

# A Framework for Monitoring Arctic Marine Mammals in the Face of Climate Change

Findings from the Workshop to Develop Monitoring Plans for Arctic Marine Mammals, Valencia, Spain, 4-6 March 2007

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## WORKSHOP AND DEVELOPMENT OF MONITORING FRAMEWORK

The U.S. Marine Mammal Commission and U.S. Fish and Wildlife Service convened an international workshop in Valencia, Spain, 4-6 March 2007 to develop monitoring strategies for arctic marine mammals.

Workshop participants recognized the need to monitor not only the population dynamics of marine mammals 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 (Figure 1).

Some of these factors are likely to respond quickly to climate change and new human activities in the Arctic, and those changes, in turn, might lead to changes in the status of marine mammal species.

Participants discussed the current population status of ringed seals and belugas (Table 1), as well as previous and ongoing research and monitoring efforts for those species. Using these species as case studies, participants developed a comprehensive monitoring framework for arctic marine mammals, including specific and general monitoring needs and tools that should be considered when developing integrated regional or species-based monitoring plans (Table 2).

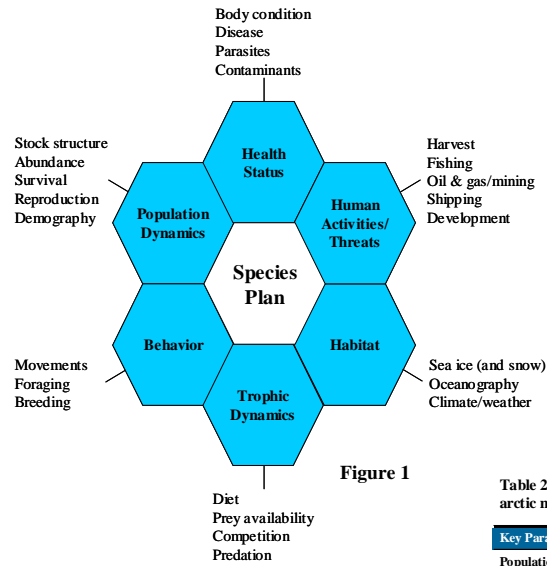


Figure 1

Table 1. Available data on population dynamics of arctic marine mammal species<sup>1</sup>. Locations shown in Figure 2.

Species	Stock	Abundance	Year	Trend
Bowhead whale	Bering-Chukchi-Beaufort Seas	10,500	2001	increasing
	E. Canada-W. Greenland	6,300	2002-2004	increasing
	Spitsbergen	unknown	—	unknown
	Okhotsk Sea	<400	1979	unknown
Beluga whale	Cook Inlet	380	2007	stable
	Eastern Bering Sea	18,100	2000	unknown
	Bristol Bay	3,300	2005	increasing
	Eastern Chukchi Sea	3,700	1989-1991	unknown
	Eastern Beaufort Sea	39,300	1992	unknown
	Foxe Basin	1,000	1983	unknown
	Western Hudson Bay	57,300	2004	unknown
	Southern Hudson Bay	1,300	1987	unknown
	James Bay	4,000	2004	unknown
	St. Lawrence River	1,200	2005	stable
	Eastern Hudson Bay	4,300	2004	declining
	Ungava Bay	<50	2007	unknown
	Cumberland Sound	1,500	1999	increasing
	E. 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	
Narwhal	Canadian High Arctic	>60,000	2002-2004	unknown
	Northern Hudson Bay	3,500	2000	unknown
Ringed seal <sup>a</sup>	West Greenland	2,000	1998-1999	unknown
	East Greenland	>1,000	1980-1984	unknown
	Arctic subspecies	~2.5 million	1970s	unknown
Bearded seal <sup>b</sup>	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 <sup>c</sup>	Canadian waters	190,000	1958-1979	unknown
	Northern Hudson Bay	2,000	2000	unknown
	Atlantic and Russian Arctic	200-250,000	1968-1969	unknown
	Okhotsk Sea	200-250,000	1968-1969	unknown
Polar bear <sup>d</sup>	Bering-Chukchi Seas	~201,000	1990	unknown
	Atlantic subspecies	18-20,000	2006	mixed
	Laptev Sea	4,000-5,000	1982	unknown
	Other regions	unknown	—	unknown
	Chukchi Sea	2,000	1993	unknown
	Southern Beaufort Sea	1,500	2006	declining
Polar bear <sup>d</sup>	Northern Beaufort Sea	1,200	1986	stable
	Viscount Melville Sound	220	1992	increasing
	McClintock Channel	280	2000	increasing
	Nowegian 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	2,700	2004	unknown
Laptev Sea	4,000-5,000	1993	unknown	

<sup>1</sup>See Arctic Report Card 2009 – <http://www.arctic.noaa.gov/reportcard/marine-mammal.html>



## RECOMMENDATIONS

To develop and implement such plans, participants recommended that arctic nations **convene international expert monitoring groups**, under - for example - the auspices of the Arctic Council's Circumpolar Biodiversity Monitoring Program, and charge the groups with -

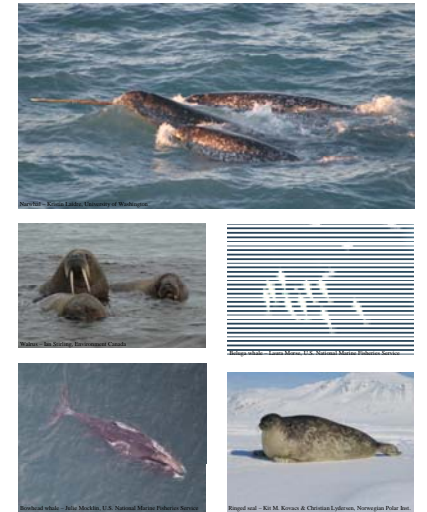
1. Developing and periodically updating comprehensive monitoring plans as described here (Figure 1, Table 2);
2. Establishing research and monitoring priorities;
3. Developing data collection and sharing protocols;
4. Promoting research and monitoring partnerships; and
5. Clarifying funding needs, identifying potential funding sources, and developing funding proposals.

Such a coordinated, multi-national, and multi-disciplinary approach is essential to ensure that adequate information is available to conserve arctic marine mammals in the face of climate change and associated changes in human activities.

Table 2. Key monitoring parameters and tools for measuring the status of arctic marine mammal populations.

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

Superscripts indicate the need for partnerships with experts outside of typical marine mammal research fields: B=biological oceanographers and fisheries biologists, C=contaminants monitoring groups (e.g., AMAP), I=industries and industry monitoring groups, L=local subsistence hunters or local monitoring networks, P=physical oceanographers and sea ice scientists, V=veterinarians and wildlife epidemiologists.



Monitoring plans must account for regional differences in the predicted impacts of climate change. Figure 3 depicts arctic climate regions<sup>7</sup> with contrasting predicted 50-year trends in summer sea ice extent - reduction in Barents, Beaufort, and Chukchi Seas; stable in Baffin Bay and the Labrador Sea; and variable predictions for the Central Arctic, East Greenland, and the Kara and Laptev Seas.

<sup>7</sup>Modified from Overland, J.E., and M. Wang. 2007. Future regional Arctic sea ice declines. *Geophysical Research Letters* 34:L17305.

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**FULL REPORT:** Simpkins, et al. 2009. *A Framework for Monitoring Arctic Marine Mammals*. CAFF International Secretariat, CAFF CBMP Report No. 16. (<http://cbmp.arcticportal.org/>)