STATUS REVIEW FOR THE EASTERN BERING SEA BELUGA WHALE STOCK
for the NAMMCO Global Review of Monodontids
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1. Distribution and stock identity

Belugas of the eastern Bering Sea (EBS) stock are found in summer near the Yukon Delta and throughout Norton Sound (Lowry *et al*. in press). As ice forms in the late autumn these whales move offshore and south as far as St. Lawrence Island to the west and Togiak Bay to the south, generally remaining in ice covered waters (Citta *et al*. 2017).

The non-uniform distribution of beluga whales in coastal waters of the Bering, Chukchi, and Beaufort Seas in summer is indicative of likely population subdivision and formed the basis for original, but provisional, stock designations (Frost and Lowry 1990). It was recognized at the time that identification of more biologically meaningful stocks would require genetic studies to elucidate the underlying patterns of demographic and reproductive relationships among seasonal groupings (O'Corry-Crowe and Lowry 1997). Over the past two decades several genetic studies have been conducted on seasonal groupings that occur adjacent to Alaska and Chukotka (Russian Federation), primarily summering and migrating groups, to resolve patterns of dispersal and gene flow. The studies revealed substantial mitochondrial DNA (mtDNA) differentiation among summering groups in Bristol Bay, Norton Sound, and Anadyr Gulf in the Bering Sea, in nearshore waters along Kasegaluk Lagoon in the Chukchi Sea, and in the Mackenzie Delta-Amundsen Gulf region in Beaufort Sea, that likely reflects long-established patterns of female-mediated philopatry and demographic isolation (O'Corry-Crowe *et al*. 1997, 2002; Brown-Gladden *et al*. 1997, Meschersky *et al*. 2008; Fig. 1). This has led to their identification as the following five demographically distinct management stocks: 1) Bristol Bay, 2) EBS, 3) Gulf of Anadyr, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Laidre *et al*. 2015, Muto *et al*. 2016). A few studies have documented lower levels of nuclear DNA (microsatellite) heterogeneity among geographic strata compared to mtDNA. This has been taken as evidence of male-mediated gene flow among summering groups, possibly in shared wintering areas (Brown-Gladden *et al*. 1999, Meschersky *et al*. 2013), or it could reflect a slower rate of drift in markers with higher effective population size (O'Corry-Crowe *et al*. 2010). More recent studies question the common wintering area hypothesis (Citta *et al*. 2017) and whether gene flow is extensive among stocks in the Bering, Chukchi, and Beaufort seas (O'Corry-Crowe *et al*. in prep.).

Beluga whales can occur in the waters of the northeastern Bering Sea, from the Yukon and Kuskokwim deltas to Norton Sound, in all seasons. Whales from more than one stock likely migrate through this region in spring and autumn between summering grounds in the northeastern Bering, and the eastern Chukchi and Beaufort Seas and wintering grounds in the central and southern Bering Sea (O'Corry-Crowe *et al*. 1997, Citta *et al*. 2017). Only one of these groupings, the EBS stock, occupies nearshore waters in the northeastern Bering in summer (Fig. 1).

The occurrence of belugas in Norton Sound in the 1840s was described by Zagoskin (1967). He noted that beginning in July "the beluga appear in great numbers with their young as they follow the fish outside the mouths of the Yukon." He described large organized hunts that occurred in mid-July in Pastol Bay, where as many as 100 animals were taken in a single drive. According to Nelson (1887), belugas usually appeared in the southern Sound between the 5th and 10th of June, and schools of 20 to over 100 animals were frequently seen in the bay nearby. He documented the summer occurrence of belugas at the mouth of the Yukon River, and as much as 800 km upstream.

A compilation of all available observations, including both scientific and traditional knowledge, showed that belugas occur throughout the coastal zone of the EBS from the mouth of the Yukon River to northern Norton Sound near Nome, with relatively few sightings made far offshore (Frost and Lowry 1990). Whales were seen from shortly after breakup (usually May) until freezeup (usually November). A further confirmation that belugas have occurred regularly in the EBS region comes from records of harvests by Alaska Native hunters at 9 villages in southern, eastern, and northern Norton Sound, and 13 villages in the Yukon delta (Lowry *et al*. 1989, Frost and Suydam 2010, Alaska Beluga Whale Committee (ABWC) unpublished).

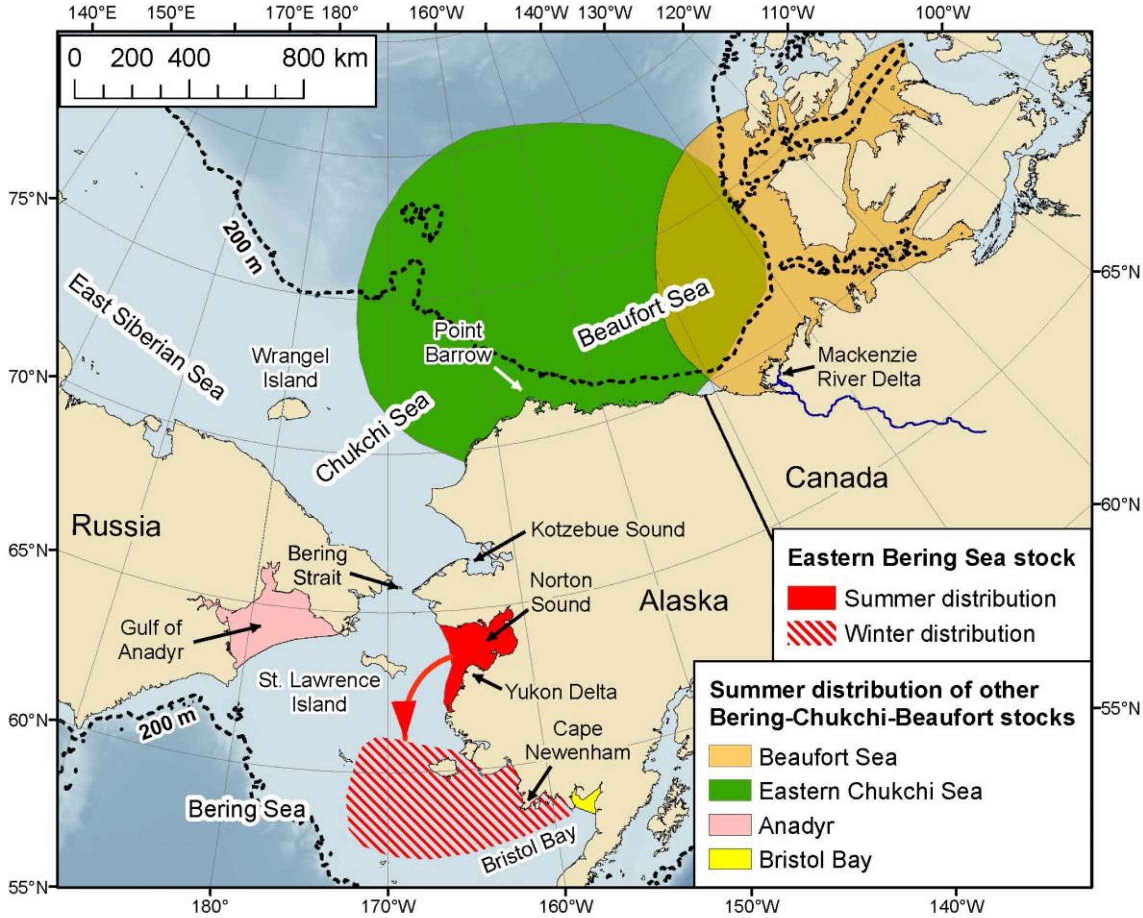

Figure 1. Map of the Bering-Chuckhi-Beaufort sea region showing summer distribution of all beluga stocks in the region and the winter distribution of the eastern Bering Sea stock.

The ABWC began flying aerial surveys for beluga whales in the EBS in 1992. Most of those surveys were flown in June when belugas were concentrated off the mouths of the Yukon River and in southern Norton Sound (Fig. 2, Lowry *et al*. 1999, Lowry *et al*. in press). Satellite depth recorders (SDRs) were attached to two beluga whales in northern Norton Sound in autumn of 2012 (Citta *et al*. 2017). Those whales remained in Norton Sound in October and early November, then with advancing sea ice cover they shifted their distribution southward but still remained in the EBS region (Fig. 1). The tagged animals were both back in Norton Sound by mid-June. Another beluga was tagged in northern Norton Sound in November 2016. That animal spent November, December, and January in the western Sound and adjacent waters of the EBS (http://www.north-slope.org/departments/wildlife-management/co-management-organizations/alaska-beluga-whale-committee/abwc-research-projects/satellite-maps-of-tagged-alaskan-beluga-stocks/satellite-tagging-maps-nov-2016).

Studies on patterns of mtDNA variation revealed that the summer beluga concentration in Norton Sound is demographically distinct from the near-resident population in Bristol Bay and groups with summering areas in the eastern Chukchi and Beaufort seas (O'Corry-Crowe *et al*. 1997, 2002; Brown-Gladden *et al*. 1997). Whales from the Yukon and Kuskokwim deltas were similar to Norton Sound but sample sizes were too small to definitively assign them to the Norton Sound subpopulation. However, the three belugas that have been SDR tagged in northern Norton Sound all spent time in the Yukon Delta. Similarly, no clear distinction has been observed between early and late summer whales in Norton Sound. The summering groups in Norton Sound were subsequently identified as the EBS population (Laidre *et al*. 2015, Muto *et al*. 2016). As with a recent 1996 event in Kotzebue Sound (see eastern Chukchi Sea assessment), analyses of mtDNA and microsatellite loci detected an anomalous occurrence of whales from another stock in Norton Sound in 1996. This atypical year most likely involved whales from the Beaufort Sea stock and the anomalous events coincided with anomalous ice years in the Bering-Chukchi-Beaufort region (O'Corry-Crowe *et al*. 2016). Recent genetic analysis of nuclear DNA in conjunction with the mtDNA work has determined that belugas of the EBS stock may interbreed with other stocks in the Bering-Chukchi-Beaufort region, possibly during winter or early spring (O'Corry-Crowe *et. al* in prep.).

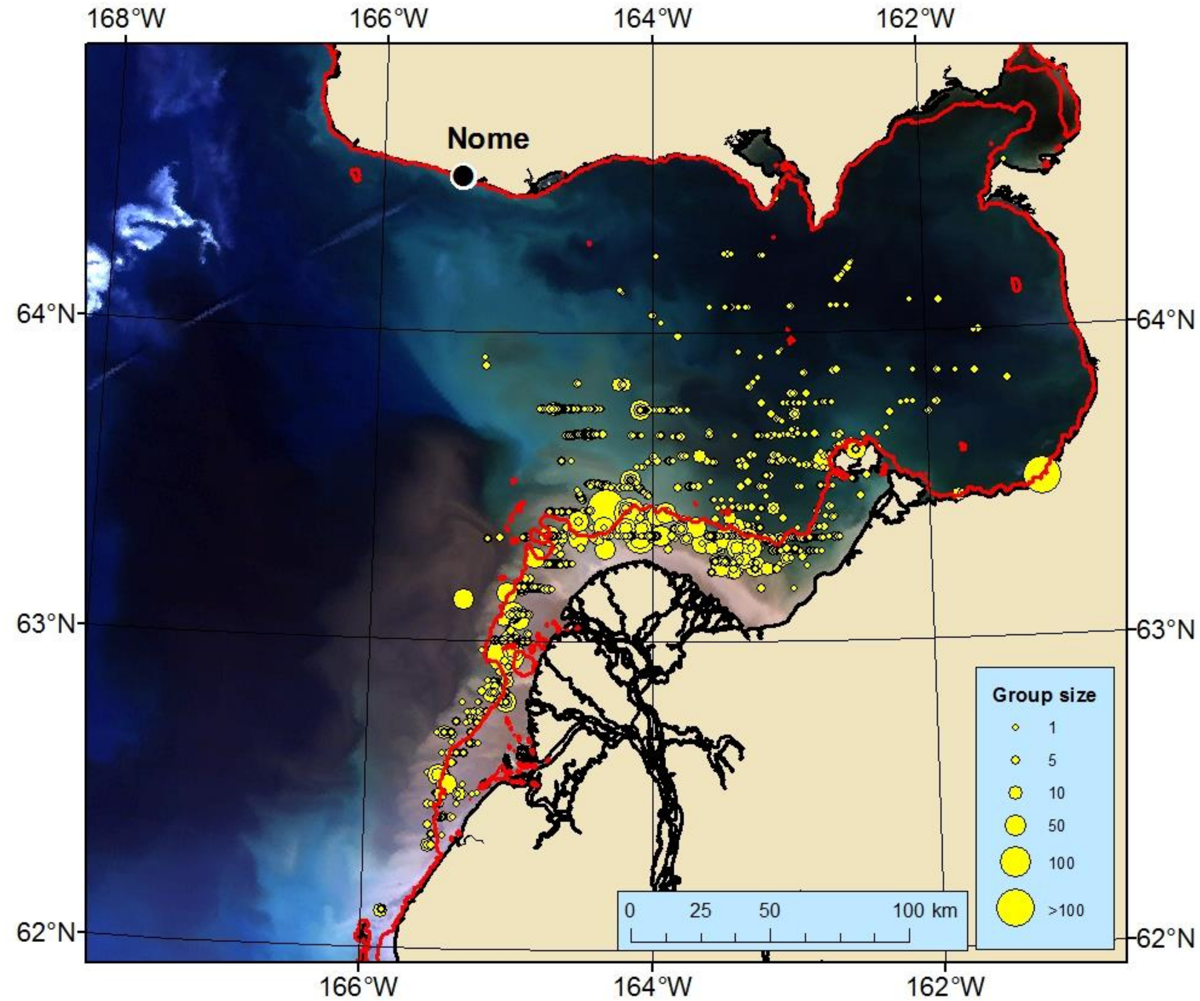

Figure 2. MODIS image of Norton Sound and the Yukon River Delta taken from the Terra satellite on 17 June 2002. Yellow dots are sightings of beluga whales made during aerial surveys 1995-2000. Red line indicates the 5m isobath. The discharge plume of the Yukon River shows as gray/brown.

2. Abundance

The ABWC has worked to develop a population estimate for the EBS stock beginning with the first systematic aerial surveys of beluga whales in the Norton Sound/Yukon Delta region flown during May, June, and September 1992, and June 1993-1995 (Lowry *et al*. 1999). Preliminary abundance estimates confirmed that the EBS stock was quite large but the estimates were not at that time considered ready to use for calculation of removable levels. Additional surveys were flown in June of 1999 and 2000. Density and abundance were estimated from the 2000 survey because it represented the most recent data and had the most complete and systematic coverage of the area (Lowry *et al*. in press). In 2000, belugas were rare in the northern portion of Norton Sound, thus the study area was reduced to central and southern Norton Sound and the Yukon Delta and divided into four strata by latitude. Density estimated with the model that received most Akaike Information Criterion support was 0.121 belugas/km^2 and the number of belugas at the surface in the study area was estimated to be 3,497 (coefficient of variation (CV) = 0.37). A generally accepted correction factor for availability of 2.0 was applied, resulting in an abundance estimate of 6,994 (95% confidence interval 3,162-15,472).

3. Anthropogenic removals

Subsistence harvest

The ABWC has collected data on Alaska Native subsistence harvests of EBS belugas since 1987 (Fig. 3a). Harvest data for 1987-2006 were reported by Frost and Suydam (2010). Here, we report EBS harvest data for 2007-2016 (ABWC, unpublished data).

Twenty-two villages harvest belugas from the EBS stock, 9 from Norton Sound and 13 from the Yukon delta (some almost 150 km from the ocean). Harvest levels have been variable, ranging from 31 in 1987 to 281 in 2002. The average annual reported harvest from this stock increased from 152 during 1987-2006 to 190 during 2007-2016. This increase was not statistically significant and is almost certainly due to better data being collected from more villages. When monitoring began in 1987, only 4 villages reported their harvest (Frost and Suydam 2010) but by 2016, 21 villages were reporting (ABWC, unpublished data). During 2007-2016 there was a small and non-significant (p = 0.55) increasing trend in the number of belugas harvested (Fig. 3b).

Reporting of struck and lost belugas is sporadic. Intermittent struck and lost data are available for the EBS stock for 17 villages during the last five years. During those years, the number of belugas struck and lost averaged 13% of the landed harvest (ABWC, unpublished data). Frost and Suydam (2010) did not report a struck and lost rate for the EBS stock.

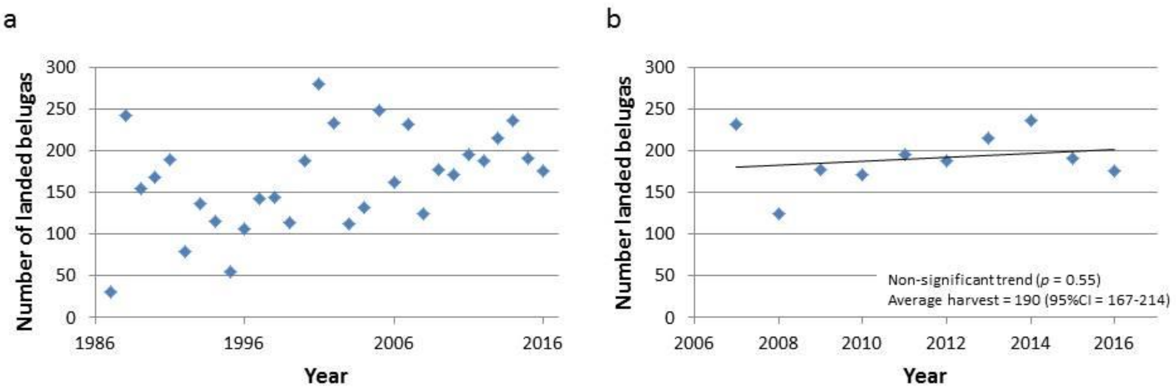

Figure 3. The number of EBS belugas landed by Alaska Native subsistence hunters during 1987–2016 (a), and the trend in the number of belugas landed during 2007–2016 (b). For more information on how harvest is documented, see Frost and Suydam (2010).

Bycatch

In the USA, some commercial fisheries that operate in federal waters (3-200 nm offshore) and may take marine mammals as bycatch are regularly monitored. In Alaska, three commercial fisheries that could have interacted with beluga whales from the EBS stock have been monitored: Bering Sea and Aleutian Islands groundfish trawl, longline, and pot fisheries. No mortality or serious injury to beluga whales was reported in those fisheries. State-managed commercial, personal use, and subsistence gillnet fisheries occur in nearshore waters of the EBS. While they are a potential source of bycatch mortality and bycatch is not systematically monitored, only one beluga whale take has been reported in a subsistence salmon gillnet, and there is no reliable estimate of total fisheries bycatch for this stock (Muto *et al*. 2016).

4. Population trajectory

There are no data on maximum net productivity for EBS belugas. For the Bristol Bay beluga stock the estimated rate of increase over the 12-year period 1992-2005 was 4.8%/year (95% confidence interval = 2.1%-7.5%; Lowry *et al*. 2008), but that may not be the maximum rate. The value measured for Bristol Bay is close to the 4%/year that is used by the National Marine Fisheries Service (NMFS) as the default maximum net productivity rate for cetaceans (Wade1988).

Because there has been only one population estimate, the trend in abundance of the EBS stock is unknown (Laidre *et al*. 2015, Muto *et al*. 2016).

5. Potential biological removals or other information on safe (sustainable) limits of anthropogenic removals

The U.S. Marine Mammal Protection Act defines the potential biological removal (PBR) as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times FR$. However, because the most recent abundance estimate available for the EBS at the time of the last NMFS Stock Assessment Report was more than eight years old the PBR for the stock was considered to be "undetermined" (Muto *et al*. 2016).

A PBR can be calculated using the abundance estimate provided in Lowry *et al*. (in press) as follows: N_{BEST} = 6,994; CV = 0.37; N_{MIN} = 5,173, R_{MAX} = 0.04; FR = 1.0; PBR = 103. It should be noted that this estimate includes an arbitrary correction factor that has no associated CV.

6. Habitat and other concerns

Because they are an ice-associated species there is concern about the possible effects on belugas of climate warming and associated loss of sea ice habitat. Laidre *et al*. (2015) found little change in the duration of the reduced ice (summer) period in the Bering Sea from 1979 to 2013. In a long-term study of belugas off West Greenland, Heide-Jørgensen *et al*. (2010) found that belugas responded to changing sea ice by shifting their distribution and that abundance increased during a period of generally declining ice cover. They stated that "Global warming and sea-ice declines may pose less of a problem for belugas than to other Arctic marine mammals." Laidre *et al*. (2008) concluded that on a rangewide basis the beluga would be the arctic cetacean least sensitive to climate change because of their wide distribution and flexible habits.

O'Corry-Crowe *et al*. (2016) analyzed long-term sighting and genetic data on belugas in the Bering, Chukchi, and Beaufort seas in conjunction with multi-decadal patterns of sea ice to investigate the influence of sea ice on spring migration and summer residency patterns. While substantial variations in sea ice conditions were found across seasons, years, and sub-regions, the pattern of beluga migration and residency was quite consistent. Those results suggest that belugas can accommodate widely varying sea ice conditions to perpetuate philopatry to traditionally used areas.

With climate warming and decreases in sea ice there will be increased human activity in northern waters and especially in the Arctic (Reeves *et al*. 2014, Laidre *et al*. 2015). In addition to oil and gas exploration and production, shipping, tourism, and other commercial development have the potential to impact belugas and their habitat. However, predicting the type and magnitude of likely impacts is difficult at this time (Muto *et al*. 2016).

Belugas that summer in the Yukon Delta region very likely feed on Pacific salmon (*Oncorhynchus* spp.). They may consume a substantial portion of some Yukon River salmon runs, thereby affecting trophic structure of the ecosystem and potentially impacting catches in commercial and subsistence fisheries (Lowry *et al*. in press).

7. Status of the stock

The EBS stock of beluga whales is one of four stocks in western Alaska that is co-managed by NMFS and the ABWC (Adams *et al*. 1993, Fernandez-Gimenez *et al*. 2006). Two of the agreed upon objectives of the management plan are to "conserve the Western Alaska beluga whale population" and to "protect Alaska Native beluga whale subsistence hunting traditions and culture" (ABWC 1999). The average harvest for the past 10 years (190) is considerably higher than the PBR calculated based on abundance surveys conducted in 2000 (103). However, the estimate of PBR is almost certainly low because the 2000 survey did not include all potential beluga habitat (e.g., the Yukon River itself), dark gray animals were particularly hard to see in muddy water coming from the Yukon, and the analysis did not account for perception bias (Lowry *et al*. in press).

The EBS beluga stock is quite large, and every June they concentrate off the mouths of the Yukon River and in Norton Sound. They are widely spread throughout the area and in essence form a single school of whales approximately 200 km long (Fig. 2). The most recent estimate of about 7,000 is based on data collected in 2000 and relies on an arbitrary correction factor to account for availability bias. A repeat of this survey is being planned for June 2017 to better estimate abundance and PBR. Additional work (e.g., tagging) is needed to develop better correction factors. Of particular concern is the effect of turbid Yukon River water on beluga sightability.

While available scientific data do not allow an estimation of population trend, local and traditional knowledge indicates that there has not been any decrease in abundance or availability of EBS belugas in recent years (ABWC, unpublished).

EBS beluga whales are not designated as "depleted" or "strategic" under the MMPA nor are they listed as "threatened" or "endangered" under the U.S. Endangered Species Act (Muto *et al.* 2016). In an assessment done in 2008, the International Union for the Conservation of Nature listed belugas as a species as "Near Threatened" and also noted that the various subpopulations should be assessed separately (Jefferson *et al*. 2012).

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