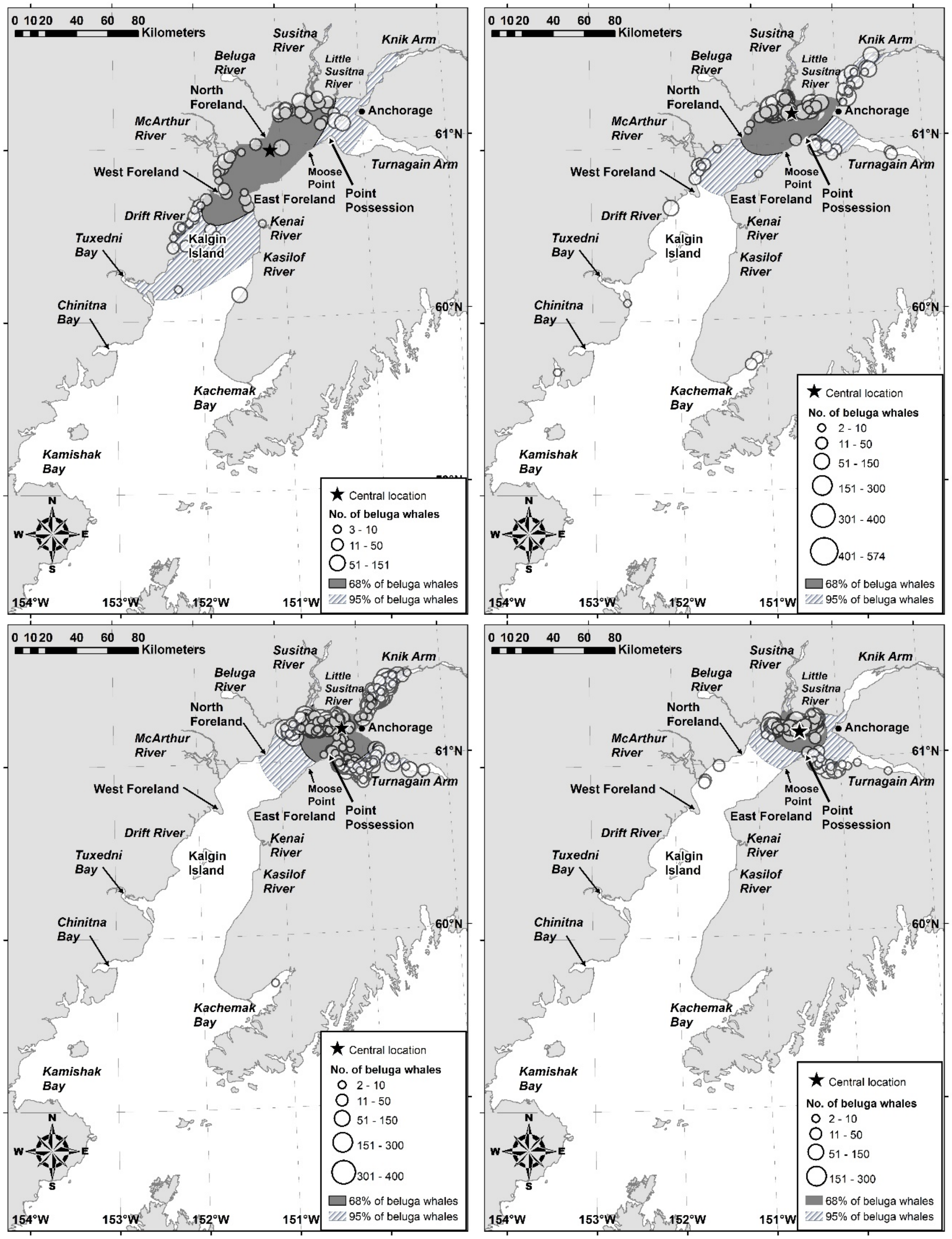

Figure 4. Areas occupied by beluga whales in Cook Inlet, Alaska, during systematic aerial surveys in 1978–79 (upper left panel), 1993–97 (upper right panel), 1998–2008 (lower left panel), and 2009–14 (lower right panel). The distribution of beluga whales around each central location for each period was calculated at 1 and 2 SD (capturing ca. 68% and 95% of the whales; shaded regions). 95% core summer distribution contracted from 7,226 sq. km in 1978–79 to 1,787 sq. km in 2009–14 (25% of the 1978–79 range) (Originally published as Figure 6 in Shelden et al. 2015).

We still lack information about winter distribution for Cook Inlet belugas. Tagging data and opportunistic sightings show whales continued to enter coastal areas of the upper inlet despite, in some instances, heavy ice conditions (Shelden et al. 2015). Unfortunately, the combination of poor sighting conditions (low light levels in winter and white whales among ice floes) and whale behavior (close association with ice, longer, deeper diving patterns, and smaller groups) made it difficult to ground truth or even detect groups during this season. This was most evident during the NMFS survey that overlapped with tagged whale locations and detected whales in January but not in February of 2002 (Shelden et al. 2015). Combining satellite-tagging with real-time acoustic monitoring and aerial ground truthing may be the best option for quantifying habitat use patterns and visual detectability during winter. Acoustic monitoring studies are currently underway in Cook Inlet (e.g., Castellote et al. 2011), detecting whales year-round, along with development of a year-round baseline of the acoustic environment in the Susitna delta.

Castellote, M., R.J. Small, S. Atkinson, M.O. Lammers, J. Jenniges, A. Rosinski, C. Garner, S. Moore, and W.W.L. Au. 2011. Acoustic monitoring of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska. J. Acoust. Soc. Am. (130):2459. (doi: 10.1121/1.3654879).

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, L. Vate Brattström, and D.J. Rugh. 2015. Annual calf indices for beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 2006-12. Mar. Fish. Rev. 77(2): 40–58. (doi:10.7755/MFR.77.2.3)

Kendall, L.S., and L. Cornick. 2015. Behavior and distribution of Cook Inlet beluga whales (*Delphinapterus leucas*) before and during pile driving activity. Mar. Fish. Rev. 77(2):106–114. (doi: 10.7755/MFR.77.2.6).

Norman, S.A., R.C. Hobbs, C.E.C. Goertz, K.A. Burek-Huntington, K.E.W. Shelden, W.A. Smith, and L.A. Beckett. 2015. Potential natural and anthropogenic impediments to the conservation and recovery of Cook Inlet beluga whales, *Delphinapterus leucas*. Mar. Fish. Rev. 77(2):89–105. (doi: 10.7755/MFR.77.2.5).

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

Rugh, D.J., B.A. Mahoney, and B.K. Smith. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-145, 26 p.

Shelden, K.E.W., K.T. Goetz, D.J. Rugh, D.G. Calkins, B.A. Mahoney, and R.C. Hobbs. 2015. Spatio-temporal changes in beluga whale, *Delphinapterus leucas*, distribution: results from aerial surveys (1977–2014), opportunistic sightings (1975–2014), and satellite tagging (1999–2003) in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):1–31. (doi:10.7755/MFR.77.2.1).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Goetz et al. (2012a.b) built upon spatial analyses previously published on early summer distribution in Cook Inlet observed during the abundance surveys (Goetz et al. 2007) and behaviors of satellite-tagged Cook Inlet whales (Hobbs et al. 2005). Since publication of Goetz et al. (2007), additional parameters and models were considered when quantifying preferred habitat during the early summer period (Goetz et al. 2012a). Goetz et al. (2012) modeled habitat preferences using the NMFS 1994–2008 abundance survey data. They found that in large areas, such as the Susitna Delta and Knik Arm, there was a high probability of beluga presence, and when present, group sizes were likely to be larger. Presence also increased closer to rivers with Chinook salmon, *Oncorhynchus tshawytscha*, runs (such as the Susitna River), and the Susitna Delta also supports two major spawning migrations of eulachon, *Thaleichthys pacificus*, a small, schooling smelt, in May and July. Stomachs from stranded belugas collected at the same time as the NMFS abundance surveys contained only Pacific salmon (Quakenbush et al. 2015).

It is not clear why belugas have not been seen in Knik Arm in June from 2008 to 2014 (Shelden et al. 2015). This change in distribution was not evident in the analyses presented by Goetz et al. (2012a) because analyses ended with the June 2008 survey. Knik Arm was not abandoned for the entire summer, however, as large groups were observed there every August during the period 2008–12 (Hobbs et al., 2015a). Goetz et al. (2012a) noted that anthropogenic disturbance, characterized as distance relative to coastal cities and oil development, was a significant predictor of beluga presence. Though presence increased with distance from these areas, the authors cautioned that many of the anthropogenic sources were south of the Susitna delta, and that prey preferences rather than avoidance of development may be a stronger driver for this predicted distribution.

Belugas appear to have stronger site fidelity during the early summer period, as evidenced by a single tagged whale and aerial survey records (Shelden et al. 2015). The one whale tagged during the beginning of this season transmitted locations throughout the entire summer period, remaining in the Susitna Delta from late May to late July, before exploring Turnagain Arm in late July, and Knik Arm in August. While some of the whales tagged in late July and August moved throughout the upper inlet in August, others remained for long periods in a few locations such as Knik Arm, the Susitna Delta, and Turnagain Arm (Shelden et al. 2015).

Preliminary analyses of the dive data collected by the tags indicate whales made shorter, shallower dives during the period from June to November compared to the longer, deeper dives recorded during December to May (Goetz et al. 2012b). Closer examination of the whale tagged in late May 1999 showed time at surface increased daily over a 2-week period from 31 May to 11 June (Hobbs et al., 2015b). This would be expected as belugas follow anadromous fish runs into shallow channels within the tidal flats of the Susitna Delta. Spending more time at the surface also increases the likelihood of aerial observers detecting these whales. Near the end of August, two of the tagged whales spent brief periods in the lower inlet. In all three years, a few whales spent time in mid-inlet waters of the upper inlet in August. These behaviors may be representative of much larger groups of whales. Unfortunately, lower inlet and most mid-inlet tag locations did not coincide with aerial survey effort or opportunistic sightings (Shelden et al. 2015).

Despite the possibility of ice entrapment, belugas remained in upper inlet waters during winter (Shelden et al. 2015). Large tidal fluctuations create a dynamic ice environment such that whales were able to access the upper reaches of Knik Arm and Turnagain Arm during the winter period. Although tagged whales transmitting locations in 2001 never entered these areas, opportunistic sightings confirmed whales were present (Shelden et al. 2015). Goetz et al. (2012b) found that movements of tagged belugas were influenced by the presence of ice in Cook Inlet during the winter. After examining the biweekly proportion of ice type (ranging from very open pack to compact ice) throughout the inlet, from Dec. 2001–Mar. 2002 and Dec. 2002–Apr. 2003, total ice cover was always less than 50% for every 2-week period. When ice was present, belugas were most commonly found in open pack ice (winter of 2001–02) and very open pack ice (winter of 2002–03). During the winter of 2001–02, belugas ($n = 2$) preferred open water only 2% of the time when ice was present compared to 30% during the winter of 2002–03 ($n = 3$). On most occasions when belugas preferred open water, ice covered less than 10% of Cook Inlet.

In addition to this close association with ice, diving was another behavior that may have confounded detection during winter aerial surveys. Analysis of the tag data indicates that whales were diving deeper and longer during the period December–May compared to the period June–November (Goetz et al. 2012b). Average depth (m) and duration (minutes) increased almost three times, from 3.0 m (SD = 4.7) to 8.2 m (SD = 12.3) and 1.6 minutes (SD = 1.9) to 5.2 minutes (SD = 5.5) for the 11 whales equipped with ST-16 tags (Goetz et al. 2012b).

In spring, when the ice breakup begins, whales gather together as they regain access to river mouths (Shelden et al. 2015). In early spring, whales continued to move throughout mid-inlet waters. Not until late spring and early summer, when anadromous fish return to natal streams, did whale behaviors shift to longer surfacing periods and shallower diving patterns (Hobbs et al. 2015b; Goetz et al. 2012b). Group sizes tended to be smaller in spring, until the end of May when whales began to coalesce into larger groups at the river mouths (Shelden et al. 2015).

Goetz, K.T., D.J. Rugh, A.J. Read, and R.C. Hobbs. 2007. Habitat use in a marine ecosystem: beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Mar. Ecol. Prog. Ser. 330:247–256. (doi: 10.3354/meps330247).

Goetz, K.T., R.A. Montgomery, J.M. Ver Hoef, R.C. Hobbs, and D.S. Johnson. 2012a. Identifying essential summer habitat of the endangered beluga whale *Delphinapterus leucas* in Cook Inlet, Alaska. Endang. Species Res. 16:135–147. (doi: 10.3354/esr00394).

Goetz, K.T., P.W. Robinson, R.C. Hobbs, K.L. Laidre, L.A. Huckstadt, and K.E.W. Shelden. 2012b. Movement and dive behavior of beluga whales in Cook Inlet, Alaska. AFSC Proc. Rep. 2012-03, 40 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2012-03.pdf

Hobbs, R.C., K.L. Laidre, D.J. Vos, B.A. Mahoney, and M. Eagleton. 2005. Movements and area use of belugas, *Delphinapterus leucas*, in a subarctic Alaskan estuary. Arctic 58(4):331–340. (doi: 10.14430/arctic447)

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, L. Vate Brattström, and D.J. Rugh. 2015a. Annual calf indices for beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 2006-12. Mar. Fish. Rev. 77(2): 40–58. (doi:10.7755/MFR.77.2.3)

Hobbs, R.C., K.E.W. Shelden, D.J. Rugh, C.L. Sims, and J.M. Waite. 2015b. Estimated abundance and trend in aerial counts of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2012. Mar. Fish. Rev. 77(1):11–31. (doi: 10.7755/MFR.77.1.2)

Shelden, K.E.W., K.T. Goetz, D.J. Rugh, D.G. Calkins, B.A. Mahoney, and R.C. Hobbs. 2015. Spatio-temporal changes in beluga whale, *Delphinapterus leucas*, distribution: results from aerial surveys (1977–2014), opportunistic sightings (1975–2014), and satellite tagging (1999–2003) in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):1–31. (doi:10.7755/MFR.77.2.1).

2.3.1.7 Other

Additional monitoring studies have occurred and in some cases are continuing in Cook Inlet. These include a novel use of video cameras to monitor whales within the Little Susitna River (Polasek et al. 2015). A citizen science study has been conducted in collaboration with AFSC Marine Mammal Laboratory scientists collecting shore-based observations along Turnagain Arm and Knik Arm (Carlson et al. 2015). On-going acoustic (Castellote et al. 2013, 2014) and visual (McKee and Garner 2010) monitoring of beluga behaviors near Eagle River in Knik Arm is being conducted by Joint Base Elmendorf Richardson personnel. A photo-identification program was initiated in 2005 by scientists at LGL Alaska Research Associates. They have created a Cook Inlet Beluga Whale (CIBW) photo-identification catalog (http://www.cookinletbelugas.com/) from images collected during shore-based and vessel surveys over 12 field seasons (2005–2016). Analyses are currently underway for this dataset and will provide information about the distribution, movement patterns, and life history characteristics of individually identified CIBWs, including mothers with calves.

Carlson, B., C. Sims, and S. Brunner. 2015. Cook Inlet beluga whales, Delphinapterus leucas, observed along the Anchorage Coast between 2008 and 2011: Results of a successful citizen science program. Mar. Fish. Rev. 77(2):115–129. (doi: 10.7755/MFR.77.2.7).

Castellote, M., C.D. Garner, R.J. Small, and R.L. Graham. 2013. Acoustic monitoring of belugas in Eagle River, Cook Inlet. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK. http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote03_acoustic-monitoring-beluga.pdf

Castellote, M., D. Gillespie, A. Maginnis, C. Garner, and R.J. Small. 2014. Real-time detection of Cook Inlet beluga whales for military mitigation. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK. http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote04_detection-cook-beluga-military.pdf

McKee, C., and C. Garner. 2010. Cook Inlet beluga whale monitoring, Eagle Bay, Fort Richardson, 2008-2009. Spoken presentation. Cook Inlet beluga whale science conference, Anchorage, AK https://alaskafisheries.noaa.gov/sites/default/files/17_cib_monitoring_eaglebay.pdf

Polasek, L., T. McGuire, J. Prewitt, B. Easley Appleyard, and L. Pinney. 2015. Assessment of remote video for monitoring of Cook Inlet beluga whales. Mar. Fish. Rev. 77(1):59–69. (doi: 10.7755/MFR.77.1.6)

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

Analysis of the five factors cited in section 4(a)(1) of the ESA that can cause a species to be endangered or threatened was completed in the Recovery Plan (NMFS, 2016).

2.4 Synthesis

Recovery criteria outlined in the Recovery Plan (NMFS 2016) are current and meet the ESA standards of objective and measurable recovery criteria by including both “biological” criteria on abundance and trends or risk analysis, and “threats-based” criteria that address the five factors outlined in section 4 of the ESA. Currently, the Cook Inlet DPS does not meet the minimum demographic criteria for reclassification to threatened (i.e., the abundance estimate for CI belugas is not greater than or equal to 520 individuals, and there is not 95% or greater probability that the most recent 25-year population abundance trend (where 25 years represents one full generation) is positive).

3.0 RESULTS

3.1 Recommended Classification:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
_____ *Extinction*
_____ *Recovery*
_____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number: No change is needed.

3.3 Listing and Reclassification Priority Number: NA

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The 64 recovery actions identified in the Recovery Plan were assigned a priority ranking. Priority 1 actions (undertaken to prevent extinction) include continuing to monitor the population to estimate abundance and analyze population trends, calving rates, and distribution (Action 1), creating a recovery coordinator position (Action 2), creating and supporting a recovery implementation task force (Action 3), and conducting an annual review workshop (Action 7). The vast majority of the recovery actions were assigned Priority 2 (actions undertaken to prevent significant decline in population level/habitat quality) and include obtaining life history data, which are lacking for this population, and assessing or mitigating anthropogenic impacts. . Priority 3 actions (all other actions necessary for recovery) were focused on education and outreach activities (Action 10 a,b,c)

5.0 REFERENCES

- *List all information and data sources used in this review. Include on this list any experts used and their affiliations and note whether they provided information or if they acted as peer-reviewers, or both.*

Burek-Huntington, K.A., J. Dushane, C.E.C. Goertz, L. Measures, C. Romero, and S. Raverty. 2015. Morbidity and mortality in stranded Cook Inlet beluga whales (*Delphinapterus leucas*). Dis. Aquat. Organ. 114(1):45-60. DOI:10.3354/dao02839

Burns, J.J., and G.A. Seaman. 1986. Investigations of belukha whales in the coastal waters of western and northern Alaska: II. Biology and ecology. U.S. Dep. Commer., NOAA, Natl. Ocean Serv., Anchorage, Alaska, Final Rep., Res. Unit 612, 129 p.

Carlson, B., C. Sims, and S. Brunner. 2015. Cook Inlet beluga whales, Delphinapterus leucas, observed along the Anchorage Coast between 2008 and 2011: Results of a successful citizen science program. Mar. Fish. Rev. 77(2):115–129. (doi: 10.7755/MFR.77.2.7).

Castellote, M., C.D. Garner, R.J. Small, and R.L. Graham. 2013. Acoustic monitoring of belugas in Eagle River, Cook Inlet. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK. http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote03_acoustic-monitoring-beluga.pdf

Castellote, M., D. Gillespie, A. Maginnis, C. Garner, and R.J. Small. 2014. Real-time detection of Cook Inlet beluga whales for military mitigation. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK. http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote04_detection-cook-beluga-military.pdf

Castellote, M., R.J. Small, S. Atkinson, M.O. Lammers, J. Jenniges, A. Rosinski, C. Garner, S. Moore, and W.W.L. Au. 2011. Acoustic monitoring of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska. J. Acoust. Soc. Am. (130):2459. (doi: 10.1121/1.3654879).

Castellote, M., T. McGuire, C. McKee, and M. Lammers. 2011. Can we hear Cook Inlet beluga whales feeding? Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK http://access.afsc.noaa.gov/pubs/posters/pdfs/pCastellote01_hear-belugas-feeding.pdf

Goetz, K.T., P.W. Robinson, R.C. Hobbs, K.L. Laidre, L.A. Huckstadt, and K.E.W. Shelden. 2012. Movement and dive behavior of beluga whales in Cook Inlet, Alaska. AFSC Proc. Rep. 2012-03, 40 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2012-03.pdf

Goetz, K.T., D.J. Rugh, A.J. Read, and R.C. Hobbs. 2007. Habitat use in a marine ecosystem: beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska. Mar. Ecol. Prog. Ser. 330:247–256. (doi: 10.3354/meps330247).

Goetz, K.T., R.A. Montgomery, J.M. Ver Hoef, R.C. Hobbs, and D.S. Johnson. 2012. Identifying essential summer habitat of the endangered beluga whale *Delphinapterus leucas* in Cook Inlet, Alaska. Endang. Species Res. 16:135–147. (doi: 10.3354/esr00394).

Hobbs, R.C. 2013. Detecting changes in population trends for Cook Inlet beluga whales (*Delphinapterus leucas*) using alternative schedules for aerial surveys. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-252, 25p.

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, L. Vate Brattström, and D.J. Rugh. 2015. Annual calf indices for beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 2006-12. Mar. Fish. Rev. 77(2): 40–58. (doi:10.7755/MFR.77.2.3)

Hobbs, R.C., C.L. Sims, K.E.W. Shelden, L. Vate Brattström, and D.J. Rugh. 2015. Annual calf indices for beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 2006-12. Mar. Fish. Rev. 77(2): 40–58. (doi:10.7755/MFR.77.2.3)

Hobbs, R.C., D J. Rugh, and D.P. DeMaster. 2000. Abundance of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2000. Mar. Fish. Rev. 62(3):37–45.

Hobbs, R.C., J.M. Waite, and D.J. Rugh. 2000. Beluga, *Delphinapterus leucas*, group sizes in Cook Inlet, Alaska, based on observer counts and aerial video. Mar. Fish. Rev. 62(3):46–59.

Hobbs, R.C., K.E.W. Shelden, D.J. Rugh, C.L. Sims, and J.M. Waite. 2015. Estimated abundance and trend in aerial counts of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2012. Mar. Fish. Rev. 77(1):11–31. (doi: 10.7755/MFR.77.1.2)
Hobbs, R.C., K.E.W. Shelden, D.J. Rugh, C.L. Sims, and J.M. Waite. 2015. Estimated abundance and trend in aerial counts of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994–2012. Mar. Fish. Rev. 77(1):11–31. (doi: 10.7755/MFR.77.1.2)
Hobbs, R.C., K.L. Laidre, D.J. Vos, B.A. Mahoney, and M. Eagleton. 2005. Movements and area use of belugas, *Delphinapterus leucas*, in a subarctic Alaskan estuary. Arctic 58(4):331–340. (doi: 10.14430/arctic447)

Hobbs, R.C., P.R. Wade, and K.E.W. Shelden. 2015. Viability of a small, geographically-isolated population of beluga whales, *Delphinapterus leucas*: effects of hunting, predation, and mortality events in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):59-88. doi: dx.doi.org/10.7755/MFR.77.2.4

Kendall, L.S., and L. Cornick. 2015. Behavior and distribution of Cook Inlet beluga whales (*Delphinapterus leucas*) before and during pile driving activity. Mar. Fish. Rev. 77(2):106–114. (doi: 10.7755/MFR.77.2.6).

Krasnova, V.V., V.M. Bel'kovich, and A.D. Chernetsky. 2006. Mother-infant spatial relations in wild beluga (*Delphinapterus leucas*) during postnatal development under natural conditions. Biol. Bull. 33(1):53–58. (doi:10.1134/S1062359006010079).

Lomac-McNair, K.S., M.A. Smultea, M.P. Cotter, C. Thissen, and L. Parker. 2015. Socio-sexual and probable mating behavior of Cook Inlet beluga whales, *Delphinapterus leucas*, observed from an aircraft. Mar. Fish. Rev. 77(2):32-39. doi: dx.doi.org/10.7755/MFR.77.2.2

Lucey, W., H.E. Abraham, G. O'Corry-Crowe, K.M. Stafford, and M. Castellote. 2015. Traditional knowledge and historical and opportunistic sightings of beluga whales, *Delphinapterus leucas*, in Yakutat Bay, Alaska. Mar. Fish. Rev. 77(1):41–46. doi: dx.doi.org/10.7755/MFR.77.1.4

McGuire, T., A. Stephens, and B. Goetz. 2016. The Susitna River Delta as a calving ground: Evidence from observation of a Cook Inlet beluga birth and the 2005-2015 seasonal and geographic patterns of neonate occurrence in Upper Cook Inlet. Poster presentation at the Alaska Marine Science Symposium, Anchorage, AK https://alaskafisheries.noaa.gov/sites/default/files/2016finalamssposter.pdf

McKee, C., and C. Garner. 2010. Cook Inlet beluga whale monitoring, Eagle Bay, Fort Richardson, 2008-2009. Spoken presentation. Cook Inlet beluga whale science conference, Anchorage, AK https://alaskafisheries.noaa.gov/sites/default/files/17_cib_monitoring_eaglebay.pdf

National Marine Fisheries Service. 2016. Recovery Plan for the Cook Inlet Beluga Whale (*Delphinapterus leucas*). National Marine Fisheries Service, Alaska Region, Protected Resources Division, Juneau, AK.

Norman, S.A., R.C. Hobbs, C.E.C. Goertz, K.A. Burek-Huntington, K.E.W. Shelden, W.A. Smith, and L.A. Beckett. 2015. Potential natural and anthropogenic impediments to the conservation and recovery of Cook Inlet beluga whales, *Delphinapterus leucas*. Mar. Fish. Rev. 77(2):89–105. (doi: 10.7755/MFR.77.2.5).

O'Corry-Crowe, G., W. Lucey, F.I. Archer, and B. Mahoney. 2015. The genetic ecology and population origins of the beluga whales, *Delphinapterus leucas*, of Yakutat Bay. Mar. Fish. Rev. 77(1):47–58. doi: dx.doi.org/10.7755/MFR.77.1.5.

Polasek, L., T. McGuire, J. Prewitt, B. Easley Appleyard, and L. Pinney. 2015. Assessment of remote video for monitoring of Cook Inlet beluga whales. Mar. Fish. Rev. 77(1):59–69. (doi: 10.7755/MFR.77.1.6)

Quakenbush, L. T., R.S. Suydam, A. L. Bryan, L.F. Lowry, K.J. Frost, and B.A. Mahoney. 2015. Diet of beluga whales, *Delphinapterus leucas*, in Alaska from stomach contents, March–November. Mar. Fish. Rev. 77(1):70–84. (doi: 10.7755/MFR.77.1.7)

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

Rugh, D.J., B.A. Mahoney, and B.K. Smith. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-145, 26 p.

Rugh, D.J., K.E.W. Shelden, and R.C. Hobbs. 2010. Range contraction in a beluga whale population. End. Species Res. 12:69–75. (doi:10.3354/esr00293).

Shelden, K.E.W., C.L. Sims, L. Vate Brattström, K.T. Goetz, and R.C. Hobbs. 2015. Aerial surveys of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, June 2014. AFSC Proc. Rep. 2015-03, 55 p. Available at: http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-03.pdf

Shelden, K.E.W., K.T. Goetz, D.J. Rugh, D.G. Calkins, B.A. Mahoney, and R.C. Hobbs. 2015. Spatio-temporal changes in beluga whale, *Delphinapterus leucas*, distribution: results from aerial surveys (1977–2014), opportunistic sightings (1975–2014), and satellite tagging (1999–2003) in Cook Inlet, Alaska. Mar. Fish. Rev. 77(2):1–31. (doi:10.7755/MFR.77.2.1).

Suydam, R.S. 2009. Age, growth, reproduction, and movements of beluga whales (*Delphinapterus leucas*) from the eastern Chukchi Sea. Ph.D. dissert., Univ. Wash., Seattle, 169p.

NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Cook Inlet Beluga Whale DPS

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

Review Conducted By:

Reviews were completed by Kim Shelden and Rod Hobbs (MML), Mandy Migura and Greg Balogh (AKR).

REGIONAL OFFICE APPROVAL:

Regional Administrator, NOAA Fisheries

for
Approve: Robert D Mecum Date: 2/22/17

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

__X__ Concur ____ Do Not Concur

Signature: ________________ Date 3/2/17