



ACCESS
Arctic Climate Change
Economy and Society



Project no. 265863

ACCESS

Arctic Climate Change, Economy and Society

Instrument: Collaborative Project
Thematic Priority: Ocean.2010-1 “Quantification of climate change impacts on economic sectors in the Arctic”

D3.61 - Climate change impacts, and human responses, affecting traditional whaling

Due date of deliverable: **31/03/2015**
Actual submission date: **19/03/2015**

Start date of project: **March 1st, 2011**

Duration: **48 months**

Organisation name of lead contractor for this deliverable: **UPC**

| Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013) | | |
|---|---|---|
| Dissemination Level | | |
| PU | Public | X |
| PP | Restricted to other programme participants (including the Commission Services) | |
| RE | Restricted to a group specified by the consortium (including the Commission Services) | |
| CO | Confidential, only for members of the consortium (including the Commission Services) | |

The D3.61 meets the requirements as described in the DoW. However, we would like to highlight that during the research it has become clear that further research, activities could make the report more robust and its conclusions possibly applied to governance of the Arctic. There are a number of resources and organizations that provided valuable information on the studies and status of marine mammals in the Arctic, including the IWC, NAMMCO (North Atlantic Marine Mammals Commission) and Alaska Eskimo Whaling Commission, but further data is needed. For example, instead of lumping the whole Arctic and distribution of marine mammals into one, it would be useful to separate the distribution and status into sub-regions. At the moment of writing this report, this information was not yet available. Nevertheless, this could make it easier to see i.e., the trends for different marine mammals. Each jurisdiction together with their neighbouring countries are responsible for scientific assessments of marine mammal populations thus justifying the division into subregions.

Contents

| | |
|---|------------------|
| <u>INTRODUCTION</u> | <u>4</u> |
| <u>MARINE MAMMAL DISTRIBUTION IN THE ARCTIC OCEAN</u> | <u>7</u> |
| <u>STATUS AND TRENDS</u> | <u>22</u> |
| <u>MONITORING MARINE MAMMAL POPULATION IN THE ARCTIC</u> | <u>23</u> |
| <u>TRADITIONAL WHALING AND CONCLUSIONS</u> | <u>25</u> |

Introduction

Marine mammals in the Arctic include cetaceans (whales and dolphins), pinnipeds (seals and walruses) and polar bears.

Marine mammals in the Arctic can be grouped into two broad categories: those that occur in the Arctic throughout most of the year and thus depend on Arctic ecosystems for all aspects of their life and those that migrate to and from the Arctic waters and therefore are subject to seasonal variations (Table 1).

Although climate change will directly affect marine mammal species, some of the worst effects will appear indirectly through changes in habitat and increased human presence and activity in the Arctic (Huntington and Moore 2008¹). The loss of sea ice should have a significant, if not serious, effect on the ecology of most marine mammals in the Arctic. Seals and Walruses use sea ice as a platform for resting, molting, calving and nursing and this is where they provide care for their young, and there is uncertainty about how these animals will compensate for the loss of ice. For Arctic marine mammals, sea ice shows to work to varying degrees as a refuge from predation by killer whales. Polar bears use sea ice as a platform for hunting. A number of marine mammals in the Arctic forage near the ice edge, on the ice or under the ice, where preys are often concentrated. Possible declines in ice-edge productivity or ice-edge prey species like polar cod, could have a significant impact on the ability to feed by marine mammals.

It is anticipated that many species of sub-Arctic marine mammals will move in the Arctic as temperatures and habitat change. These species can compete with Arctic marine mammals for prey or habitat, affect predator-prey relationships, and introduce new diseases and parasites to Arctic marine mammals. Warmer temperatures and longer open water seasons will be accompanied by increasing human activities, including commercial shipping, commercial fishing, military activities, oil and gas operations, tourism and coastal development. These activities present multiple risks for marine mammals, including human disturbance or noise pollution (WP4), collisions with ships, direct and indirect interactions from the fishery (WP2), exposure to contaminants, and loss or degradation of habitats important for breeding and feeding. Recent data show that the severity of these risks will increase over time in the Arctic.

This Deliverable presents an exhaustive literature survey of the distribution of the sub-Arctic and Arctic Population of marine mammals as well as considerations on ways to monitor not only the dynamics of their populations but also the key factors that drive those dynamics, including behavior, health status, trophic dynamics, habitat quality and availability, and the effects of human activities described in WP2, WP3 and WP4.

| ARCTIC SPECIES | SUB-ARCTIC SPECIES |
|---|--|
| Bowhead whale (<i>Balaena mysticetus</i>) | Gray whale (<i>Eschrichtius robustus</i>) |
| Beluga (<i>Delphinapterus leucas</i>) | Humpback whale (<i>Megaptera novaeangliae</i>) |
| Narwhal (<i>Monodon monoceros</i>) | Fin whale (<i>Balaenoptera acutorostrata</i>) |
| Bearded seal (<i>Erignathus barbatus</i>) | Killer whale (<i>Orcinus orca</i>) |
| Ringed seal (<i>Phoca hispida</i>) | Hooded seal (<i>Cystophora cristata</i>) |
| Walrus (<i>Odobenus rosmarus</i>) | Harp seal (<i>Phoca groenlandica</i>) |
| Polar bear (<i>Ursus maritimus</i>) | Ribbon seal (<i>Histiophoca fasciata</i>) |
| | Spotted seal (<i>Phoca largha</i>) |

Table 1. Marine mammal species in the Arctic and sub-Arctic

See below illustrations of the seven cetacean species found in the Arctic and sub-Arctic

¹ Huntington, H.P., and S.E. Moore, eds. 2008. Arctic Marine Mammals and Climate Change. Ecological Applications 18:2(Supplement).

*Bowhead whale*²



Beluga



Narwhal



Gray whale



² All illustrations are © Pieter Folkens

Humpback whale



Fin whale



Orca



Marine Mammal Distribution in the Arctic Ocean

As an example, the Barents Sea marine mammal distribution can be found in Figure 1. Note that this map was built based not only on published scientific data but also on internal reports and opportunistic sightings for it must taken with precaution and as only an example. A detailed analysis of the distribution of marine mammals and their interactions with human activities, especially Oil & Gas exploration and exploitation sites in the Barents Sea can be found in D4.51

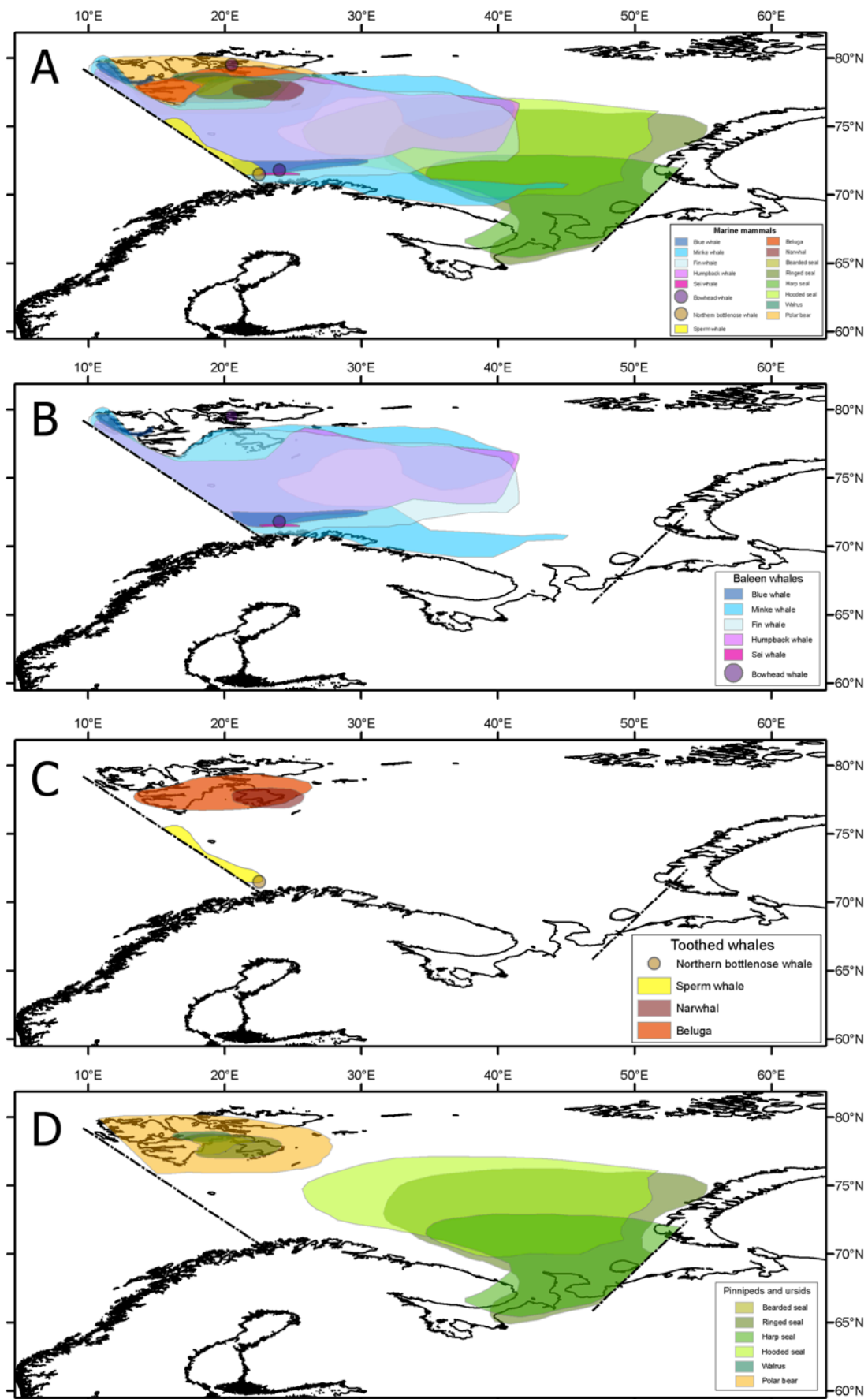


Figure 1. Example of annual distribution of marine mammal species in the Barents Sea. The pointed line shows the limit of the Barents sea. Data over this limit was not considered in this study.

The following map shows the Areas of heightened ecological significance that were identified for each of the 16 Large Marine Ecosystems (LMEs) within the Arctic area.



Figure 2. The 16 Arctic Large Marine Ecosystems. Source: Protection of the Marine Environment (PAME)

The following table (Table 2) presents a synthesis of the current knowledge on the presence of marine mammals in the Arctic and sub-Arctic (see Table 1). A full list of referenced data is also given per region in Table 3.



of noise
minals

| Species | Scientific name | IUCN status | Region | Year's period | | |
|------------|-------------------|-----------------------------|--------|--|-------------------------|---------------------------|
| Polar bear | Polar bear | <i>Ursus maritimus</i> | VU | Beaufort Sea (East - Amundsen Gulf) | Fall and winter : south | Spring and summer : north |
| | | | | Barrow Barents sea (Svalbard - Norway) Spitsbergen (Svalbard archipelago) Kara sea Chukchi Sea (Alaska) Hudson Bay (Churchill – West) Bellot strait Dundas island Jones Sound Southern Baffin Island Greenland | Winter | |
| Pinnipeds | Bearded seal | <i>Erignathus barbatus</i> | LC | In polynyas Barrow Chukchi sea Northeastern Beaufort Sea Kara sea Hooper Bay, Pt. Hope, Diomede East greenland Spitsbergen | Winter Summer | |
| | Northern fur seal | <i>Callorhinus ursinus</i> | VU | Bering sea | | |
| | Harbor seal | <i>Phoca vitulina</i> | LC | Baffin Island Prince William Sound Cooper rives delta Kara sea | | |
| | Harp seal | <i>Phoca groenlandica</i> | LC | Southern Barents Sea Greenland (West – Jan Mayen) Kara Sea Laptev Sea Estuary Canada | | |
| | Hooded seal | <i>Cystophora cristata</i> | VU | Greenland (North and West) Barents, Kara, Laptev Sea | | |
| | Ribbon seal | <i>Histiophoca fasciata</i> | DD | Diomede, Hooper Bay (Alaska), Pt. Hope | | |
| | Ringed seal | <i>Pusa hispida</i> | LC | In polynyas (Canadian Arctic) Greenland Beaufort sea | Winter | |

| | | | | | |
|----------------------|----------------------|------------------------------|----|---|---|
| Baleen whales | | | | Chukchi sea (Shishmaref) Spitsbergen (Svalbard archipelago) – Northern Norway Barrow (northwest) Hudson bay and strait – Ungava Bay Barents, Kara, Laptev Seas Baffin sea and Bay (Grise Fiord) Holman Island, Sachs Harbour, Pangnirtung Dundas Island Bellot strait, Queens channel Diomede , Hooper Bay, Pt. Hope | Summer Spring |
| | Spotted seal | <i>Phoca largha</i> | DD | Little Diomede (Bering strait), Hooper Bay (Alaska), Shishmaref (Chukchi sea) | |
| | | | | In polynyas at Dundas Island and Northeast water Barrow (Northwest) Jan Mayen East Greenland and Spitsbergen Kara sea Little diomede (Alaska) North Baffin sea Bering sea Akulivik, Inukjuak (Canada) | Overwintering |
| | Walrus | <i>Odobenus rosmarus</i> | DD | | |
| | Blue whale | <i>Balaenoptera musculus</i> | EN | Jan Mayen | |
| | | | LC | Baffin Bay Polynyas of the Northwater, Cumberland sound, Roes Welcome sound Bering Sea (Western Arctic) Cape Bathurst - Eastern Beaufort Sea Western and Northern Alaska (Barrow) | Winter Summer Winter Spring – Summer (July through September) Spring and autumn |
| | Bowhead whale | <i>Balaena mysticetus</i> | | Northeastern Chukchi sea | winter |
| | Fin whale | <i>Balaenoptera physalus</i> | EN | Southeasten Greenland | |
| | Gray whale | <i>Eschrichtius robustus</i> | | Northern Bering Sea | Spring and Summer |

| | | | | | |
|--------------------|-----------------------|-----------------------------------|----|--|--|
| Sperm whales | | | | (Chirikov Basin) and Chukchi Sea | Fall |
| | | | | Canadian Beaufort Sea | |
| | Humpback whale | <i>Megaptera novaeangliae</i> | LC | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | LC | West and Southeast Greenland Svalbard - Norway Barents Sea North East Atlantic | April : enter in the BS October (Summer) : leave the BS Summer |
| | Sei whale | <i>Balaenoptera borealis</i> | EN | | |
| | Sperm whale | <i>Physeter macrocephalus</i> | LC | North Atlantic | Summer |
| Beluga and Narwhal | Beluga | <i>Delphinapterus leucas</i> | NT | Baffin bay and Island (Cumberland sound - Panguituk) Polynyas Canadian Arctic Cook Inlet Beaufort Sea - Inuvialuit region (Mackenzie Bay and Paulatuk) Point Hope, Chukchi Sea – Point Lay Western Greenland Hudson strait (Kimmirut and Kangiqsujuag) – Hudson Bay (Arviat) Svalbard - Spitsbergen Northwest of Barrow Kara sea | Winter Winter Spring - summer |
| | Narwhal | <i>Monodon monoceros</i> | NT | Baffin Bay (Landcaster sound and Pont Inlet) High Arctic summering grounds Low Arctic Wintering grounds West and Northern Greenland Southern Ellesmer Island (Grise Fiord) Svalbard | Summer Winter (10 November to 15 January) |

| | | | | | |
|-----------------------|--|-----------------------------------|----|---|--------|
| Ocean Dolphins | Killer whale | <i>Orcinus orca</i> | LC | Canadian Beaufort Sea Eastern Canadian archipelago | |
| | Long-finned pilot whale | <i>Globicephala melas</i> | LC | | |
| | White-beaked dolphin | <i>Lagenorhynchus albirostris</i> | LC | Subarctic and arctic waters | Summer |
| | North Atlantic Bottlenose Dolphin | <i>Hyperoodon ampullatus</i> | DD | North Atlantic | Summer |
| Porpoises | Harbor porpoise | <i>Phocoena phocoena</i> | LC | Subarctic North – Mainly coastal West Greenland | |

Table 2. Synthesis of the current presence and distribution of marine mammals in the Arctic (a full list, including bibliography references, can be found in annex)

The following tables represents an exhaustive literature survey showing the presence and status of marine mammals in the Arctic and sub-Arctic regions, together with references.

| Observatory / Reference | Species | Scientific name | Density | IUCN status | Region | Year's period |
|----------------------------------|--------------------------------|-----------------------------------|---------|-------------|--------|---------------|
| Arctic Ocean (Hausgarten) | Sei whale | <i>Balaenoptera borealis</i> | | EN | | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | | |
| | Killer whale | <i>Orcinus orca</i> | | LC | | |
| | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | |
| | Fin whale | <i>Balaenoptera physalus</i> | | EN | | |
| | Sperm whale | <i>Physeter macrocephalus</i> | | LC | | |
| | Blue whale | <i>Balaenoptera musculus</i> | | EN | | |
| | Long-finned Pilot whale | <i>Globicephala melas</i> | | LC | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | | |
| HMMV | Sperm whale | <i>Physeter macrocephalus</i> | | LC | | |

| | | | | | | | | |
|--|--------------------------------|-----------------------------------|--|----|-------------------------------|------------------------------|------------|----------------------------------|
| (Haakon Mosby Mud Volcano) – Norwegian Margin Observatory | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | | | |
| | Fin whale | <i>Balaenoptera Physalus</i> | | EN | | | | |
| | Blue whale | <i>Balaenoptera musculus</i> | | EN | | | | |
| | Killer whale | <i>Orcinus orca</i> | | LC | | | | |
| | Sei whale | <i>Balaenoptera borealis</i> | | EN | | | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | | | | |
| | Long-finned Pilot whale | <i>Globicephala melas</i> | | LC | | | | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | | | | |
| Storegga – Norwegian Margin Observatory | Narwhal | <i>Monodon monoceros</i> | | NT | | | | |
| | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | | | |
| | Blue whale | <i>Balaenoptera musculus</i> | | EN | | | | |
| | Sperm whale | <i>Physeter macrocephalus</i> | | LC | | | | |
| | Killer whale | <i>Orcinus orca</i> | | LC | | | | |
| | Fin whale | <i>Balaenoptera physalus</i> | | EN | | | | |
| | Long-finned Pilot whale | <i>Globicephala melas</i> | | LC | | | | |
| | Sei whale | <i>Balaenoptera borealis</i> | | EN | | | | |
| Laidre et al, 2005 | Narwhal | <i>Monodon monoceros</i> | | NT | Baffin bay | | Summer | Winter (10 November- 15 January) |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | High Arctic summering grounds | Low Arctic wintering grounds | Baffin Bay | |
| | Bowhead whales | <i>Balanea mysticetus</i> | | LC | Baffin bay | | Winter | |

| | | | | | | |
|------------------------|-----------------------|------------------------------------|--|----|--|----------|
| Norstrom et al, 1994 | Northern fur seal | <i>Callorhinus ursinus</i> | | VU | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Polynyas / Canadian Arctic | Winter |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Polynyas | Winter |
| | Walrus | <i>Odobenus rosmarus divergens</i> | | DD | Polynyas | Winter |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Polynyas / Canadian Arctic | winter |
| | Harbor porpoise | <i>Phocoena phocoena</i> | | LC | Subarctic north, mainly coastal | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | Throughout the Arctic and Sub-Arctic circumpolar regions | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | Canadian Arctic | |
| Alter et al, 2010 | Beluga | <i>Delphinapterus leucas</i> | | NT | Cook Inlet | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | West and Northern Greenland | |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | (Arctic and subarctic waters) / Barrow (Alaska) | / Spring |
| | White-beaked dolphins | <i>Lagenorhynchus albirostris</i> | | LC | (Subarctic and arctic waters) | Summer |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | (Subpolar) | |
| | Harbor porpoise | <i>Phocoena phocoena</i> | | LC | Subarctic | |
| Huntington et al, 2009 | Bowhead whale | <i>Balaena mysticetus</i> | | LC | | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | | |
| | Killer whale | <i>Orcinus orca</i> | | DD | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | | |
| | Fin whale | <i>Balaenoptera physalus</i> | | EN | | |
| | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | |

| | | | | | | |
|-------------------------|--------------------------|-----------------------------------|--|----|---|--|
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | | |
| | Walrus | <i>Odobenus rosmarus</i> | | DD | | |
| | Harp seal | <i>Phoca groenlandica</i> | | LC | | |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | | |
| | Ribbon seal | <i>Histiophoca fasciata</i> | | DD | | |
| | Spotted seal | <i>Phoca largha</i> | | DD | | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | | |
| Muir et al, 1992 | Ringed seal | <i>Pusa hispida</i> | | LC | Arctic Canada , W. Greenland, E. Beaufort sea, Chukchi sea, Spitsbergen | |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | Western Greenland | |
| | Harp seal | <i>Phoca groenlandica</i> | | LC | Western Greenland | |
| | Northern fur seal | <i>Callorhinus ursinus</i> | | VU | Bering sea | |
| | Walrus | <i>Odobenus rosmarus rosmarus</i> | | DD | N. Greenland, N. Baffin Sea, N. Bering sea | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | Beaufort sea, Canadian Arctic (East/central Arctic) | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Beaufort sea, W. and E. Hudson Bay | |
| | Minke whale | <i>Balaenoptera physalus</i> | | LC | W. Greenland | |
| | Fin whale | <i>Balaenoptera Physalus</i> | | EN | S.E Greenland | |
| | Harbor porpoise | <i>Phocoena phocoena</i> | | LC | W. Greenland | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | Western Baffin Bay, western Greenland waters | |
| Fish et al, 2005 | Polar bear | <i>Ursus maritimus</i> | | VU | Svalbard (Norway) – Churchill (Canada) | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Arviat region | |
| | Walrus | <i>Obdobenus rosmarus</i> | | DD | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Svalbard region – Ungava Bay | |
| | Harp seal | <i>Phoca groenlandica</i> | | LC | Barents sea | |
| | Harbor seal | <i>Phoca vitulina</i> | | LC | Baffin Island | |
| | Narwhal | <i>Monodon</i> | | NT | | |

| | | | | | | |
|---------------------|-----------------|------------------------------------|--|----|--|---|
| | | <i>monoceros</i> | | | | |
| Becker et al, 1993 | Ringed seal | <i>Pusa hispida</i> | | LC | Barrow, Chukchi Sea | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Barrow, Chukchi Sea | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Point Hope, Chukchi Sea / Point Lay, Chukchi Sea | |
| | Harbor seal | <i>Phoca vitulina</i> | | LC | Prince William sound | |
| | Walrus | <i>Odobenus rosmarus</i> | | DD | | |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | | |
| Tilbury et al, 2002 | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | Bering and Chukchi seas | Spring and Summer |
| | Fin whale | <i>Balaenoptera physalus</i> | | EN | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | | |
| | Harbor porpoise | <i>Phocoena phocoena</i> | | LC | | |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | Alaska | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | | |
| Hobbs et al, 2003 | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | West and Southeast Greenland, West Svalbard, Barents Sea | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Eastern Canadian Arctic and Western Greenland | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Hudson Bay, Northeastern and Western Greenland, Svalbard, Northern Norway, Canadian Arctic | |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | Bering, Chukchi and Beaufort Seas | Migrating from the Bering sea overwintering |
| | Polar bear | <i>Ursus maritimus</i> | | VU | Circumpolar Arctic | |
| Bluhm et al, 2010 | Bowhead whale | <i>Balaena mysticetus</i> | | LC | Canada Basin – Northeast of Barrow | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Canada Basin | |
| Braune et al, | Walrus | <i>Obdobenus rosmarus rosmarus</i> | | DD | | |

| | | | | | | | |
|-------------------------|-----------------------|-----------------------------------|----|----------------------------|--|-------------------------------|--|
| 2005 | Beluga | <i>Delphinapterus leucas</i> | | NT | Inuvialuit region (Mackenzie Bay and Paulatuk – Beaufort Sea), Hudson strait (Kimmirut and Kangiqsujaq), Hudson Bay (Arviat), Baffin Island (Cumberland sound), Svalbard, Alaska, Pangsirtung | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Grise Fiord, Sachs Harbour, Holman Island, Alaska, Western and central Canadian Arctic archipelagos, Beaufort sea, Chukchi sea, Ungava Bay, Hudson strait, Baffin Sea, Pangsirtung | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | | | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | Southern Ellesmer Island (Grise Fiord), Baffin Bay (Landcaster sound and Pond Inlet), Western Greenland, Svalbard | | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | Northwest Alaska, Beaufort Sea (Amundsen gulf), East Greenland, Svalbard, Southern Baffin Island, Hudson Bay, Jones sound | Fall and Winter : South (ice) | Spring and Summer : North (when ice melts) |
| Dehn et al, 2006 | Polar bear | <i>Ursus maritimus</i> | | VU | Barrow (Alaskan Arctic) | | Winter |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Greenland, Point Lay and Wainwright (Alaska) | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Barrow (Alaska) | Holman | Summer |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Barrow (Alaska) | | Summer |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | | | |
| | Walrus | <i>Odobenus rosmarus</i> | | DD | Barrow, Little diomedea (Alaska), Akulivik, Inukjuak (Canada) | | Summer |
| | Spotted seal | <i>Phoca largha</i> | | DD | Little diomedea, Shishmaref (Alaska) | | |
| | Ribbon seal | <i>Histiophoca fasciata</i> | | DD | Little diomedea, Hooper Bay (Alaska) | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | Lorino, Lavrentiya (Russia) | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | West Greenland, Svalbard, Norway | | |
| Harbor seal | <i>Phoca vitulina</i> | | LC | Copper Rives Delta, Alaska | | | |

| | | | | | | | | | | |
|-------------------------------|------------------------|-----------------------------------|---------------------|----|---|--|-----------------------------|--------|--------------------|-------------------------------|
| | Harp seal | <i>Phoca groenlandica</i> | | LC | Estuary Canada | | | | | |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | Greenland | | | | | |
| | Narwhal | <i>Monodon monoceros</i> | | NT | Circumpolar Arctic , Greenland | | | | | |
| | Harbor porpoise | <i>Phocoena phocoena</i> | | LC | Greenland | | | | | |
| Richardson et al, 1985 | Bowhead whale | <i>Balaena mysticetus</i> | | EN | Bering sea | Eastern Beaufort sea | Western and Northern Alaska | Winter | Summer (feeding) | Spring and Autumn (migration) |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | | | | | | |
| | Humpback whale | <i>Megaptera novaeangliae</i> | | LC | | | | | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | LC | | | | | | |
| Stirling, 1997 | Ringed seal | <i>Pusa hispida</i> | Abundant | LC | Canadian arctic archipelago, Eastern Beaufort sea, Western Hudson Bay, Western Baffin Bay, Bellot Strait, Penny strait, Queens Channel, Hell gate Polynya | Dundas Island | | | Spring | |
| | Polar bear | <i>Ursus maritimus</i> | Low density | VU | Western Hudson Bay, Eastern Beaufort Sea, Bellot strait | Dundas Island | | | Spring | |
| | Bowhead whale | <i>Balaena mysticetus</i> | | LC | Eastern Canadian Arctic (polynyas of the Northwater, Cumberland Sound, Roes Welcome Sound) | Beaufort Sea Coast (Cape Bathurst polynya) | Summer | | Spring (Migration) | |
| | Walrus | <i>Odobenus rosmarus</i> | Abundant | DD | Northeast water Polynya | Polynya at Dundas Island | overwintering | | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Northeastern Beaufort Sea | | | | | |
| | Wassman, 2011 | Killer whale | <i>Orcinus orca</i> | | DD | Eastern Canadian Arctic Archipelago | | | | |

| | | | | | | | | | | | |
|---------------------------|---------------|-----------------------------------|--|----------------------------|----|--|---|-----------------------|--------------------------|--------|---------------------------------|
| Moore et al, 2010 | Bowhead whale | <i>Balaena mysticetus</i> | | | LC | Northern Bering Sea, Northeastern Chukchi Sea | Barrow | Canadian Beaufort Sea | Winter (début migration) | Spring | Summer (July through September) |
| | Beluga | <i>Delphinapterus leucas</i> | | | NT | Northwest of Barrow | | | Spring-Summer | | |
| | Walrus | <i>Odobenus rosmarus</i> | | | DD | Northwest of Barrow | | | | | |
| | Polar bear | <i>Ursus maritimus</i> | | | VU | Northwest of Barrow | | | | | |
| | Ringed seals | <i>Pusa hispida</i> | | | LC | Northwest of Barrow | | | | | |
| | Gray whale | <i>Eschrichtius robustus</i> | | | LC | Beaufort Sea | | | Winter | | |
| Miquel J.C., 2001 | Polar bear | <i>Ursus maritimus</i> | | | VU | Kara sea | | | | | |
| | Walrus | <i>Odobenus rosmarus</i> | | | DD | Kara sea | | | | | |
| | Beluga | <i>Delphinapterus leucas</i> | | | NT | Kara sea | | | | | |
| | Ringed seal | <i>Pusa hispida</i> | | | LC | Kara sea | | | | | |
| | Harp seal | <i>Phoca groenlandica</i> | | | LC | Kara sea | | | | | |
| | Harbor seal | <i>Phoca vitulina</i> | | | LC | Kara sea | | | | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | | LC | Kara sea | | | | | |
| Bluhm et al, 2007 | Gray whale | <i>Eschrichtius robustus</i> | 1546 (2007), 15,000-20,000 (before 1900), 4000(after 1900),26,000 (1998) | | LC | Baja California North | Chirikov Basin (Northern Bering Sea), Chukchi Sea | | Winter | Summer | Fall |
| Lindsrom et al, 2009 | Harp seal | <i>Phoca groenlandica</i> | | | LC | Barents sea | | | | | |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | Stay in the Barents sea : 5% of total stock size | Peak abundance in mid July | LC | Enter in the Barents Sea (April) | Leave the Barents sea (October) | | Summer | | |
| Quakenbush et Citta, 2008 | Polar bear | <i>Ursus maritimus</i> | | | VU | Chukchi sea (Alaska), Beaufort sea(Arctic Canada), Greenland | | | | | |
| | Ringed seal | <i>Pusa hispida</i> | | | LC | Diomede (Bering strait), Hooper Bay (Alaska), Pt. Hope, Shishmaref | | | | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | | LC | Hooper Bay, Pt. Hope (Alaska), Diomede | | | | | |
| | Spotted seal | <i>Phoca largha</i> | | | DD | Shishmaref (Chukchi sea), Diomede, | | | | | |

| | | | | | | | |
|-----------------------------|--|-----------------------------------|--------------|---------------------------|---|----|-----------------------------|
| | | | | | Hooper Bay | | |
| | Ribbon seal | <i>Histiophoca fasciata</i> | | DD | Diomede, Pt. Hope | | |
| Andersen et al, 2006 | Polar bear | <i>Ursus maritimus</i> | | VU | Spitsbergen (Svalbard archipelago) | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Spitsbergen | | |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | North Greenland Sea | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Spitsbergen | | |
| | Harp seal | <i>Phoca groenlandica</i> | | LC | Southern Barents Sea | | |
| | Beluga | <i>Delphinapterus leucas</i> | | NT | Spitsbergen | | |
| | Blue whale | <i>Balaenoptera musculus</i> | | EN | Jan Mayen | | |
| | Walrus | <i>Odobenus rosmarus</i> | | DD | Jan Mayen | | |
| | Richardson et al, 1990 | Bowhead whale | | <i>Balaena mysticetus</i> | | LC | Bering Sea (Western Arctic) |
| Gray whale | | <i>Eschrichtius robustus</i> | | LC | Canadian Beaufort Sea | | |
| Killer whale | | <i>Orcinus orca</i> | | DD | Canadian Beaufort Sea | | |
| Joiries, C.R., 1992 | Harp seal | <i>Phoca groenlandica</i> | | LC | Barents, Kara, Laptev seas, Jan Mayen sector of the Greenland sea | | |
| | Hooded seal | <i>Cystophora cristata</i> | | VU | Barents, Kara, Laptev seas | | |
| | Ringed seal | <i>Pusa hispida</i> | | LC | Barents, Kara, Laptev seas | | |
| | Bearded seal | <i>Erignathus barbatus</i> | | LC | Barents, Kara, Laptev seas | | |
| | Walrus | <i>Odobenus rosmarus</i> | | DD | East Greenland and Spitsbergen | | |
| | Sperm whale | <i>Physeter macrocephalus</i> | | LC | North Atlantic | | Summer |
| | North Atlantic Bottlenose whale | <i>Hyperoodon ampullatus</i> | Non abundant | DD | North Atlantic | | Summer |
| | Minke whale | <i>Balaenoptera acutorostrata</i> | | LC | North East Atlantic | | Summer |
| | Killer whale | <i>Orcinus orca</i> | | LC | | | |
| | Polar bear | <i>Ursus maritimus</i> | | VU | | | |

Table 3. Literature survey of the distribution and status of the marine mammal species per species and region

Status and Trends

The status of a species (in terms of stock and abundance) is a function of both its population dynamics and the key factors that determine these dynamics, including behaviour, health status, trophic dynamics, habitat and effects human of activities. With few exceptions, previous assessments of marine mammals in the Arctic have focused on population dynamics and achieved only limited success (Table 4). In addition, much of the existing information is outdated and only provides a snapshot of the situation rather than a reliable assessment of long-term trends.

| Species | Stock | Abundance | Year | Trend |
|---------------|--|------------------------|-------------------|-----------------------|
| Bowhead whale | Bering-Chukchi-Beaufort Seas | 10,500 | 2001 | increasing |
| | E. Canada-W. Greenland Svalbard | 6,300 unknown | 2002-2004 — | increasing unknown |
| Beluga | Okhotsk Sea | unknown | — | unknown |
| | Cook Inlet | 380 | 2000 | declining |
| | Eastern Bering Sea | 18,100 | 1989-1991 | unknown |
| | Bristol Bay | 1,600 | 2000 | increasing |
| | Eastern Chukchi Sea | 3,700 | 1992 | stable |
| | Eastern Beaufort Sea | 39,300 | 1999 | stable |
| | Foxe Basin | 1,000 | 1983 | unknown |
| | Western Hudson Bay | 25,000 | 1978 & 1987 | unknown |
| | Southern Hudson Bay | 1,300 | 1987 | unknown |
| | James Bay | 7,900 | 2001 | unknown |
| | St. Lawrence River | 1,100 | 1997 | stable |
| | Eastern Hudson Bay | 1,200 | 2001 | declining |
| | Ungava Bay | <50 | 2007 | unknown |
| | Cumberland Sound | 1,500 | 2001 | increasing |
| Narwhal | Eastern High Arctic-Baffin Bay | 21,200 | 1996 | stable |
| | West Greenland | 7,900 | 1998-1999 | unknown |
| | 3 stocks in Okhotsk Sea | 18-20,000 | 1987 | unknown |
| | 11 additional stocks | unknown | — | unknown |
| | Canadian High Arctic Northern Hudson Bay | 70,000 3,500 | 2002-2004 2000 | unknown unknown |
| Ringed seal | Eastern Baffin Island | 15,000 | 1993 | unknown |
| | West Greenland | 2,000 | 1998-1999 | unknown |
| | East Greenland | >1,000 | 1980-1984 | unknown |
| | Arctic subspecies | ~2.5 million | 1970s | unknown |
| Bearded seal | Baltic Sea subspecies | 5,000-8,000 | 1990s | mixed |
| | Lake Saimaa subspecies | 280 | 2005 | increasing |
| | Lake Ladoga subspecies | 3,000-5,000 | 2001 | unknown |
| | Okhotsk Sea subspecies | >800,000 | 1971 | unknown |
| | Bering-Chukchi Seas | 250-300,000 | 1970s | unknown |
| Walrus | Canadian waters | 190,000 | 1958-1979 | unknown |
| | Atlantic and Russian Arctic Okhotsk Sea | unknown 200-250,000 | — 1968-1969 | unknown unknown |
| | Atlantic subspecies | 18-20,000 | 2006 | mixed |
| Polar bear | Bering-Chukchi Seas | ~201,000 | 1990 | unknown |
| | Laptev Sea | 4,000-5,000 | 1982 | unknown |
| Polar bear | Other regions Chukchi Sea | unknown 2,000 | — 1993 | unknown unknown |
| | Southern Beaufort Sea | 1,500 | 2006 | declining |
| | Northern Beaufort Sea | 1,200 | 1986 | stable |
| | Viscount Melville Sound | 220 | 1992 | increasing |
| | McClintock Channel | 280 | 2000 | increasing |
| | Norwegian Bay | 190 | 1998 | declining |
| | Lancaster Sound | 2,500 | 1998 | stable |
| | Gulf of Boothia | 1,500 | 2000 | stable |
| | Foxe Basin | 2,200 | 1994 | stable |
| | Western Hudson Bay | 940 | 2004 | declining |
| | Southern Hudson Bay | 1,000 | 1988 | stable |
| | Baffin Bay | 2,100 | 1998 | declining |
| | Davis Strait | 1,700 | 2004 | unknown |
| | Kane Basin | 160 | 1998 | declining |
| | Barents Sea | 3,000 | 2004 | unknown |
| Laptev Sea | 4,000-5,000 | 1993 | unknown | |

Table 4 Available data on population dynamics of arctic marine mammal species. Information on abundance, trends, and the year when the most recent data were collected are summarized by stock, except for ringed seals, bearded seals, and walruses, whose stock structure is unknown. Adapted from Richter-Menge et al. (2008).

Monitoring Marine Mammal Population in the Arctic

The U.S. Marine Mammal Commission and U.S. Fish and Wildlife Service convened an international workshop in Valencia, Spain during 4-6 March 2007³ to develop a general monitoring strategy for arctic marine mammals. The workshop participants included 53 scientists and members of arctic indigenous communities with expertise in the biology and ecology of marine mammals, arctic oceanography and climate, sea ice, marine mammal health, subsistence harvest and biosampling networks, and monitoring techniques. Participants identified key parameters for monitoring population status and research tools for assessing those parameters (Figure 3).

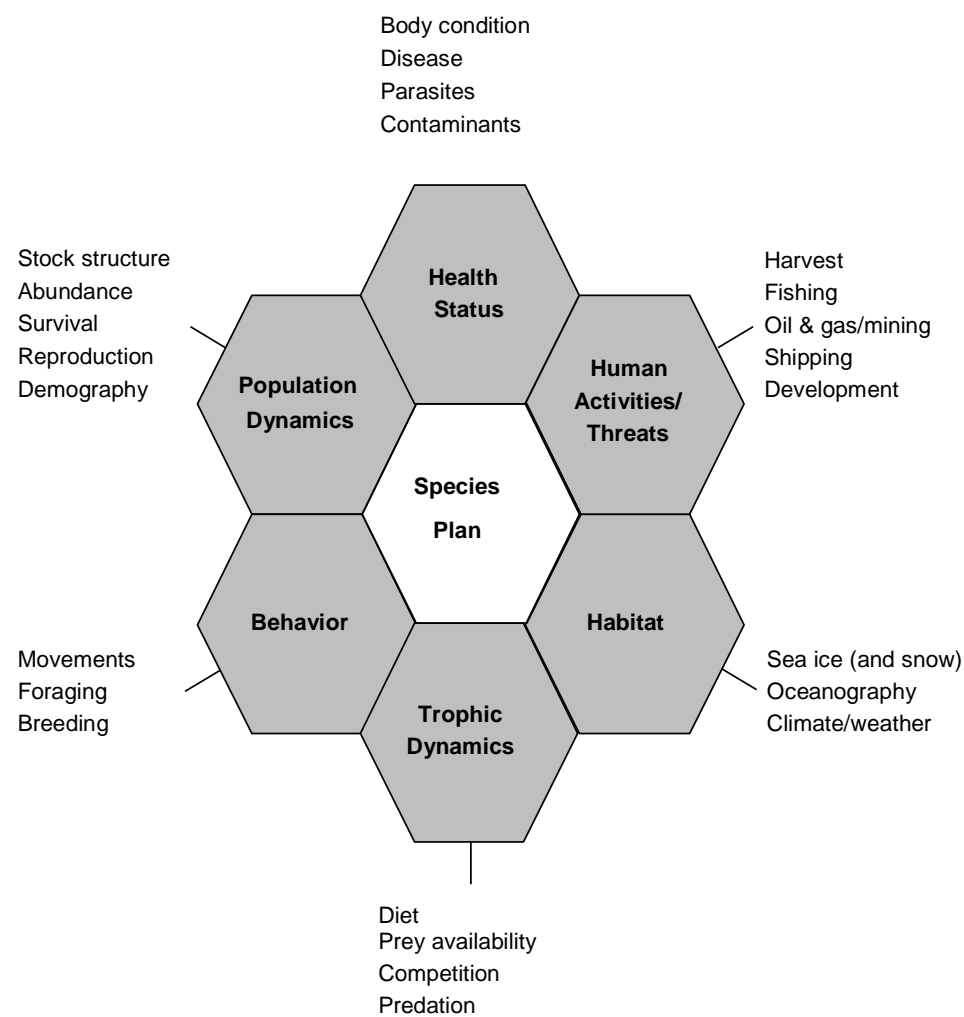


Figure 3 The components of a comprehensive plan for monitoring the status of a marine mammal species or stock, including population dynamics, the factors that influence those dynamics, and examples of parameters that might be monitored for each factor (see Table 5)

³ Michael Simpkins, Kit M. Kovacs, Kristin Laidre, Lloyd Lowry, *A Framework for Monitoring Arctic Marine Mammals - Findings of a Workshop Sponsored by the U.S. Marine Mammal Commission and U.S. Fish and Wildlife Service, Valencia, March 2007*. CAFF International Secretariat, CAFF CBMP Report No. 16.

| Key Parameters | Primary Monitoring Tools |
|---|--|
| Population Dynamics | |
| Population structure | Genetic analyses (biological samples from remote biopsies, live captures, subsistence harvest, strandings, ice entrapments) Distribution and movements (surveys, satellite tagging, local observations) |
| Abundance & trends | Visual surveys (aerial, boat-based, shore-based) Infrared or multispectral surveys (aerial, remote-sensing) Mark-recapture methods (tagging, tattooing, branding, photo-ID) |
| Survival & reproductive rates | Biological samples (e.g., reproductive tracts; harvested, stranded, entrapped animals) Mark-recapture methods Demography from surveys (for species with visually-distinct sex and age classes) |
| Behavior | |
| Migration & distribution | Remote tracking (VHF & satellite-linked tags) Local observations (villages ¹ , research stations) |
| Foraging | Remote tracking |
| Breeding | Local observations Passive acoustic monitoring (for vocal species) Genetic analyses (biological samples from remote biopsies, live captures, subsistence harvest, strandings, ice entrapments) |
| Health Status | |
| Body condition | Morphometry (captured, harvested, stranded, entrapped animals) Photogrammetry (i.e., remote morphometry) |
| Diseases & parasites | Necropsies (harvested, stranded, entrapped animals) Analyses of tissue samples (biopsies, live captures, harvested, stranded, entrapped animals) |
| Contaminants | Analyses of tissue samples (biopsies, live captures, harvested, stranded, entrapped animals) |
| Habitat | |
| Sea ice (extent, thickness, concentration, duration) | Remote sensing (e.g., AVHRR, microwave) Local observations (villages, research stations) |
| Snow (depth, duration) [primarily for ringed seals] | Local observations (villages, research stations) Remote sensing (microwave?) |
| Primary production (amount, location, bloom timing) | Oceanographic cruises Local observations (villages, research stations) Remote sensing (chlorophyll) |
| Trophic Dynamics | |
| Prey availability & quality | Diet (stomach and fecal samples, fatty acids, stable isotopes) Prey abundance & distribution (pelagic & benthic prey surveys) |
| Competition (arctic or formerly sub-arctic species) | Surveys of competitors Studies of behavior of competitors |
| Predation | Surveys of predators (e.g., killer whales, polar bears) Studies of behavior of predators |
| Human Activities | |
| Subsistence harvest | Harvest monitoring programs (government or local) |
| Coastal development, Fishing, Shipping, Oil & gas/mining operations, Tourism, Military activities | Continual assessment of new activities and potential or observed impacts on arctic marine mammals ¹ |

Table 5. Key monitoring parameters and tools for assessing the status of arctic marine mammal populations. Based primarily on ringed seals and belugas, these parameters and tools are expected to pertain, at least generally, to all arctic marine mammal species.

Traditional Whaling and Conclusions

Many coastal Arctic peoples have relied on subsistence harvests of marine mammals for centuries, and their cultures are rich in traditional ecological knowledge of marine mammals, including views regarding their behaviour, movements, the natural history and habitat. This knowledge can guide or increase research, management, and conservation efforts for marine mammals. Traditional marine mammal hunters constantly monitor local environmental conditions and the availability, behaviour and condition of the animals on which they depend for their livelihood, and they can be the first to detect significant changes in the Arctic due to climate change. Marine mammals taken by subsistence hunters may also be used for scientific research, to provide information on rates of reproduction, nutrition and health status (body condition, disease, parasites and contaminants). In addition, facilities (eg, airports) in the coastal villages of the Arctic and the equipment and skills of local people can provide essential support for a variety of other research and monitoring.

However, despite a very successful workshop in June 2014 where most of the indigenous Arctic people gathered in the context of ACCESS and where this issue was discussed, it was very difficult to find reliable data that could help in the understanding of the status of marine mammals traditionally hunted in those regions. A greater effort should be conducted to visit these coastal populations, provide the tools listed in Table 5 and assist them in the collection of data necessary to frame a coherent collaboration.

In any case, a comprehensive monitoring of marine mammals in the Arctic certainly require coordination and cooperation among agencies and nations of the Arctic.

Logistical and technical difficulties often require expensive solutions and generally limited research can be conducted. Local monitoring efforts can help solving the problem of accessibility, but only near the coastal villages. Subsistence takes can provide biological samples from harvested animals, although the collection of these samples is limited to certain areas mainly in Alaska, Canada, Greenland and eastern Russia. Remote imaging from satellites provides useful information on certain topics (eg, atmosphere and surface conditions), but it may be limited by cloud cover or difficult to distinguish between the characteristics of land and ice in the coastal zone. These and other technical and logistical challenges can be overcome, but only with adequate funding and collaborative approaches.