

Overview of Arctic research and assessment activities: cetacean-relevant updates on ACIA, PAME, AMAP, IPY, ICARPII and recent publications

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ARCTIC CLIMATE IMPACT ASSESSMENT (ACIA)

The Arctic Climate Impact Assessment (ACIA) was an international project of the Arctic Council³ and the International Arctic Science Committee (IASC), a non-governmental organization focused on facilitation of arctic research. The ACIA synthesized information on climate variability, climate change and increased ultraviolet radiation (<http://www.acia.uaf.edu/>), as summarized by Krahn at the IWC SC/57 symposium 'High Latitude Sea Ice Environments: Effects on Cetacean Abundance, Distribution and Ecology.' The loss of sea ice documented and projected in the ACIA report (see Fig. 1) has become the focus of scientific investigations regarding the potential for transition of the Arctic marine environment to a different climate state (e.g., Lindsay and Zhang 2005; Overpeck et al. 2005). While loss of sea ice habitat has immediate negative effects on ice-obligate marine mammals (i.e., polar bear, walrus and ice seals), impacts to arctic cetaceans are less certain (Laidre et al. in review; Moore and Huntington in review). The ACIA (2004) provides a science foundation that has launched reviews on topics such as Arctic shipping (see PAME), focused research questions to be addressed during the International Polar Year (IPY) and guided development within the framework of the second International Conference on Arctic Research Planning (ICARPII).

PROTECTION OF THE ARCTIC MARINE ENVIRONMENT (PAME)

The PAME is a working group of the Arctic Council (<http://www.pame/is>), with the overarching goal of developing measures related to the protection of the Arctic marine environment through coordinated action programs that complement existing international legal arrangements. The PAME working group has undertaken an Arctic Marine Shipping Assessment (AMSA) in response to **ACIA Key Finding #6: *Reduced sea ice is very likely to increase marine transport and access to resources.*** The AMSA will be conducted 2005-2008, will consider the circumpolar arctic and is a direct follow-up to the Arctic Marine Strategic Plan (AMSP), as summarized in the Arctic Marine Transport Workshop Report (Brigham and Ellis 2004).

The AMSA follows on to the ACIA's projection of increased Arctic sea route access (Fig. 1). Specifically the ACIA sea ice projections for the Russian Northern Sea Route suggest an increasing length of the navigation season. Existing and future arctic shipping activity includes a broad range of vessels (e.g. tankers, bulk carriers, container ships, tug-barge combinations, fishing vessels, passenger ferries & cruise ships, research vessels, icebreakers and offshore supply vessels). Anticipated impacts to cetaceans include: (1) increased potential for collision injury or mortality; and (2) elevated underwater noise levels concomitant with vessel traffic (Greene and Moore 1995; Hildebrand 2005). Further, increases in shipping activities may disrupt subsistence hunting by Arctic inhabitants either by direct interference or in relation displacement of wildlife.

ARCTIC MONITORING AND ASSESSMENT PROGRAM (AMAP)

The AMAP is another working group of the Arctic Council (<http://www.amap.no/>) with current objectives of providing information on threats to the Arctic environment and of supporting Arctic governments in taking remedial and preventive actions relating to contaminants. The AMAP persistent organic pollutant (POPs) Expert Group met in Burlington, Ontario, Canada in March 2006 to plan future work that would

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³ The Arctic Council is a high-level intergovernmental forum, consisting of member nations: Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America.

contribute effectively to assessments of POPs in the Arctic and would also support the needs of global agreements (e.g., the Stockholm Convention) for information from the Arctic region. The Expert Group decided to focus its work over the next few years on evaluating data and writing review articles about emerging contaminants-of-concern (e.g., brominated flame retardants and perfluorinated chemicals used as stain-resistant coatings) that have been rapidly increasing in Arctic biota, including cetaceans. Further increases to the already high POPs burden in many Arctic cetacean species may have adverse health implications.

INTERNATIONAL POLAR YEAR (IPY)

The IPY is envisioned as an intense internationally coordinated campaign of research that will initiate a new era in polar science (<http://www.ipy.org>). The IPY will extend from March 2007 through March 2009, with projects at both poles and co-sponsorship by a Joint Committee of the International Council for Science and the World Meteorological Organization. In early November 2004, researchers were invited to send expressions of Interest (EoIs) to the IPY program office, resulting in over 870 submissions. The Joint Committee assessed and clustered the EoIs into six themes comprising 50+ topics ([http://www.ipy.org/Assessment Summary](http://www.ipy.org/Assessment%20Summary)) and encouraged researchers to integrate research plans, as possible.

While not a comprehensive review of extant proposals, at least four projects have potential links to Arctic cetaceans, as briefly summarized below.

Canadian Flaw Lead (CFL): Dave Barber, Canada

The CFL project will over-winter an icebreaker in the flaw lead in sea ice that develops along the west coast of Banks Island, extending southeastward to the Cape Bathurst polynya and Amundsen Gulf. The organizers propose to monitor the use of the flaw lead by marine mammals over winter with emphasis on predator-prey interactions between polar bears, ringed seals and bearded seals. A special component of the proposed research is an investigation into the chronology of flaw lead development during spring and the primary production cascades into the life processes of migrant marine mammals (including beluga and bowhead whales) and sea birds. This project is linked to GWAMM (see next topic).

Global Warming and Arctic Marine Mammals (GWAMM): Steve Ferguson, Canada

The GWAMM projects focus both on the health and well-being of Northern Communities, as well as climate change impacts and adaptation in marine mammals. Its goals include: (a) assessment of the present environmental status; (b) provision of a synoptic measure of polar region marine environmental processes; (c) quantification of past and present natural environmental and social changes in the Arctic; (d) improved projections of future change; and (e) advancement of knowledge on all scales regarding links and interactions between polar regions and the rest of the globe.

Pan-Arctic Tracking of Belugas (PATOB): Mads Peter Heide-Jorgensen, Denmark & Rod Hobbs, USA

The PATOB project plans to attach satellite transmitters and, in some locations, oceanographic data loggers to 100 belugas per year over three years. These instruments will allow a synoptic snapshot to be obtained of the pattern and timing of beluga movements in relation to sea ice, surface temperature, primary productivity, bathymetry, as well as temperature and salinity at depth through beluga dive profiles. This baseline will provide invaluable information for comparisons through time as the Arctic undergoes climate change. Belugas will be tagged across their range in Svalbard, Russia, Alaska, Canada and Greenland. The study will take advantage of past success in satellite tagging of belugas and will train local people and young scientists in fieldwork, data analysis and educational outreach. Tissue samples, measurements and other data will be collected from each tagged beluga to aid auxiliary studies. A real-time web-based display of beluga movements is planned as a window for the public to view this research program in (near) real time.

Study of Environmental Arctic Change: Plans for Implementation during the IPY and Beyond: ARCUS

The Study of Environmental Arctic Change (SEARCH) was conceived as an integrated, multidisciplinary approach to study the complex suite of interrelated changes observed in the arctic system over the past few decades. Projects under the program umbrella (<http://www.arcus.org/search/searchprojects>) were initiated

in 2003, but the IPY offers an opportunity to consolidate and expand existing studies and to implement observation networks. In preparation for IPY, the SEARCH Science Steering Committee organized an implementation workshop that was held 23-25 May 2005 (SEARCH 2005). Seven core science questions were identified, with implementation activities grouped under three themes (Observing, Understanding and Responding). The US National Science Foundation (NSF) provided an Announcement of Opportunity for IPY projects, with proposals due by 1 May 2006. Proposals are anticipated to be focused on process and modelling studies of marine environment dynamics (i.e. atmospheric forcing, hydrography, sea ice, production and trophic cascades) with relevance to arctic cetaceans.

SECOND INTERNATIONAL CONFERENCE ON ARCTIC RESEARCH PLANNING (ICARPII)

The ICARPII, held in Copenhagen Denmark from 10-12 November 2005 brought together over 480 scientists, policy makers, research managers, indigenous peoples and others interested in the future of Arctic research (<http://www.icarp.dk>). Conference participants reviewed and revised long-range (10-15 year) science plans, drafted by 12 working groups. Notably, the overall conclusion was one of 'shifting paradigms'. That is, the Conference Proceedings stated that: *Since the first ICARP, held in 1995 in New Hampshire, there has been a paradigm shift to a more holistic and multi-dimensional perspective in the Arctic. Specifically this perspective includes more integrally the human dimension, the social sciences and indigenous insights, as well as recognition that the Arctic is a system that can no longer be divided into traditional disciplines nor treated as separate from the planet as a whole and hence requires integration of Arctic processes into the earth system.* Final multidisciplinary research plans should be available by June 2006 (some are online now: <http://www.icarp.dk/WGreports/>) and will include opportunities for coordination of cetacean research across a suite of atmospheric, oceanographic, biologic and social science disciplines.

RECENT PUBLICATIONS

Environment and Sea Ice

Grebmeier, J.M., J.E. Overland, S.E. Moore, E.V. Farley, E.C. Carmack, L.W. Cooper, K.E. Frey, J.H. Helle, F.A. McLoughlin and S.L. McNutt. 2006. A major ecosystem shift in the northern Bering Sea. *Science* 311: 1461-1464.

Meier, W. J. Stroeve F. Fetterer and K. Knowles. 2005. Reduction in Arctic sea ice cover no longer limited to summer. *EOS Transactions of the American Geophysical Union* 86: 326-327.

Moore, S.E. and K.L. Laidre. 2006. Trends in sea ice cover within habitats used by bowhead whales in the western Arctic. *Ecological Applications* 16(4): in press.

Cetacean Body Condition and Health

Beineke, A., Siebert, U., McLachlan, M., Bruhn, R., Thron, K., Failing, K., Muller, G. and Baumgartner, W. 2005. Investigations of the potential influence of environmental contaminants on the thymus and spleen of harbor porpoises (*Phocoena phocoena*). *Environ. Sci. Technol.* 39(11):3933-8.

Dehn, L.-A., Follmann, E.H., Rosa, C., Duffy, L.K., Thomas, D.L., Bratton, G.R., Taylor, R.J. and O'Hara, T.M. 2006. Stable isotope and trace element status of subsistence-hunted bowhead and beluga whales in Alaska and gray whales in Chukotka. *Mar. Pollut. Bull.* 52(3):301-19.

Dehn, L.-A., Follmann, E.H., Thomas, D.L., Sheffield, G.G., Rosa, C., Duffy, L.K. and O'Hara, T.M. in press. Trophic relationships in an Arctic food web and implications for trace metal transfer. *Sci. Total Environ.*

de Wit, C.A., Alaee, M. and Muir, D.C.G. 2006. Levels and trends of brominated flame retardants in the Arctic. *Chemosphere* in press.

Fisk, A.T., de Wit, C.A., Wayland, M., Kuzyk, Z.Z., Burgess, N., Letcher, R., Braune, B., Norstrom, R., Blum, S.P. and Sandau, C. 2005. An assessment of the toxicological significance of anthropogenic contaminants in Canadian arctic wildlife. *Sci. Total Environ.* 351-352:57-93.

Herman, D.P., Burrows, D.G., Wade, P.R., Durban, J.W., LeDuc, R.G., Matkin, C.O. and Krahn, M.M. 2005. Feeding ecology of eastern North Pacific killer whales from fatty acid, stable isotope, and organochlorine analyses of blubber biopsies. *Mar. Ecol. Prog. Ser.* 302:275-91.

Hoekstra, P.F., O'Hara, T.M., Backus, S.M., Hanns, C. and Muir, D.C.G. 2005. Concentrations of persistent organochlorine contaminants in bowhead whale tissues and other biota from northern Alaska: Implications for human exposure from a subsistence diet. *Environmental Research* 98(3):329-40.

Krahn, M.M., Herman, D.P., Matkin, C.O., Durban, J.W., Barrett-Lennard, L., Burrows, D.G., Dahlheim, M.E., Black, N., LeDuc, R.G. and Wade, P.R. In review. Use of chemical profiles in assessing the feeding ecology of eastern North Pacific killer whales. *Mar. Environ. Res.*

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Figure 1. Projections of sea ice reductions and associated shipping routes, from ACIA (2004).

