

parts of the region, and showed movement southward before this winter calling peak and northward after it. Calling was present year-round, though at very low levels in late spring and summer. Fin whale (*B. physalus*) calling, which was analyzed from peaks in aggregated spectra, showed a similar overall pattern to blue whale calling, except that there was much more of it, especially at higher latitudes. Fin whale calls occurred year-round as well. Airgun sounds, which were analyzed using automatic detection followed by manual checking, were present in all seasons at all latitudes, occurring on 100% of days examined in some months. Results show that the broad-scale spatiotemporal pattern of whale calling matches what is known about north-south seasonal migration of these species of whales combined with seasonal variation in vocalization rates. The airgun results show the high prevalence of airgun sounds, which appear to originate principally from petroleum exploration thousands of kilometers distant.

### Aerial and vessel surveys of the undersea warfare training range site alternative in Onslow Bay, NC, USA

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In response to the US Navy's plan to construct an Undersea Warfare Training Range (USWTR) along the US Atlantic coast, a multi-institutional, comprehensive monitoring program has been implemented in Onslow Bay, NC. This effort incorporates aerial and vessel surveys and passive acoustic monitoring to investigate density, distribution and seasonal abundance of marine mammals and sea turtles. Ten, 74-km transect lines cover the proposed USWTR site, which straddles the shelf-break and incorporates both shallow shelf habitat and deeper, pelagic waters. This is the first such dedicated survey effort of an offshore site in the northwestern Atlantic. From June 2007 - March 2009, 32 complete aerial surveys covering 24,016 km, and 45 single track-line vessel surveys covering 3,334 km were conducted. One hundred thirty eight cetacean sightings (n = 2,114 individuals) representing five different species were made. *Tursiops truncatus* (72 sightings, 1031 individuals), and *Stenella frontalis* (36 sightings, 751 individuals), were most frequently encountered. Individual photo-identification images were obtained of *T. truncatus*, *S. frontalis*, *Globicephala* spp. and *Grampus griseus* during vessel surveys; biopsy samples of *T. truncatus* and *S. frontalis* have also been collected. *T. truncatus* was observed throughout the entire survey area, whereas *S. frontalis* was encountered exclusively on the continental shelf. *Steno bredanensis*, *G. griseus* and *G. macrorhynchus* were less commonly observed and were only found offshore of the shelf-break. *T. truncatus* and *S. frontalis* were observed in 10 and 7 calendar months, respectively. In contrast, *G. macrorhynchus* and *G. griseus* were observed during three calendar months (May - July), whereas *S. bredanensis* were encountered during only two months (April and June). Combined vessel and aerial sighting data are currently being used to generate the first density estimates for cetaceans in this area. By combining multiple methodologies we hope to provide the most effective monitoring program of the proposed USWTR.

### Co-management of bowhead whales in Nunavut, Canada

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The hunting and utilization of bowhead whales (*Balaena mysticetus*) is of significant cultural value to the Inuit of Nunavut and was a major negotiating point in the Nunavut Land Claims Agreement (NLCA). Since 1993, a total of 7 bowhead hunts have taken place. Nunavut Tunngavik Inc., Regional Wildlife Organizations, Hunter's and Trapper's Organizations, the Department of Fisheries and Oceans, the Nunavut Wildlife Management Board and the Nunavut Inuit Wildlife Secretariat each play a specific and significant role in the successful harvest and management of the eastern arctic bowhead population. Decision-making about the harvest of a large

cetacean species involves not only local individuals, but also competing regional, national, and international participants. In this multi-scale environment, a comprehensive co-management approach is utilized to foster the trust and mutual respect among participants needed to implement effective management. This paper discusses the nature and evolution of bowhead co-management in Nunavut. While other reports have documented the results of the bowhead harvests, we discuss the complex dynamics between multiple scales of management and locally executed mechanisms. This includes participation in an Eastern Arctic Bowhead Recovery Team, the development and execution of hunt plans and hunting protocols and participation in public hearings.

### U.S. Navy protective measures assessment protocol

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Conducting safe, effective training at sea is one of the most important events the U.S. Navy does in peacetime. However, as stewards of the environment, the Navy also takes prudent steps to minimize the effect of that training on the marine environment. A significant milestone supporting the U.S. Navy's marine stewardship efforts was reached in 2004 with the implementation of the Protective Measures Assessment Protocol (PMAP) software tool. The Navy worked cooperatively and synergistically with industry to develop and implement a computer-based decision support tool that provides commanders with situational awareness and appropriate protective measures during routine training events. The protective measures contained in PMAP include many actions were already common practice, such as posting trained lookouts and avoiding critical areas. The user enters data on the location, time and type of exercise, and PMAP provides environmental awareness information (e.g. habitat features), and a report of environmental protective measures to manage potential environmental risks. The protective measures of PMAP aid in designing training events that comply with environmental policy and Navy doctrine. To meet the challenges of complying with applicable laws and regulations [i.e. Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA)], Navy continually enhances the utility of PMAP. In the current version released April 2009, users now have the ability to update PMAP data via the internet. This allows for rapid revision when new protective measures are developed or when updated environmental information becomes available. This capability ensures the most current and scientifically relevant information is available to support exercise planning. Additionally, this version incorporates the protective measures currently in place in order to support the recently completed environmental analyses associated with MMPA and ESA compliance. PMAP is a valuable resource to support conducting safe, effective at sea training required by U.S. Law.

### Evaluating the effects of contaminants on the health of Western Canadian Arctic beluga whales (*Delphinapterus leucas*): A toxicogenomics approach

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As top predators, beluga whales (*Delphinapterus leucas*) bioaccumulate persistent polychlorinated biphenyls (PCBs), polybrominated diphenylethers (PBDEs), as well as the methylated form of mercury (MeHg). We collected samples from 24 beluga whales (liver, muscle, skin and blubber) harvested by Inuvialuit hunters in the Beaufort Sea. Beluga-specific genomics techniques were developed to evaluate contaminant-sensitive gene expression using quantitative polymerase chain reaction (qPCR). Expression of the aryl hydrocarbon receptor (AhR) and glucocorticoid receptor alpha (GR) in blubber correlated with PCBs ( $r^2 = 0.62$ ,  $p = 0.003$ ; and  $r^2 = 0.43$ ,  $p = 0.027$ ; respectively), as well as with mercury concentrations in skin ( $r^2 = 0.52$ ,