SC/66a/SM/14

Global Review of the Status of Beluga Whale Populations

Dan Hubbell & Sarah Baulch

INTERNATIONAL WHALING COMMISSION

Global Review of the Status of Beluga Whale Populations

Hubbell, D.[1] & Baulch, S.[2]

1. Environmental Investigation Agency (EIA), PO Box 53343, Washington, DC 20009, USA. Contact: dhubbell@eia-global.org
2. Environmental Investigation Agency (EIA), 62-63 Upper Street, London N1 0NY, UK.

Abstract

More than half (15) of the global beluga (white whale, *Delphinapterus leucas*) populations are depleted or are likely depleted, and gaps in data on overall abundance and trends remain for many populations. Many populations face threats from multiple anthropogenic activities including shipping, subsistence takes, oil and natural gas activities, bycatch, nearshore industrialization, pollution and live capture for the international aquarium trade. This paper reviews the available data on population abundance, trends and anthropogenic threats for all 29 beluga populations. In light of potential impacts from climate change and increasing industrial activity in the Arctic, and the poor knowledge of the abundance and status of many populations, a precautionary approach to development is necessary. The authors recommend further study on the delineation of populations, up-to-date abundance and status assessments, close monitoring of impacts from increased anthropogenic activity, identification of key habitat areas for protection, and enhanced collaboration with the International Maritime Organization (IMO) and Arctic Council to ensure the establishment of adequate measures to protect belugas from anthropogenic activities.

Introduction

With a global abundance of at least 150,000 individuals, the beluga whale (white whale, *Delphinapterus leucas*) is one of three cetaceans endemic to the Arctic (Reeves *et al*., 2014). During the winter many beluga populations migrate thousands of kilometres to offshore waters associated with pack ice before returning to specific coastal estuaries, rivers, and bays to moult and calve, while the seasonal movements of some populations, including Cook Inlet, and the St. Lawrence Estuary, are more localised (Allan & Angliss, 2014). On the basis of this estuarine fidelity, the International Whaling Commission (IWC) Scientific Committee Sub-committee on Small Cetaceans identified 29 populations in 2000, based on genetic sampling, traditional ecological knowledge, and telemetric evidence (IWC, 2000).

Seasonal fidelity to specific coastal areas historically made many beluga populations more susceptible to overexploitation by commercial whaling. Although all commercial whaling operations have ceased, 15 populations remain depleted as a result of this historical activity. Unsustainable catches by subsistence hunters have significantly reduced certain populations, including Cook Inlet in the United States where catches reached 20% of the population annually from 1994-1998 (Allan & Angliss, 2014). Uncertainty remains about the status of many populations, and portions of the beluga range are still unsurveyed (Jefferson *et al*., 2014). Individual populations are now subject to different levels of threat from various anthropogenic

activities, including shipping, nearshore industrialization, subsistence hunts, and oil and natural gas exploration.

Noise from shipping, construction, and oil and natural gas activities is a growing threat as Arctic ice retreat opens up new areas of the Arctic to exploitation, with the degree of disturbance likely to depend on the type, magnitude, and duration of noise. In some cases, belugas have shown some degree of habituation and can remain present in heavily trafficked areas such as Cook Inlet and the St. Lawrence Estuary (Huntington, 1999). Conversely, two separate studies in the Canadian Arctic observed that belugas fled rapidly from ice-breaking ships at distances of 35-50km, and alarm vocalizations were triggered by vessels at distances of up to 80km (Marine Mammal Commission, 2007).

Industrial development has already impacted, and is likely to further affect, beluga populations. In addition to impacts due to increased noise levels, pollution from industrial sources has been posited as a source for the abnormally high rate of cancer found in 27% of the beluga population in the St. Lawrence Estuary (Martineau, 2012). Hydrological shifts caused by hydroelectric dams can cause changes in riverine flow and estuarine water temperature, causing belugas to abandon the impacted area (Huntington, 1999). For example, the damming of the Manicouagan River in the St. Lawrence Estuary may have led the region's population to abandon the area (COSEWIC, 2004). Approximately 60% of the beluga's current regular annual range (7,720,828 km^2) is within known hydrocarbon regions (Reeves *et al*., 2014). Exploration of these regions is already underway, and 9% of the beluga range is within existing or possible lease areas, raising the possibility of an oil spill in their range (Reeves *et al*., 2014). Threats related to human development are likely to increase as climate change permits further access to their Arctic range.

Global climate change is already having a significant impact on the Arctic marine environment, with both direct and indirect impacts on beluga whales. Although the degree of warming varies, 11 of 12 regions showed trends toward earlier spring, later Autumn sea ice, and longer summers from 1979-2013 (Lairdre *et al*., 2015). Projections estimate the region will experience a temperature shift of 2.8 to 7.8 degrees Celsius by 2100 (Meltofte, H. 2013). In 2014, sea ice levels receded to 1.9 million square miles, the sixth-lowest recorded extent (Gertz, 2014). Although belugas are not considered an ice dependent species, they will likely be impacted by declining prey availability and increased exposure to predation from killer whales (Reeves, 2009). Exposure to new pathogens is also possible; the parasite *Toxosplasmosa gondii* was found in 10% of beluga whales caught from the Beaufort Sea population in 2013, the first time this parasite has been detected in a marine mammal in the Arctic (Nuwer, 2014). More research is needed to determine the cumulative impact sea ice loss will have on beluga whales.

At a global level, the beluga population is classified as 'Near Threatened' by the International Union for the Conservation of Nature (IUCN) (Jefferson *et al*., 2012). Only the Cook Inlet population has been individually assessed by the IUCN, and classified as 'Critically Endangered'. The IUCN has noted that other well studied and at risk populations (e.g. East Hudson Bay, Ungava Bay, and West Greenland) require individual classification (Jefferson *et al*., 2012).

STATUS BY POPULATION

The United States

All five populations of beluga whales within the waters of the United States are protected under the Marine Mammal Protection Act (MMPA). Catches for commercial purposes are considered unlawful, and any activities likely to injure or harass belugas must also qualify for an Incidental Harassment Authorization (IHA) (MMPA, 1972). Subsistence catches are co-managed by the National Marine Fisheries Service (NMFS), and the Alaska Beluga Whale Committee. A Potential Biological Removal (PBR) is calculated for each population, accounting for the size of the catch and other potential impacts from anthropogenic activities to ensure that any hunts are sustainable (Allan & Angliss, 2014). All information concerning catches, including struck and lost rates are reported to NMFS on a regular basis (Allan & Angliss, 2014).

Development in the United States Arctic and Near Arctic

The United States has seen a significant increase in human activities in the Alaskan Arctic, and other regions populated by beluga whales. These include the development of oil and natural gas offshore resources, commercial and leisure shipping, and potential open pit mining (Reeves *et al*., 2014). In May 2015, the Bureau of Ocean Energy Management (BOEM) gave conditional approval for Royal Dutch Shell to drill six exploratory wells within its Chukchi Sea leasing area, 70 miles northwest of the village of Wainwright (Callahan, 2015). One further lease sale each is planned for the Chukchi Sea, the Beaufort Sea, and Cook Inlet in BOEM's 2017-2022 lease program (BOEM, 2015). Although the Northwest Passage is less immediately viable to commercial shipping than the Russian Northern Sea Route (NSR), at least one month of ice-free shipping is anticipated by 2020-2030 in the Northwest Passage (O'Rourke, 2014). Tour operators have already taken interest and tentatively scheduled cruises through the Northwest Passage for 2016, which will be accompanied by an ice-management vessel (Lovitt, 2014).

Passing through beluga populations' summer and winter habitat range and key migratory routes, these activities will likely impact many or all of the United States' beluga whale populations due to increased anthropogenic noise from shipping and oil and natural gas exploration and extraction, as well as increasing the risk of an oil spill in beluga habitat.

Bristol Bay

The Bristol Bay beluga population has increased over the last two decades. Based on surveys conducted between 1993 and 2005, the population is estimated to have increased by 65%, from 1,555 whales in 1994 to an average estimate of 2,877 whales from surveys in 2004 and 2005, representing an increase of 4.8% per year (Allen & Angliss, 2014). The population has no history of overexploitation and recent subsistence catches are below the calculated PBR (Wade *et al*., 2012; Goodwin, 2013).

Cook Inlet

The population of beluga whales in Cook Inlet is the only beluga population that has been individually assessed by the IUCN and was categorized as 'Critically Endangered' (Lowry *et al*., 2012). Subsistence catches from the population have likely occurred since the area was first settled, and by the 1920s commercial and sport hunting placed added pressure on the beluga population (Mahoney & Sheldon, 2000). Following the passage of the MMPA in 1972,

commercial and sport hunting ceased (Lowry *et al*., 2012). In the 1980s, human population growth and improved technology led to a significant increase in the number of whales landed by subsistence hunters each year, with an average of 67 whales removed each year from 1994-1998, approximately 20% of the population's size (IWC, 2000; Mahoney & Sheldon, 2000). From 1979-2000, the population declined by 75% (over approximately 1.5 generations) (Lowry *et al*., 2012).

In 2000, the NMFS assessed the population as depleted under the MMPA, and banned all catches except for limited subsistence whaling. When the population's average abundance dropped below 350 for the five-year period from 2003-2007, the allowable catch for the subsequent 2008-2012 period was set to zero (Allen & Angliss, 2014). In spite of ending all hunting, the population was still declining at a rate of 0.4% annually from 2004-2014 (Shelden *et al*., 2015). In 2008, the Cook Inlet population was listed as Endangered under the 1973 United States Endangered Species Act, and a recovery plan was drafted (Allen & Angliss, 2014). Exactly why Cook Inlet's belugas have failed to recover is still being studied. Overfishing of prey species, disturbance by anthropogenic noise sources including oil and natural gas development, natural threats, such as predation by killer whales, and potential social disruption due to overhunting may all play a role in the population's critical status.

Eastern Bering Sea

The Eastern Bering Sea beluga population is the largest in the United States, with a preliminary abundance estimate of 19,186 (CV=0.32) based on surveys in 2000 (Allan & Angliss, 2014). Stock Assessment Guidelines state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate. The PBR for the East Bering Sea beluga population is therefore considered undetermined and as no systematic surveys were conducted prior to 1992, the existing data are also not sufficient to evaluate population trends. Without this information, it cannot be determined whether existing catches, which averaged 180 per year from 2008 to 2012, are sustainable (Allan & Angliss, 2014).

In 2015, the United States Army Corps of Engineers tentatively selected the Port of Nome in the Eastern Bering Sea for expansion as a deepwater port (Joling, 2015). If the project proceeds the beluga population may be impacted by increased noise generated from the use of impact pile driving in construction at a distance of 2.5 miles (USACE, 2015). There is also the possibility that sediments containing high levels of arsenic and mercury may be re-suspended by dredging the harbour (USACE, 2015). The expanded harbour will also expose the population to disturbance from increased vessel traffic.

Eastern Chukchi Sea

The trend of the beluga population in the Chukchi Sea is considered unknown and uncertainty remains regarding its current abundance. The current population estimate of 3,710 is based on aerial surveys conducted during 1989-1991. An incomplete survey in 1998 returned a similar number of sightings and a new estimate is expected this year based on aerial surveys in 2012 (Allen & Angliss, 2014). Average subsistence catches were 57.4 whales per year from 2008-2012. Due to abundance estimates being older than eight years, the PBR is currently considered undetermined.

With oil and natural gas exploration planned in the Chukchi Sea, the population may face additional impacts from human activities. In 2015, Royal Dutch Shell calculated a nonfatal harassment of 974 belugas from the combined Eastern Chukchi and Beaufort Sea populations of 42,968 whales from ice management activities as well as seismic exploration, equivalent to 2.27% of the combined populations (Federal Registry, 2015). However, Shell's calculated harassment does not distinguish between populations, or properly account for the size of migratory pods, which often reach more than 1,000 whales (Federal Registry, 2015). The actual number of whales disturbed may therefore be higher resulting in a greater potential impact on the Eastern Chukchi Sea population. The Chukchi Sea belugas have also been impacted by anthropogenic noise from the Red Dog Mine, an open pit iron and zinc mine that has been in operation since 1989. In 2009, the Environmental Protection Agency (EPA) found that increased vessel traffic and anthropogenic activity had caused the beluga population to alter their seasonal migratory route (EPA, 2009).

Canada/United States

Beaufort Sea

The Beaufort Sea population of beluga whales is estimated at 39,258 (CV=0.229), based on aerial surveys conducted in 1992 (Allen & Angliss, 2014). As trend data indicate that the population is stable or increasing, the 1992 estimate has been deemed sufficient to use, resulting in a PBR of 649. The mean subsistence take in Canadian (2005-2009) and U.S. (2008-2012) waters is 100 and 65.6 whales respectively (Allan & Angliss, 2014).

In 2010, the Canadian government established the Tarium Niryutait Marine Protected Area (TNMPA), encompassing 1,800 km² of the beluga's Canadian summering estuary habitat in three sites along the Mackenzie Delta-Beaufort delta (Stewart, 2013). The TNMPA permits industrial activities including fishing, dredging, transportation, and hydrocarbon exploration and production provided they do not "disturb, damage or destroy or remove from them, any living marine organism or any part of its habitat" (Harwood *et al*., 2014; SOR, 2010). As there have been no surveys of the Canadian portion of the beluga's Beaufort Sea range since 1992, updated surveys are needed to determine local concentrations within the TNMPA to minimize the overlap with industrial activities (Harwood *et al*., 2014). Disturbance from oil and natural gas development in the United States portion of the Beaufort Sea and the Canadian Mackenzie Basin is likely to impact this population in the future (COSEWIC 2004; Federal Registry, 2015). The region contains an estimated 25% of Canada's untapped natural gas (Reeves *et al*., 2014).

Canada

The IWC identified ten populations of beluga whales within Canadian waters (IWC, 2000). All catches have been managed under the Fisheries Act of 1867, currently under the Beluga Protection Regulations as amended in 1990 (COSEWIC, 2004). Nationally, hunts are managed by the Department of Fisheries and Oceans (DFO), with local hunts organized and co-managed by local organizations including the Nunavut Wildlife Management Board (NWMB) and Nunavik Marine Region Wildlife Board (NMRWB) (COSEWIC, 2004). Catches are only prohibited for the St. Lawrence Estuary population. All catches, including information on struck and lost rates are reported to DFO.

Under the 2002 Species at Risk Act (SARA), the Committee on the Status of Endangered Wildlife in Canada was established, and tasked with assessing the status of each population and compiling recovery plans for those considered of Special Concern or Endangered (COSEWIC, 2004).

Development in the Canadian Arctic

As with the United States, the Canadian Arctic has drawn increasing industrial interest in recent years, particularly in regards to oil and natural gas exploration, shipping, and mining. For commercial and leisure purposes, Canada's Northwest Passage and the Arctic Bridge Route from Murmansk to the Hudson Bay are likely to increase in use by commercial and leisure vessel traffic. Construction of at least one deepwater port in the Hudson Bay is anticipated (Reeves *et al*., 2014).

Development of extractive resources, including the Mary River iron mine on Baffin Island, will also result in increased shipping. Permitted to extract 18 million tonnes of ore annually, the mine anticipates moving its first shipment of ore in the summer of 2015, and plans on utilizing ice breakers in order to continue extraction year-round (Mercer, 2015; Reeves *et al*., 2014).

Cumberland Sound

The Cumberland Sound beluga population has declined significantly due to overhunting. Though records are incomplete, large-scale commercial hunts occurred from 1868 to 1939, with catches of between 65 and 800 whales a year (Mitchell & Reeves, 1981). From its estimated pre-exploitation population size of 8,465, the population declined due to commercial and unregulated subsistence catches, to 500-700 individuals by 1981, 12% of its initial size (DFO, 2005; Brodie *et al*., 1981). In the early 1980s, a quota system was instituted, with a limit set at 35 in 1992 and then increased to 41 per year in 2003 (DFO, 2005). Hunters landed an average of 42 whales from 2003-2009, a level considered sustainable (DFO, 2013; DFO, 2002). The advised Total Allowable Harvest from the DFO is presented as total allowable landed catch, taking into account hunt losses (DFO, 2008). There are indications that in recent years struck and loss rates may be exacerbated by the disproportionate number of hunters (COSEWIC, 2004). As a condition of the 2003 increase in the catch limit, the community has agreed to collect information on the struck and loss rate.

Noise pollution has also been identified as a concern for the Cumberland population, with the number of belugas declining in areas where they were previously concentrated, such as Clearwater Fjord (COSEWIC, 2004).

The population's abundance and trend is currently unclear. Aerial surveys in 2009 resulted in a corrected population estimate of 788 belugas, less than half of the 1999 estimate of 1,960 belugas (DFO, 2005; DFO, 2013). It is possible that one or more major aggregations may have been missed during the 2009 survey, and another survey is needed to better determine population size and trends.

St. Lawrence Estuary

The St. Lawrence River is home to the southernmost population of beluga whales in the world. The population is considered a relict Arctic population, and is genetically distinct from other Canadian populations (COSEWIC, 2004). Catches from the St. Lawrence population began in 1580 by residents of Basque Island in the St. Lawrence Estuary (Dionne, 2007). In 1928, the Government of Quebec enacted a 15 dollar bounty per tail fluke, and subsidized the use of

bombs under the belief that the whales were a nuisance species competing with the region's commercial fisheries (Dionne, 2007). From 1880 to 1950, hunters landed approximately 15,000 whales (DFO, 2012). Following a 1946 study which proved the belugas' impact on fish populations was negligible, the bounty was removed, though smaller scale sport and subsistence catches continued (Dionne, 2007). Commercial and subsistence hunting was banned in 1979 under the Beluga Protection Regulations in the Fisheries Act. From the cessation of hunting to the early 2000s, aerial surveys detected that the population was stable, or increasing at an abnormally low rate, to 1,238 in 1997 (0.13% annually). It has subsequently declined to a corrected abundance of 889 in 2012 (-1.13% annually) (95% CI 672-1167) (IWC, 2000; DFO, 2014b).

Pollution and other anthropogenic stressors are the likely source of both the population's slow growth and subsequent decline. Both the St. Lawrence Estuary and its headwaters in the Great Lakes Region are heavily industrialized, and links have been postulated between pollution from industrial sources such as aluminium smelters and the abnormally high rate of cancer and tumours in the beluga population. From 1983 to 2012, an annual average of 15 belugas carcasses were reported stranded in the estuary; these strandings likely represent less than 25% of total beluga mortalities in a given year (DFO, 2014b; Martineau, 2012). Necropsies conducted on the carcasses found that 14% of adults had died from some form of cancer, a higher rate than has been found in any other marine mammal population (Martineau, 2012). While specific sources of pollutants such as polycyclic aromatic hydrocarbons (PAHs) from the aluminium smelting process have declined, newborn mortality has significantly increased since 1999. The overall proportion of newborn belugas has decreased from 6-8% prior to 1999 to 4-6% after 2007, and there are signs that many female belugas have switched from a 3-year reproductive cycle (indicating a successful birth) to a 2-year cycle (indicating premature mortality) (DFO, 2014b).

Other anthropogenic stressors may also be contributing to the population's decline. Noise pollution caused by commercial shipping and other recreational boat traffic in the St. Lawrence Estuary may disturb animals, with each commercial vessel navigating the St. Lawrence Estuary exposing up to 53% of the beluga population to noise levels likely to alter individual behaviours (DFO, 2014b).

A recovery plan was created for the population in 1995, and was revised in 2012. The population's status was assessed as 'Threatened' in 2004, but this was upgraded to 'Endangered' under the Species at Risk Act by COSEWIC in December, 2014 (COSEWIC, 2014).

Ungava Bay

The population of belugas in Ungava Bay is very small and possibly extirpated (COSEWIC, 2004). Aerial surveys conducted in 1983, 1993, 2001, and 2008 detected no belugas along transect lines, but a minimum of 200 belugas would be required for detection (Doniol-Valcroze & Hammill, 2012). The most recent estimate of the population is 32, based on continued sightings of belugas in Ungava Bay during the summer. Given the strong estuarine fidelity assumed for each population, it is assumed that these belugas represent the Ungava Bay population, rather than other migratory populations such as the East Hudson Bay belugas (Doniol-Valcroze & Hammill, 2012).

Intensive commercial hunts took an estimated 1,340-2,000 individuals during the period of 1877-1897 (Doniol-Valcroze & Hammill, 2012). In August 1962, sightings of between 400-500 whales were reported in Ungava Bay (Doniol-Valcroze & Hammill, 2012). Subsistence hunts

were encouraged, and an additional 745 whales were taken between 1975 and 1984 (Doniol-Valcroze & Hammill, 2012). Though catch limits were implemented in 1986, and the total catch has declined, the catch limits have been regularly exceeded (George 1998; 2008). The median age of landed whales has declined from 14 years in the period of 1980-1987 to 8.5 years during 1993-1999, a potential sign of overexploitation (COSEWIC, 2004). Even the capture of one beluga from Ungava Bay would exceed the calculated PBR of 0.16 individuals (DFO, 2011). Although the Department of Fisheries and Oceans (DFO) considers any takes in Ungava Bay potentially unsustainable, a catch limit of 10 whales was approved for 2014 by DFO, and 11 whales were landed (DFO, 2015). To protect the possible habitat of any surviving whales from the Ungava Bay population, the Mucalic River Estuary is closed to any catches (Rogers, 2014).

The Ungava Bay population was classified as 'Endangered by the committee on the Status of Endangered Wildlife in Canada in 1988, and retained this classification when reassessed in 2004 (COSEWIC, 2004). Other threats to this population include noise pollution from motor boats and shipping traffic (COSEWIC, 2004).

Eastern Hudson Bay

The beluga population of East Hudson Bay has been depleted by commercial and subsistence hunting and until recently was in decline. Commercial hunting, beginning in the late 1800s/early 1900s, reduced the population from an estimated historical abundance of 12,500 to an estimated 4,118 (CI 2,219-8765) by 1985 (Doniol-Valcroze, 2011). Though commercial hunting ceased and subsistence catches became subject to a quota in 1986, the population continued to decline due to unsustainable subsistence hunting. The most recent aerial surveys conducted in 2011 returned a corrected population abundance of 3,240 individuals (CV 48.9%) (DFO, 2014). Catch limits have been periodically reduced in accordance with scientific advice, but have historically been exceeded. From 1986 to 2012, the catch limit was adhered to in three years, exceeding catch limits in all other years over this period. A reduction in the median age of landed belugas indicates potential overexploitation (Doniol-Valcroze *et al*., 2011).

The mixing of whales from different populations during their migration poses a challenge to management. The East Hudson Bay belugas migrate through the Hudson Strait, as does the more abundant West Hudson Bay population. Seasonally, an estimated 10-20% of whales landed in the Strait are from the Eastern Hudson Bay population (Rogers, 2014). In 2009, management of the Nunavik beluga populations passed to the NWMB in coordination with DFO (Doniol-Valcroze *et al*., 2011). In 2014, the management scheme for the East Hudson Bay belugas was revised under a Total Allowable Take (TAT) system, with a total catch limit of 162 whales permitted over the period from 2014-2017 (Rogers, 2014). Under the TAT, all whales taken in the Nunavik region will be counted at different rates against the Eastern Hudson Bay population quota, based on the likelihood of the landed whale's population of origin (Rogers, 2014). The hunt is no longer seasonal, though community allotments by season are still used to restrict overall takes (Rogers, 2014). However, DFO assessed that the TAT scheme left a 50% chance that the Eastern Hudson Bay population would decline if 180 belugas were taken in the three-year period (DFO, 2014). DFO also noted that the allotted TAT would make population recovery to even the population's reduced 1980s abundance unlikely (DFO, 2014).

In 2004, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the population as 'Threatened' under the Species at Risk Act (COSEWIC, 2004). In addition to subsistence hunting, anthropogenic disturbances caused by increasing ship traffic and possible

prey depletion due to commercial fisheries are considered potential stressors on the population (COSEWIC, 2004).

James Bay

The James Bay population is relatively abundant. The IWC classified the population as a distinct population in 2000, with an abundance of 3,300 (IWC, 2000). Aerial surveys in 2001, 2004, 2008, and 2011 returned corrected abundance estimates of 17,285, 8,364, 19,439 (CV 66%), and 14,967 (CI: 8,316-26,939) respectively (Gosselin *et al*., 2013). The most recent 2011 estimate is considered the most precise, and suggests that the distinct population in James Bay is likely larger than 10,000 individuals. Large concentrations of belugas observed in northwestern James Bay may be a migratory portion of a separate South Hudson Bay population, but additional genetic information is needed to determine the population relationships (Gosselin *et al*., 2013).

Historically, James Bay has not been the site of large commercial or subsistence catches, or threatened by other anthropogenic activities. Five individuals were landed as part of the 2014 Nunavik hunting season and an unquantified number of whales were taken during their spring and autumn migrations through the Hudson Bay and Hudson Strait (DFO, 2015; COSEWIC, 2004). To reduce catches from the endangered Eastern Hudson Bay population, a new pilot program will permit hunters from Kuujjuaraapik to land whales in James Bay from December 1 to June 1 each year as a part of the new 2015-2017 management plan (Rogers, 2014).

Western Hudson Bay

The population of beluga whales in the west Hudson Bay is the most abundant in Canada, with a conservative estimated population of 57,300 whales (COSEWIC, 2004). DFO manages the population as a western-northern-southern Hudson Bay population, combining several populations which were classified as separate populations by the IWC Scientific Committee (Foxe Basin, Frobisher Bay, and south Hudson Bay). The west Hudson Bay population has remained stable, with an uncorrected estimate of 25,100 belugas in 1987 aligning closely to the 27,200 animals observed during 2004 surveys (Richard, 2005).

There are relatively large catches from the western Hudson Bay population by the Nunavik and Nunavut communities, though hunting in the major summer Manitoba estuaries is minimal (COSEWIC, 2004). In 2003, communities landed an estimated 764 whales, a significant increase from the estimated 300-400 annually reported in the IWC 2000 review (COSEWIC, 2004; IWC, 2000). This is below the calculated PBR of 1,071.

The western Hudson Bay population was assessed as being of Special Concern in 2004, both due to the catches from subsistence hunts and the possible impacts of hydroelectric dams and increased shipping in Hudson Bay (COSEWIC, 2004). The port of Churchill has been identified as a possible site for an expanded deepwater port, which is likely to lead to a major increase in noise from shipping (Reeves *et al*., 2014).

Foxe Basin

The identity of the Foxe Basin population remains unclear. Classified as a separate population by the IWC Scientific Committee in 2000, the population was estimated at 1,000 individuals, with a PBR of 25 (IWC, 2000). Though genetic sampling is sparse, Foxe Basin may include belugas from the western Hudson Bay in spring, the High Arctic in late summer, or its own population returning to specific summer estuaries (de March & Postma, 2003). For management purposes, Foxe Basin is grouped as part of a western-northern-southern Hudson Bay population. More

research is needed to determine whether Foxe Basin is indeed a separate population and to provide information on abundance and population trends.

South Hudson Bay

There are few data on the population of belugas in the waters of the southeastern Hudson Bay. The IWC Scientific Committee recognized this as a discrete population, with an initial estimated abundance of 1,299 (IWC, 2000). Local hunters have supported this claim, but its precise size and relationship with populations in James Bay and the western Hudson Bay remains unclear (COSEWIC, 2004). For management purposes, the southern Hudson Bay population has been grouped as part of a western-northern-southern Hudson Bay population. More research is needed to determine the relationship between these populations.

Frobisher Bay

The relationship of belugas in Frobisher Bay with the other Hudson Bay populations remains unclear, and further research is needed to determine structures. The IWC Scientific Committee recognized a population of unknown size, with an annual subsistence take of five whales, but for management purposes Frobisher Bay's belugas are grouped as a part of the genetically similar western Hudson Bay population (IWC, 2000; DFO, 2010). Water tests conducted in 2013 found high levels of ammonia and heavy metals in Frobisher Bay, originating from the city of Iqaluit's landfill and sewage treatment plant (CBC News, 2014). The city's growth has outpaced public infrastructure development, and research should be conducted to determine any potential impact of these contaminants on Frobisher Bay's belugas.

Greenland/Canada

Development in Arctic Greenland/Canada

Greenland has expressed a similar interest to Canada in developing mining and hydrocarbon resources in Baffin Bay. On the Greenland west coast, mines (including the Isua iron mine, with an estimated value of US$2.3 billion) are likely to increase pressure on the beluga population through increased vessel traffic and the use of ice-management vessels (Hornby *et al*., 2015). Greenland has also declared plans to focus on developing oil and natural gas resources in Baffin Bay and the Davis Strait, though development may be slowed by political resistance and unfavourable economic conditions (Gregoire, 2014).

Baffin Bay/Eastern High Arctic

The beluga population in the Canadian High Arctic is relatively abundant and stable. Based on aerial surveys conducted in 1996, the population has a corrected abundance of 21,213 (Laidre *et al*., 2014). Of this population, 17,328 are estimated to remain in the Baffin Bay-North Water area in the winter, while the remainder migrate to the western coast of Greenland (IWC, 2000). Whether these actually represent two separate populations with distinct summer estuarine fidelity requires further research.

Subsistence catches from the Canadian population number less than 100 a year, below the calculated PBR of 345 based on the 1996 estimate (COSEWIC, 2004; DFO, 2008). Other anthropogenic impacts on this population are currently minimal, but may increase as the Northwest Passage attracts interest as a leisure cruise route (COSEWIC, 2004).

West Greenland

It is unknown how many distinct populations of belugas winter off the west coast of Greenland, but at least one is from the Canadian High Arctic. All of these populations historically faced pressure from commercial hunts and continue to be hunted for subsistence purposes. Belugas south of 66°N disappeared entirely following a period of intense catches from 1906-1929 (NAMMCO, 2006). Catches of 35,339 whales were reported along Greenland's west coast from 1954-2011 (Heide-Jørgensen & Hansen, 2012). However, due to underreporting, an absence of catch reports from some municipalities, and a lack of accounting for the hunt's struck and lost rate, this figure does not account for all of the whales killed and the reconstructed catch estimate is actually estimated to be 28% larger than reported (Heide-Jørgensen & Hansen, 2012). In its 2000 review, the IWC assessed that the West Greenland population had declined an estimated 60% from 1981-1994 and more recently the total west Greenland population was estimated to be at 22% of its 1954 size (Alvarez-Flores & Heide- Jørgensen, 2004; IWC, 2000).

In response to the decline, Greenland banned drive hunts in 1995, and implemented a quota system in 2004 (Heide-Jørgensen & Hansen, 2012; NAMMCO, 2013). Catches averaged 215 belugas annually from 2008 to 2012 (Statistics Greenland, 2014). These data include struck and lost whales, although underreporting has been a problem historically (NAMMCO, 2014).

The most recent catch limit of 330 is slightly above the North Atlantic Marine Mammal Commission's (NAMMCO) suggested quota of 310, and a 2013 Joint Working Group with the Joint Commission on Narwhal and Beluga (JCNB) noted that the estimated growth rate of 5% may be "overly optimistic" when compared with the normal annual estimated growth of 2-4% (NAMMCO, 2014; NAMMCO, 2013). Aerial surveys in 2006 give a corrected estimate of 10,595 (CI 4,903-24,650) for the population, well below its calculated historic abundance of 26,000 (Laidre *et al*., 2015; NAMMCO, 2012), and more surveys are needed to monitor the population's trend.

The population is threatened by disturbance from planned oil and natural gas exploration, as well as impacts from the Greenland halibut commercial fisheries industry (a beluga prey species) (COSEWIC, 2004). In the latter case, the impact on beluga populations has not been well studied.

Svalbard

The island chain of Svalbard is home to a beluga population of unknown size. There have been historical catches by commercial hunters beginning in the 18th century, but records from Russian whalers are incomplete (NAMMCO, 2005). From 1866-1960 Norwegian whalers also removed more than 15,000 individuals from the population (NAMMCO, 2005). While it is likely that the population has been depleted by these historical mortalities, it has never been surveyed and its exact size and range is unknown. In its 2000 review, the IWC Scientific Committee classified the belugas near Franz Josef Land as a separate population pending further research, and the distinction between the two populations still remains unclear (IWC, 2000). Sightings of belugas along the east coast of Greenland are also attributed to the Svalbard population (NAMMCO, 2005). Surveys are needed to determine the exact size and range of the Svalbard population and there are plans for satellite tagging, genetic sampling, and a new abundance survey, commencing 2017 at the earliest. A total of 87% of Svalbard's 12-mile territorial seas are under managed protection either as national reserves or national parks, encompassing the population's summer estuarial habitat (SOE Norway, 2015). Industrial activities, including construction that would

potentially pollute or harm the marine environment, are prohibited, though cruise ships and leisure traffic are generally permitted in these areas (SOE Norway, 2015).

The Svalbard Islands are one of the most heavily trafficked areas of the High Arctic. In the last 15 years cruise tourism has doubled, exposing the Svalbard beluga population to increased disturbance from anthropogenic noise (Reeves *et al*., 2014). The archipelago is also considered a likely site for oil and natural gas development. The area is thought to contain between 65 and 165 million barrels of oil, and the Norwegian government has planned to expand lease sales on the Svalbard continental shelf (Reeves *et al*., 2014; Petersen, 2015).

The Russian Federation

Information on the abundance, trends, and number of beluga populations in the coastal waters of the Russian Federation remains incomplete. Traditionally, the Russian distribution of beluga populations is divided into two distinct geographic areas separated by the ice mass between the Laptev and East Siberian Seas (IWC, 2000). Within these areas the IWC identified 13 putative populations: Svalbard, Franz Josef Land, the Ob and Yenisey Gulfs of the Kara Sea, Onezhsky Bay (White Sea), Dvinsky Bay (White Sea), Mezensky Bay (White Sea), Southwest Laptev Sea, West Chukchi Sea, the Anadyr Gulf, Shelikov Bay, Shantar Bay, and the Sakhalin/Amur River near the Okhotsk Sea (IWC, 2000).

The exact number of populations and their respective abundance remains an ongoing area of study. Research by V.M. Belkovich states that the White Sea belugas divide into eight local breeding populations with different summer estuary habitats (Lukin & Andrianov, 2012). Efforts to properly delineate and survey the White Sea populations along transect lines are ongoing. The most recent cumulative estimate for White Sea abundance is 5,593 (CV=13.5%), based on aerial surveys conducted in 2011 (Solovyev *et al*., 2012). The Gulf of Anadyr was also surveyed in 2006, with an estimated abundance of 15,127 (CI 7,447-30,741) (Laidre *et al*., 2015).

Russian beluga populations were historically subject to catches by both commercial and subsistence hunters, though records are incomplete. Catches in the west central Sea of Okhotsk utilized seine nets, with a peak catch of 2,800 recorded in 1933 (Reeves *et al*., 2011). Subsequent catches declined to hundreds, then effectively ceased by 1963, although commercial hunting was not prohibited until 1999 (Reeves *et al*., 2011). Beluga hunting in the Russian Arctic is also reported to have virtually ceased, although large quotas of 1,220-1,550 for subsistence hunts remained, at least until 2005 (the last year on record) (Marine Mammal Council Russia, 2008). One permit for the commercial hunt and export of beluga meat for human consumption was made in 1999, when Russian officials issued a permit for 200 whales from the Sea of Okhotsk (Reeves *et al*., 2011). Thirty-one belugas were captured and 13 tonnes of meat shipped to Hakodate, Japan before Russia withdrew the permit (Reeves *et al*., 2011).

Russia is the only nation to currently capture and export live belugas for oceanaria or marine parks. Under a Total Allowable Take (TAT) system, live captures have occurred annually since 1986 from the Sakhalin-Amur population in the southern part of Sakhalinsky Bay (Reeves *et al*., 2011). The quota was increased from 212 individuals in 2012 to 263 in 2013 (18 for scientific purposes and 245 for educational or cultural display) (Shpak & Glazov, 2014). This take is significantly higher than the calculated PBR of 29 for the population, the abundance of which was estimated at 3,961 whales based on aerial surveys in 2009-2010 (Reeves *et al*., 2011). The number of applicants looking to export live belugas increased from 3-5 to 14 in 2013 (Glazov *et*

al., 2014). In 2013, 81 whales were caught and transported to holding facilities (Shpak & Glazov, 2014). Observers detected 34 whales killed incidental to capture operations, and at least seven belugas died during temporary holding in Sakhalinsky Bay (Shpak & Glazov, 2014). This mortality rate is likely a conservative estimate, as at least one team took steps to conceal a beluga mortality during capture operations (Shpak & Glazov, 2014).

Anthropogenic pollution, both chemical and radioactive, is considered a threat to beluga populations in Russia (IWC, 2000). The Amur River is the world's tenth longest river, spanning a number of heavily industrialized regions similar to the St. Lawrence Estuary. Like the St. Lawrence, high levels of chemical pollution have been documented in the river (Reeves *et al*., 2011). Rates of persistent organic pollutants (POPs) are especially high in the Sea of Okhotsk populations, with tissue samples eight times as contaminated as samples taken from White Sea belugas (Glazov *et al*., 2012).

Other anthropogenic impacts from shipping and oil and natural gas exploration are expected to increase in the Russian Arctic. Prior to the implementation of economic sanctions against Russia in October 2014, companies ExxonMobil and Rosneft announced the discovery of 100 million tonnes of oil in a well drilled in the Kara Sea (Nilsen, 2014). It is likely that these resources will be further developed in the future. Developing these resources will also necessitate increased shipping, with over 700 oil and gas tanker transits between the Pechora Basin and Murmansk expected by 2020-2030 (Reeves *et al*., 2014). In addition to the increased anthropogenic noise, these activities increase the risk of an oil spill from either well or shipping sources.

Conclusion

Although the threat of commercial hunting has ended, the beluga whale still faces an uncertain future. Fifteen populations remain either depleted or likely depleted, and information is still needed to determine the abundance and trends of many populations. In its 2000 assessment, the IWC Sub-committee on Small Cetaceans recommended that populations that were either depleted, small in size, or currently declining be considered highest priority for conservation concern, that genetic and contaminant studies be undertaken to resolve questions of population delineation, and that surveys and tissue and teeth sampling be conducted to determine health and abundance (IWC, 2000). New research has been conducted in all of these areas since the assessment, but further studies are needed to determine population abundance and status of many populations, particularly the Russian populations. A joint workshop on monodontids held by NAMMCO, the Canada-Greenland Joint Commission on Narwhal and Beluga, the Alaska North Slope Borough and others is planned, but has not yet occurred (IWC, 2015).

Climate change has already resulted in major changes in the Arctic, with significant changes in sea ice extent and duration (Laidre *et al*., 2015). This in turn is influencing human activities, with significant increases expected in shipping traffic and oil and natural gas exploration. These activities pose a risk to the species across much of its global range. In its 2014 Workshop on Impacts of Increased Marine Activities on Cetaceans in the Arctic, the IWC emphasized the risk new development may pose and the role the Commission has to play in ensuring the Arctic marine environment is protected (IWC, 2014). To facilitate this role, the Workshop recommended enhancing its cooperation with the International Maritime Organization (IMO) and Arctic Council, supporting the IMO's Polar Code to ensure safer navigation in the Arctic, and developing a better summary of the present status of cetacean populations, movement, and

important habitat of Arctic species (IWC, 2014). Bearing these recommendations in mind, the following recommendations are made in regards to better assessing the status of beluga populations and informing necessary protection measures throughout their range:

- Conduct an up-to-date assessment of all populations, particularly those where no data are available or data are out of date (17 populations): Eastern Bering Sea, Bristol Bay, West Hudson Bay, Foxe Basin, Frobisher Bay, South Hudson Bay, the Eastern High Arctic/Baffin Bay, West Greenland, Svalbard, Franz Josef Land, Ob Gulf, Yenisey Gulf (Kara Sea), Southwest Laptev Sea, West Chukchi Sea, Anadyr Gulf, Frobisher Bay, and the Beaufort Sea (see Table 1);
- Reduce commercial live captures to zero given uncertainties regarding the status of the populations involved and mortality rates during the capture process;
- Further study the impacts of noise, shipping, bycatch and pollution on beluga populations and ascertain measures to mitigate such impacts;
- Identify areas of habitat that are critical for the sensitive breeding periods for each population and their wintering grounds and migratory routes;
- Ensure that all subsistence takes do not exceed sustainable catch levels and that struck and lost animals are reported;
- Prioritise conservation measures for populations that are depleted, small in size or currently declining and also in areas where hydrocarbon exploration and extraction, increased shipping traffic, or other activities overlap with key areas of beluga habitat. Conservation measures may include: vessel routing measures, the creation of Areas to be Avoided, ship speed restrictions, and monitoring for impacts from increased underwater noise and activity; and
- Consistent with the recommendations from the IWC Arctic Workshop (2014), the IWC should:
    - Enhance its cooperation with the International Maritime Organization (IMO) and support implementation and enhancement of the Polar Code to ensure the inclusion of adequate measures to protect belugas and other marine mammals;
    - Enhance its cooperation with the Arctic Council and its committees and working groups, particularly its working group on Protection of the Marine Environment (PAME) and its work to develop a framework for a pan-Arctic marine protected area (MPA) network.
    - Develop an up-to-date review of the present status of cetacean populations, movement, and important habitat of Arctic species;
    - Contribute to efforts to develop common standards, measures and monitoring across the Arctic; and
    - Collate a summary of advice relevant to the Arctic that the IWC has provided with respect to a number of issues, including: climate change, chronic and acute noise, oil spills, ship strikes, fishery bycatch and habitat degradation.

Table 1: Summary of available information on beluga populations

Red indicates a depleted or likely depleted population, green indicates a stable population, and black indicates that the population status is unknown. See Annex I for list of references by population.

Country	Population	Population Size	Status and National Designation	Year of Survey (Reference Number)
United States	Bristol Bay	2,877 (CV=0.23)	Stable or Increasing	2004-2005[1]
	Cook Inlet	340 (CV=0.08)	Depleted, Endangered	2014[2]
	Eastern Bering Sea	19,186 (CV=0.32)	Unknown	2000[3]
	Eastern Chukchi Sea	3,710	Unknown	1989-1991[4]
U.S./Canada	Beaufort Sea	39,258 (CV=0.23)	Stable or Increasing	1992[5]
Canada	Cumberland Sound	788(CV=0.51)	Depleted, Threatened	2009[6]
	St. Lawrence River	889 (95%CI: 672-1167)	Depleted, Endangered	2012[7]
	Ungava Bay	32 (95%CI: 0-92)	Possibly Extirpated, Endangered	2008[8]
	East Hudson Bay	3,351 (CV=0.49)	Depleted, Endangered	2011[9]
	West Hudson Bay	57,342	Stable, Special Concern	2004 [10]
	James Bay	14,967 (95%CI: 8,316-26,939)	Stable	2011 [11]
	Foxe Basin	1,000	Unknown	2004 [12]
	Frobisher Bay	Unknown	Unknown	2004 [13]
	South Hudson Bay	1,300	Unknown	2004 [14]
Canada/ Greenland	Eastern High Arctic/ Baffin Bay	21,213 (95% CI=10,985-32,619)	Stable	1996 [15]
Greenland	West Greenland	10,595 (CV=0.43)	Depleted	2006 [16]
Norway	Svalbard	Unknown	Likely Depleted	Unknown[17]
Russia	Franz Josef Land	Unknown	Unknown	Unknown[18]
	Ob Gulf (Kara Sea)	Unknown	Depleted	Unknown[19]
	Yenisey Gulf (Kara Sea)	Unknown	Depleted	Unknown[20]
	Onezhsky Bay (White Sea) (All pops)	5,593 (CV=0.13)	Likely Depleted	2011[21]
	Dvinsky Bay (White Sea) (All pops)	5,593	Likely Depleted	2011[22]
	Mezensky Bay (White Sea) (All pops)	5,593	Depleted	2011[23]
	Southwest Laptev Sea	Unknown	Unknown	Unknown[24]
	West Chukchi Sea/ Eastern East Siberian Sea	Unknown	Unknown	Unknown[25]
	Anadyr Gulf	15,127 (95% CI 7,447-30,741)	Unknown	2006[26]
	Shellikov Bay (Sea of Okhotsk)(All pops)	12,226 (CV=6.8)	Depleted	2010[27]
	Shantar Bay (Sea of Okhotsk) (All pops)	12,226 (CV=6.8)	Depleted	2010[28]
	Sakhalin/Amur River (Sea of Okhotsk) (All pops)	3,961 (of 12,226)	Depleted	2009-2010[29]

Figure 1: Population range of the beluga whale

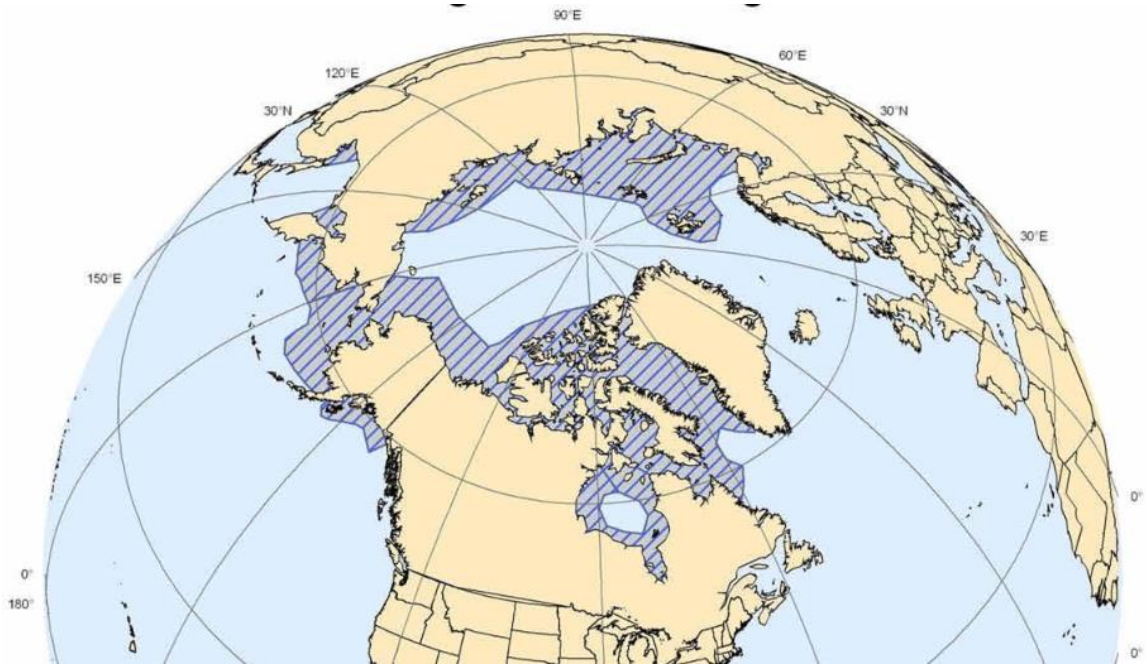

Image adapted from: NMFS, 2007.

References

Allen, B. M., and R. P. Angliss (2014). Draft Arctic Marine Mammal Stock Assessments, 2014. NOAA. Available at: http://www.nmfs.noaa.gov/pr/sars/pdf/draft_alaska_2014_sars_final.pdf

BOEM, (2015). 2017-2022 OCS Oil and Gas Leasing Program. Available at: http://www.boem.gov/five-year-program-2017-2022/

Callahan, J. (2015). BOEM Conditionally Approves Shell's Revised Chukchi Sea Exploration Plan. *Bureau of Ocean Energy Management*. Available at: http://www.boem.gov/press05112015/

CBC News. (2014). Ammonia, toxic metals leaching into Frobisher Bay. Available at: http://www.cbc.ca/news/canada/north/ammonia-toxic-metals-leaching-into-frobisher-bay-1.2507755

COSEWIC website. (2014). Canadian Wildlife Continue to Struggle. Available at: http://www.cosewic.gc.ca/eng/sct7/sct7_3_24_e.cfm

Curtis, G. (1996). Environmental Problems. Russia, A country study. Washington: GPO (United States Government Printing Office) for the library of Congress. Web. 1 August, 2014. Available at: http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ru0062)

de March, B. G. E. and Postma, L. D. (2003). Molecular genetic stock discrimination of belugas (*Delphinapterus leucas*) hunted in Eastern Hudson Bay, Northern Quebec, Hudson Strait, and Sanikiluaq (Belcher Islands), Canada, and comparisons to adjacent populations. Arctic 56:111-124.

DFO (2005). Recovery Potential Assessment of Cumberland sound, Ungava Bay, Eastern Hudson Bay and St. Lawrence beluga populations (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/036.

DFO. (2008). Total allowable harvest recommendations for Nunavut narwhal and beluga populations. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/035.

DFO. (2010). Stock definition of Belugas and Narwhals in Nunavut. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/079.

DFO. (2012). Recovery Strategy for the beluga whale (*Delphinapterus leucas*) St. Lawrence Estuary population in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 88 pp + X pp.

DFO. (2013). Advice on size and trend of the Cumberland Sound beluga whale population, 1990 to 2009.DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/003.

DFO. (2014a). Harvest advice and effects of a flexible total allowable take system for Nunavik Beluga (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/005.

DFO. (2014b). Status of beluga (*Delphinapterus leucas*) in the St. Lawrence River estuary. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/076.

DFO, (2015). Beluga Whale Hunt Statistics by Community and Hunting Area, Period from 2014-01-01 to 2014-12-31. DFO Can. Available at: http://www.qc.dfo-mpo.gc.ca/peches-fisheries/statistiques-statistics/documents/beluga/BELUGA2014-eng.pdf

Dionne, S., Gourbilière, C., (2007) St. Lawrence Beluga. Encyclopedia of French Cultural Heritage in North America. Available at: http://www.ameriquefrancaise.org/en/article-294/St._Lawrence_Beluga.html

Doniol-Valcroze, T., Gosselin, J.F. and Hammill, M.O. (2014). Impacts of a flexible Total Allowable Take system on beluga conservation in the Nunavik Marine Region. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/004. v+17p.

Doniol-Valcroze, T, Hammill, M. O. and Lesage, V. (2011). Information on abundance and harvest of eastern Hudson Bay beluga (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Res. Doc. 2010/121. iv + 13 p.

Doniol-Valcroze, T. and Hammill, M. O. (2012). Information on abundance and harvest of Ungava Bay beluga. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/126. iv + 12 p.

EPA, (2009). Red Dog Mine Extension: Aqqaluk Project. Available at: http://dnr.alaska.gov/mlw/mining/largemine/reddog/pdf/rdseis2009vol1.pdf

State of the Environment Norway, (2015). Protected Areas. Available at: http://www.environment.no/Topics/Biological-diversity/Protected-areas/

George, J. (1998). Beluga management in Nunavik drowns in a sea of chaos. *Nunatsiaq News*. Available at: http://www.nunatsiaqonline.ca/archives/nunavut980930/nvt80904_07.html

George, J. (2008). Nunavik hunters resist 2008 beluga quotas. *Nunatsiaq News*. Available at: http://www.nunatsiaqonline.ca/archives/2008/804/80418/news/nunavik/80418_1118.html

Gertz. E (2014). Nine things you need to know about polar sea ice. *The Guardian*. Available at: http://www.theguardian.com/vital-signs/2014/dec/11/arctic-antarctic-sea-ice-explainer

Glazov, D.M., Shpak, O.V., Rozhnov, V.V. (2014). Live extractions of belugas (Delphinapterus leucas) in Sakhalinsky Bay in 2013- population impact assessment. *Marine Mammals of the Holarctic.*

Goodwin C. (2013). Alaska Beluga Whale Committee. Available at: http://www.nmfs.noaa.gov/pr/pdfs/permits/openwater/abwc.pdf

Gosselin, J.-F., Doniol-Valcroze, T. and Hammill, M.O. (2013). Abundance estimate of beluga in eastern Hudson Bay and James Bay, summer 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/016. vii + 20 p.

Gregoire, L. (2014). Greenland pushing ahead with oil and gas development. *Nunatsiaq Online*. Available at: http://www.nunatsiaqonline.ca/stories/article/65674greenland_pushing_ahead_with_oil_and_gas_development/

Heide-Jørgensen, M. P. and Hansen, R. G. (2012). Catch statistics for belugas in Greenland 1862 to 2011. NAMMCO/JCNB Joint Working Group on narwhals and belugas Copenhagen February 2012. NAMMCO/SC/19-JCNB/SWG/2012-JWG/14

Hornby, L. Milne, R., Wilson, J., (2015). Chinese group General Nice takes over Greenland mine. *Financial Times*. Available at: http://www.ft.com/cms/s/0/22842e82-9979-11e4-a3d7-00144feabdc0.html#axzz3ZqHiQAxh

Huntington, H.P., Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik. (1999). Traditional Knowledge of the Ecology of Beluga Whales (*Delphinapterus leucas*) in the Eastern Chukchi and Northern Bering Seas, Alaska. *Arctic*, Vol 52. No. 1

IWC (2000). Report of the Scientific Committee, Annex I. Journal of Cetacean Research & Management. 2 (Suppl.)

IWC. (2013). Report of the Scientific Committee. Annex L: Report of the Sub-committee on Small Cetaceans. IWC/65A/Rep1 8-9

IWC. (2014). Report of the IWC Workshop on Impacts of Increased Marine Activities on Cetaceans in the Arctic.

IWC. (2015). 25a Global Review of Monodontids (Steering Group). Available at: https://iwc.int/group-globalrevmonodontids

Jefferson, T.A., Karkzmarski, L., Laidre, K., O'Corry-Crowe, G., Reeves, R., Rojas-Bracho, L., Secchi, E., Slooten, E., Smith, B.D., Wang, J.Y. & Zhou, K. (2012). *Delphinapterus leucas*. The IUCN Red List of Threatened Species. Version 2014.3. Available at: www.iucnredlist.org

Joling, D. (2015). Alaska deepwater port proposed for Arctic vessels. *Alaska Dispatch News*. Available at: http://www.adn.com/article/20150219/alaska-deepwater-port-proposed-vessels-arctic-waters

Laidre, K. L., Stern, H., Kovacs, K. M., Lowry, L., Moore, S. E., Regehr, E. V.. & Ugarte, F. (2015). Arctic marine mammal population status, sea ice habitat loss, and conservation recommendations for the 21st century. *Conservation Biology*.

Lovitt, R (2014). Crystal Cruises sets its sights on Northwest Passage. *CNBC News*. Available at: http://www.cnbc.com/id/101964824

Lowry, L., O'Corry-Crowe, G. & Goodman, D. (2012). *Delphinapterus leucas* (Cook Inlet subpopulation). The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>

Meltofte, H. (2013). The Arctic Biodiversity Assessment: Status and Trends in Arctic Biodiversity; the Full Report. *Convention on Arctic Flora and Fauna*. Pg. 28 Available at: http://www.arcticbiodiversity.is/the-report

Marine Mammal Protection Act (1972). U.S. code: 16 U.S.C. 1361

NAMMCO. (2006). Status of Marine Mammals in the North Atlantic: The Beluga Whale. Available at: http://www.nammco.no/webcronize/images/Nammco/667.pdf

NAMMCO. (2012). Report of the Nineteenth Meeting of the NAMMCO Scientific Committee. *North Atlantic Marine Mammal Council*. Tasiilaq, East Greenland.

NAMMCO. (2013). NAMMCO Annual Report 2013. *North Atlantic Marine Mammal Council*. Tromsø, Norway, 247 pp.

NAMMCO. (2014). NAMMCO Annual Report 2014. *North Atlantic Marine Mammal Council* Tromsø, Norway, 305 pp.

Nilsen, T. (2014). Discovers Kara Sea oil a week before sanctions hit. *Barents Observer*. Available at: http://barentsobserver.com/en/energy/2014/09/discovers-kara-sea-oil-week-sanctions-hit-29-09

NMFS (2007). Beluga Whale Range. Office of Protected Resources. http://www.fisheries.noaa.gov/pr/pdfs/rangemaps/belugawhale.pdf

O'Rourke. R. (2014). Changes in the Arctic: Background and Issues for Congress. Congressional Research Service Pg. 118 http://www.fas.org/sgp/crs/misc/R41153.pdf

Pettersen, T. (2015). Russia protests drilling in Svalbard zone. *Barents Observer*. Available at: http://barentsobserver.com/en/energy/2015/05/russia-protests-drilling-svalbard-zone-05-05

Reeves, R. (2009). Beluga Whales and Climate Change The IUCN Red List of Threatened Species, 2009. Available at: http://cmsdata.iucn.org/downloads/fact_sheet_red_list_beluga_v2.pdf

Reeves, R., Brownell, R. L., Burkanov, V. N., Kingsley, M. C., Lowry, L. F., & Taylor, B. L. (2011). Sustainability assessment of beluga (Delphinapterus leucas) live-capture removals in the Sakhalin-Amur region, Okhotsk Sea, Russia. Report of an independent scientific review panel. *Occasional Papers of the Species Survival Commission*, *44*.

Reeves, R., Ewins, P., Agbayani, S., Heide-Jørgensen, M. P., Kovacs, K., Lydersen, C., Suydam, R., Elliott, W., Polet, G., van Dijk, Y., Blijleven, R. (2014). Distribution of endemic cetaceans in relation to hydrocarbon development and commercial shipping in a warming Arctic. Marine Policy 44.

Rogers, S. (2014). Nunavik's new beluga management system promises different results. *Nunatsiaq News.* Available at: http://www.nunatsiaqonline.ca/stories/article/65674nunaviks_new_beluga_harvest_system_promises_more_flexibility/http://www.nunatsiaqonline.ca/stories/article/65674nunaviks_new_beluga_harvest_system_promises_more_flexibility/

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 Processed Rep. 2015 - 03, 55p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv.

Shpak O.V, Glazov D.M. (2014). Update report on the white whale (*Delphinapterus leucas*) live-captures in the Okhotsk Sea, Russia. IWC Scientific Committee. SC/65b/SM14

Solovyev, B., Glazov D., Chernook V., Nazarenko E., Chelintsev N., Rozhnov, V. (2012). Distribution and abundance of beluga whales (*Delphinapterus leucas*) in the White Sea and in the Southern part of the Barents Sea based on aerial counts in august 2011. Marine Mammals of the Holarctic, Vol 2 pp. 264-268.

Statistics Greenland (2014). Greenland in Figures, 2014. Available at: http://www.stat.gl/publ/en/GF/2014/pdf/Greenland%20in%20Figures%202014.pdf

Stewart, D.B. (2013). Species inhabiting the Tarium Niryutait Marine Protected Area in the Canadian Beaufort Sea – Mackenzie Delta. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/091. iv + 82 p.

U.S. Army Corps of Engineers, (2015). Draft Integrated Feasibility Report, Draft Environmental Assessment (EA), and Draft Finding of No Significant Impact (FONSI). Alaska Deep-Draft Arctic Port System Study.

Annex I: References for Population Table

1. Allen, B. M., and R. P. Angliss (2014). Draft Arctic Marine Mammal Stock Assessments, 2014. NOAA. Available at: http://www.nmfs.noaa.gov/pr/sars/pdf/draft_alaska_2014_sars_final.pdf
2. 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, June2014. AFSC Processed Rep. 2015-03, 55p. Alaska Fish. Sci. Cent., NOAA, http://www.afsc.noaa.gov/Publications/ProcRpt/PR2015-03.pdf
3. Allan & Angliss, 2014
4. Ibid.
5. Ibid.
6. DFO. (2013a). Advice on Size and Trend of the Cumberland Sound Beluga Whale Population. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/003. Available at: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_003-eng.pdf
7. DFO (2013b). Status of Beluga (Delphinapterus Leucas) in the St. Lawrence River Estuary. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/076.
8. DFO (2011). Information on abundance and harvest of Ungava Bay beluga. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/126. Available at: http://www.dfo-mpo.gc.ca/Csas-sccs/publications/resdocs-docrech/2011/2011_126-eng.pdf
9. Gosselin, J-F. Doniol-Valcroze, T. Hammil, M.O. 2013. Abundance estimate of beluga in eastern Hudson Bay and James Bay, summer 2011. DFO Can. Sci. Advis. Sec. Research Document 2013/016 Available at:http://www.dfo-mpo.gc.ca/library/348721.pdf
10. Richard, P. R. (2005) An estimate of the Western Hudson Bay beluga population size in 2004. Canadian Science Advisory Secretariat. Research Document 2005/017. Available at:
11. http://www.dfo-mpo.gc.ca/CSAS/Csas/DocREC/2005/RES2005_017_e.pdf
12. Gosselin et al., 2013
13. IWC (2000). Report of the Scientific Committee, Annex I. Journal of Cetacean Research & Management. 2 (Suppl.)
14. Ibid
15. Ibid
16. Laidre, K. L., Stern, H., Kovacs, K. M., Lowry, L., Moore, S. E., Regehr, E. V.. & Ugarte, F. (2015). Arctic marine mammal population status, sea ice habitat loss, and conservation recommendations for the 21st century. *Conservation Biology*.
17. Laidre et al., 2015
18. IWC, 2000
19. Laidre et al., 2015
20. Ibid.
21. Ibid.
22. Glazov, D.M., Chernook V.I., Boltunov A.N, Mukhametov L.M, Shpak O.V., Nazarenko E.A. 2008. "Aerial Survey of white whales (Delphinapterus leucas Pall.) in the White Sea in 2000, 2002 and 2005. Marine Mammal Commission.
23. Ibid.
24. Ibid.
25. Laidre et al., 2015
26. Ibid.
27. Reeves, R. R. Brownelle, R. L., Burkanov, V., Kingsley, M. C., Lowry, L. F., Taylor, B. L., (2011) Sustainability Assessment of Beluga (Delphinapterus leucas) Live-capture Removals in the Sakhalin-Amur Region, Okhotsk Sea, Russia. IUCN. Available at: https://portals.iucn.org/library/efiles/documents/ssc-op-044.pdf
28. Ibid.
29. Ibid.