BELUGA WHALE (*Delphinapterus leucas*): Eastern Chukchi Sea Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980) and are closely associated with open leads and polynyas in ice-covered regions (Hazard 1988). In Alaska, depending on season and region, beluga whales may occur in both offshore and coastal waters, with summer concentrations in upper Cook Inlet, Bristol Bay, the eastern Bering Sea (i.e., Yukon Delta and Norton Sound), eastern Chukchi Sea, and Beaufort Sea (Mackenzie River Delta) (Hazard 1988, O'Corry-Crowe et al. 1997) (Fig. 1). Seasonal distribution is affected by ice cover, tidal conditions, access to prey, temperature, and human interaction (Lowry 1985). Data from satellite transmitters attached to a few whales from the Beaufort Sea, Eastern Chukchi Sea, and Eastern Bering Sea stocks show ranges that are relatively distinct month to month for these populations' summering areas and autumn migratory routes (e.g., Hauser et al. 2014, Citta et al. 2017). The few transmitters that lasted through the winter showed that beluga whales from these summering areas overwinter in the Bering Sea; the stocks may use separate wintering locations and probably remain separated through the winter (Suydam 2009, Citta et al. 2017).

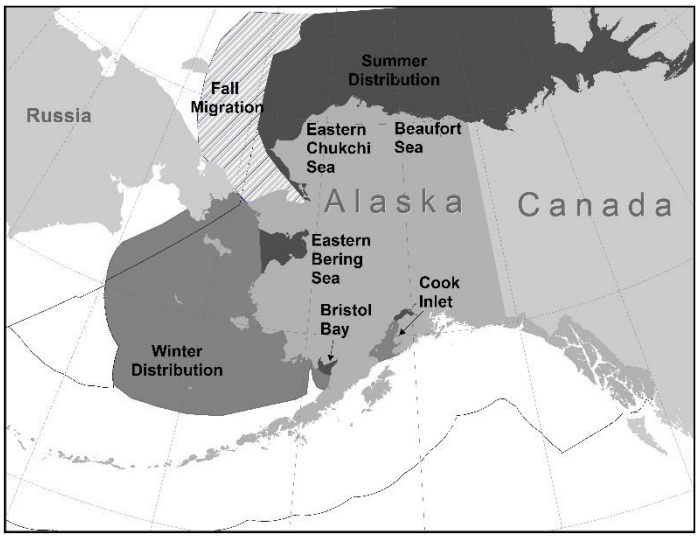

Figure 1. Approximate distribution for all five beluga whale stocks. Summering areas are dark gray, wintering areas are lighter gray, and the hashed area is a region used by the Eastern Chukchi Sea and Beaufort Sea stocks for autumn migration.

The Beaufort Sea and Eastern Chukchi Sea stocks of beluga whales migrate between the Bering and Beaufort seas. Beaufort Sea beluga whales depart from the Bering Sea in early spring, through the Chukchi Sea and into the Canadian waters of the Beaufort Sea where they remain in the summer and fall, returning to the Bering Sea in late fall. Eastern Chukchi Sea beluga whales migrate out of the Bering Sea in late spring and early summer, into the Chukchi Sea and western Beaufort Sea where they remain in the summer, returning to the Bering Sea in the fall. The Eastern Bering Sea stock remains in the Bering Sea but moves south near Bristol Bay in winter and returns north to Norton Sound and the mouth of the Yukon River in summer (Suydam 2009, Hauser et al. 2014, Citta et al. 2017). Beluga whales found in Bristol Bay (Quakenbush 2003; Citta et al. 2016, 2017) and Cook Inlet (Hobbs et al. 2005, Goetz et al. 2012, Shelden et al. 2015) remain in those areas throughout the year, showing only small seasonal shifts in distribution.

Eastern Chukchi Sea beluga whales move into coastal areas, including Kasegaluk Lagoon, in late June and animals are sighted in the area until about mid-July (Frost and Lowry 1990, Frost et al. 1993, Suydam et al. 2001). Data from satellite tags attached to Eastern Chukchi Sea beluga whales captured in Kasegaluk Lagoon during the summer showed these whales traveled 1,100 km north of the Alaska coastline, into the Canadian Beaufort Sea within 3 months (Suydam et al. 2001, Hauser et al. 2014). This movement indicated some overlap in distribution with the Beaufort Sea beluga whale stock during late summer. Satellite-telemetry data from 23 whales tagged during 1998-2007 suggest variation in movement patterns for different age and/or sex classes during July-September (Suydam et al. 2005). Adult males used deeper waters and remained there for the duration of the summer. All beluga whales that moved into the Arctic Ocean (north of 75°N) were males, and males traveled through 90% pack ice to reach deeper waters in the Beaufort Sea and Arctic Ocean (79-80°N) by late July/early August. Adult and immature female beluga whales remained at or near the shelf break in the Chukchi Sea. After October, only three tags continued to transmit and those whales migrated south through the eastern Bering Strait into the northern Bering Sea, remaining north of Saint Lawrence Island during the winter (Hauser et al. 2014, Citta et al. 2017). A

whale tagged in the eastern Chukchi Sea in 2007 overwintered in the waters north of Saint Lawrence Island during 2007/2008, then moved to near King Island in April and May before moving north through the Bering Strait in late May and early June (Suydam 2009).

The following information was considered in classifying beluga whale stock structure based on the Dizon et al. (1992) phylogeographic approach: 1) Distributional data: geographic distribution discontinuous in summer (Frost and Lowry 1990); 2) Population response data: distinct population trends among regions occupied in summer; 3) Phenotypic data: unknown; and 4) Genotypic data: mitochondrial DNA analyses indicate distinct differences among the five summering areas (O'Corry-Crowe et al. 1997). Based on this information, five beluga whale stocks are recognized within U.S. waters: 1) Cook Inlet, 2) Bristol Bay, 3) Eastern Bering Sea, 4) Eastern Chukchi Sea, and 5) Beaufort Sea (Fig. 1).

POPULATION SIZE

Frost et al. (1993) estimated the minimum size of the Eastern Chukchi Sea beluga whale stock at 1,200 whales, based on counts of animals from aerial surveys conducted during 1989-1991. Survey effort was concentrated along the sea side of the 170-km long Kasegaluk Lagoon, an area known to be regularly used by beluga whales during the open-water season. The offshore areas that these beluga whales are known to frequent were not surveyed. Therefore, these targeted surveys provided only a minimum count. If this count is corrected using radio-telemetry data, for the proportion of animals that were diving and thus not visible at the surface (2.62: Frost and Lowry 1995) and for the proportion of newborns and yearlings not observed due to small size and dark coloration (1.18: Brodie 1971), the total corrected abundance estimate for the Eastern Chukchi Sea stock is 3,710 whales ($1{,}200 \times 2.62 \times 1.18$).

During 25 June to 6 July 1998, aerial surveys were conducted in the eastern Chukchi Sea (DeMaster et al. 1998). The maximum single day count (1,172 whales) was derived from a photographic count of a large aggregation near Icy Cape (1,018 whales), plus whales counted along an ice edge transect (154 whales). This count is an underestimate, because it was clear to the observers that many more whales were present along and in the ice than they were able to count and only a small portion of the ice edge habitat was surveyed. Furthermore, only one of five beluga whales equipped with satellite tags a few days earlier remained within the survey area on the day the peak count occurred (DeMaster et al. 1998). It is not possible to estimate abundance from the 1998 survey. Not only were a large number of whales unavailable for counting, but the large Icy Cape aggregation was in shallow, clear water (DeMaster et al. 1998) and a correction factor (to account for missed whales) does not exist for beluga whales encountered in such conditions.

In July 2002, aerial surveys were conducted again in the eastern Chukchi Sea (Lowry and Frost 2002). Those surveys resulted in a peak count of 582 whales. A correction factor for animals that were not available for the count is not available. Offshore sightings during this survey combined with satellite-tag data collected in 2001 (Lowry and Frost 2001, 2002) indicate that nearshore surveys for beluga whales will only result in partial counts of this stock.

Aerial surveys were conducted as part of the Alaska Fisheries Science Center-Marine Mammal Laboratory's Aerial Surveys of Arctic Marine Mammals (ASAMM) project in the northeastern Chukchi and Alaska Beaufort seas in late June through August 2012 (Clarke et al. 2013). Line-transect analysis resulted in an estimate of 5,547 surface-visible beluga whales (CV = 0.22) in the study area (Lowry et al. 2017). Data from satellite-linked dive recorders were used to develop correction factors to account for animals that were missed because they were outside of the study area or diving too deep to be seen, resulting in a total abundance estimate of 20,752 beluga whales (CV = 0.70) (Lowry et al. 2017).

Minimum Population Estimate

For the Eastern Chukchi Sea beluga whale stock, the minimum population estimate (N_{MIN}) is calculated according to Equation 1 from the potential biological removal (PBR) guidelines (Wade and Angliss 1997): $N_{MIN} = N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{½})$. Using the population estimate of 20,752 and the associated coefficient of variation (CV) of 0.70, N_{MIN} for this stock is 12,194 whales.

Current Population Trend

The population trend for the Eastern Chukchi Sea beluga whale stock is unknown.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is unavailable for this beluga whale stock. Hence, until additional data become available, the default maximum theoretical net productivity rate (R_{MAX}) for cetaceans of 4% will be used for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

PBR is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor ($F_R$) for this stock is 1.0, the value for cetacean stocks that are thought to be stable in the presence of a subsistence harvest (DeMaster 1995, Wade and Angliss 1997). Therefore, the PBR for this stock is 244 beluga whales ($12{,}194 \times 0.02 \times 1.0$).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Detailed information for each human-caused mortality, serious injury, and non-serious injury reported for NMFS-managed Alaska marine mammals in 2011-2015 is listed, by marine mammal stock, in Helker et al. (2017); however, only the mortality and serious injury data are included in the Stock Assessment Reports. The total estimated annual level of human-caused mortality and serious injury for Eastern Chukchi Sea beluga whales in 2011-2015 is 67 beluga whales: 0.2 in U.S. commercial fisheries and 67 in subsistence takes by Alaska Natives (including 0.4 incidental to Marine Mammal Protection Act (MMPA)-authorized research). Assignment of mortality and serious injury to the Eastern Chukchi Sea, Eastern Bering Sea, and Bristol Bay stocks when stock is unknown, and the event occurred at a time and in an area where the three stocks could occur, may result in overestimating stock specific mortality and serious injury in federal commercial fisheries. Potential threats most likely to result in direct human-caused mortality and serious injury of this stock include entanglement in fishing gear.

Fisheries Information

Detailed information (including observer programs, observer coverage, and observed incidental takes of marine mammals) for federally-managed and state-managed U.S. commercial fisheries in Alaska waters is presented in Appendices 3-6 of the Alaska Stock Assessment Reports.

During 2011-2015, one beluga whale mortality occurred in the Bering Sea/Aleutian Islands pollock trawl fishery (Table 1; Breiwick 2013; MML, unpubl. data). A genetics sample was collected but has not been analyzed. Since the stock of the beluga whale is unknown, and the event occurred at a time and in an area where the Eastern Chukchi Sea, Eastern Bering Sea, and Bristol Bay stocks could occur, this mortality has been assigned to all three stocks (NMFS 2016).

Table 1. Summary of incidental mortality and serious injury of Eastern Chukchi Sea beluga whales due to U.S. commercial fisheries in 2011-2015 and calculation of the mean annual mortality and serious injury rate (Breiwick 2013; MML, unpubl. data). Methods for calculating percent observer coverage are described in Appendix 6 of the Alaska Stock Assessment Reports.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean estimated annual mortality
Bering Sea/Aleutian Is. pollock trawl	2011	obs data	98	0	0	0.2 (CV = 0.09)
	2012		98	0	0	
	2013		97	1	1.0	
	2014		98	0	0	
	2015		99	0	0	
Minimum total estimated annual mortality						0.2 (CV = 0.16)

In the nearshore waters of the southeastern Chukchi Sea, substantial efforts occur in gillnet (mostly set nets) and personal-use fisheries. Although a potential source of mortality, there have been no reported beluga whale takes as a result of these fisheries and such incidental takes could be counted as subsistence harvest.

The minimum mean annual mortality and serious injury rate incidental to U.S. commercial fisheries in 2011-2015 is 0.2 beluga whales from this stock.

Alaska Native Subsistence/Harvest Information

The subsistence take of beluga whales from the Eastern Chukchi Sea stock is provided by the Alaska Beluga Whale Committee (ABWC). The most recent subsistence harvest estimates for the stock are provided in Table 2 (ABWC, unpubl. data, 2016). The annual subsistence take by Alaska Native villages averaged 67 beluga whales landed from the Eastern Chukchi Sea stock in 2011-2015.

Table 2. Summary of Eastern Chukchi Sea beluga whales landed by Alaska Native subsistence hunters in 2011-2015 (ABWC, unpubl. data, 2016). It should be noted that the 2011 report includes takes at Kivalina (2 in 2011) and Kotzebue/Noatak (30 in 2011) which likely are from a population that is genetically distinct from the whales that comprise the Eastern Chukchi Sea beluga whale stock. These are minimum estimates of the total number of beluga whales taken, since the struck and lost data are not consistently provided.

Year	Reported total number landed
2011	64
2012	52
2013	87
2014	59
2015	72
Mean annual number landed	67

Other Mortality

Mortality and serious injury may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Two beluga whale deaths occurred incidental to research on ice seals in the Beaufort Sea in 2012 (Helker et al. 2017), resulting in a mean annual mortality and serious injury rate of 0.4 beluga whales from this stock in 2011-2015. Since these animals were subsequently used for subsistence purposes by Alaska Natives, this mortality is accounted for in the harvest data for 2012 (Table 2).

STATUS OF STOCK

A minimum estimate of the mean annual mortality and serious injury rate incidental to U.S. commercial fisheries (0.2 beluga whales) is less than 10% of the PBR (10% of PBR = 24 whales) and, thus, can be considered insignificant and approaching zero mortality and serious injury rate. The total estimated annual level of human-caused mortality and serious injury (67 beluga whales) is less than the PBR (244 whales). Eastern Chukchi Sea beluga whales are not designated as depleted under the MMPA or listed as threatened or endangered under the Endangered Species Act. Therefore, the Eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock. The historical level and population trend is unknown and, given the uncertainty of the data, we are unable at this time to assess the status of this stock relative to its Optimum Sustainable Population.

There are some key uncertainties in the assessment of the Eastern Chukchi Sea stock of beluga whales. Coastal subsistence fisheries will occasionally cause incidental mortality or serious injury of a beluga whale; these incidental takes used for subsistence purposes are not always reported to the ABWC and included in the estimate of subsistence harvest for the stock.

HABITAT CONCERNS

Evidence indicates that the arctic climate is changing rapidly and significantly, and one result of this change is a reduction in the extent and duration of sea ice in at least some regions (ACIA 2004, Johannessen et al. 2004). These changes are likely to affect marine mammal species in the Arctic. Ice-associated animals, such as the beluga whale, are sensitive to changes in arctic weather, sea-surface temperatures, and ice extent, and the concomitant effect on prey availability. Decreases in seasonal sea ice may also increase the risk of killer whale predation (O'Corry-Crowe et al. 2016). Eastern Chukchi Sea beluga whales tagged between 2004 and 2012 were distributed farther north and east in September-November than those tagged between 1993 and 2002 (Hauser et al. 2017). Further, the median date at which tagged whales departed the Beaufort and Chukchi seas during their southbound migrations was 14-33 days later overall in 2004-2012 versus 1993-2002 (Hauser et al. 2017). There are

insufficient data to make reliable predictions of the effects from arctic climate change on beluga whales; however, Laidre et al. (2008) and Heide-Jørgensen et al. (2010) concluded that on a worldwide basis beluga whales were likely to be less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behavior. Stafford et al. (2016) found that dive behavior of Eastern Chukchi Sea beluga whales was correlated to wind speed and direction. When winds were from the WSW, whales made shallow dives likely exploiting the front developed by the Alaska Coastal Current between the coast and the deep Arctic basin. Strong winds from the ENE resulted in deeper, longer dives (Stafford et al. 2016). East winds are increasing in the Arctic (Pickart et al. 2009), thus, beluga whales may be spending more time diving at greater depths. Increased human activity in the Arctic, including increased oil and gas exploration and development and increased nearshore development, has the potential to impact beluga whale habitat (Moore et al. 2000, Lowry et al. 2006). However, predicting the type and magnitude of the impacts is difficult.

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