Floe by floe, the ice surrenders its secrets

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A juvenile hooded seal on the ice off of the coast of northeastern Greenland. Credit: OATRC 2013

Bowhead and minke whale sightings, extensive ice floe measurements and the successful retrieval of important moored instruments are among the successes of a multinational team of ice engineering researchers and marine biologists during their first week off the coast of northeastern Greenland on the Swedish icebreaker Oden.

"The general atmosphere on the cruise is quite good," says Raed Lubbad, cruise director and an associate professor at the Norwegian University of Science and Technology's centre for Sustainable Arctic Marine and

Coastal Technology (SAMCoT), via email. "We have a lot of new equipment that we installed onboard Oden and have had some quite exciting times looking at the data coming out from these instruments."

The two-week cruise has been designed to allow the scientists onboard to measure and quantify different aspects of sea ice, icebergs and their interaction with the ship. The group is now in an area where they deployed underwater moorings last year with the goal of collecting the instruments on the moorings and deploying new instruments. The instrument packages on the moorings have been busily collecting a year's worth of ice and ocean current data.

Five marine mammal researchers are also aboard the vessel, where they have been conducting acoustic research and combining conventional marine mammal observations with more high-tech approaches.

Rare bowhead whale sightings

Marine mammal biologist Jürgen Weissenberger reports by email that as of 25 August, biologists have seen 8 polar bears, including a female and two second-year cubs that were far out at sea, in an area rich with seals.

The observers, led by Jan Durnick from Marine Observers in Denmark, have been using lookouts with binoculars as well as an infrared camera system and satellite-telemetered passive acoustic techniques. In addition to the polar bears, they have recorded 58 whales and dolphins and 83 seals as of 25 August.

But the biggest surprise, the researchers say, was the sighting of big whale blows in front of the ship, which were identified as bowhead whales.

These whales belong to the Svalbard stock of bowheads, which is

considered to be the smallest baleen whale stock in the world, and are among the rarest and most endangered whales in the Atlantic Ocean.

"Between 2006 and 2008 only 17 bowheads have been seen off East Greenland," the group reports, "so even our few observations make a significant contribution to the knowledge about their distribution and abundance."

Advanced 3D cameras, sound recorders

In addition to observing marine mammals directly, a team of scientists from the University of Alaska and the University of Delaware has installed an advanced 3D camera system on Oden to characterize the icescape while the vessel is underway.

By combining these data with the marine mammal observations, the group hopes to learn to recognize the characteristics of the ice cover that make it suitable as habitat for walrus and seals. The number of marine mammals sighted and the variety of ice encountered so far represents an excellent basis for developing this knowledge, the group reports.

Marine mammals use sound as the primary way to get information about their environment (echolocation), for finding food, to communicate with other members of their species and to listen for possible predators. This makes these animals very sensitive to changes in how sound propagates, as well as to the influence of artificial sources.

Sound travels differently in ice-covered waters than in open water due to variations in temperature and salinity. In collaboration with the Laboratory of Applied Bioacoustics from the Technical University of Catalonia, BarcelonaTech (UPC, Spain) the biologists deployed two sound recorders at 200m depth. These recorders will continuously record the ambient noise and may possibly detect vocalizations from Arctic

species. However, this data will only be available when the recorders are recovered.

"The input of many other scientists present on board who study different aspects of the current status of the region will significantly contribute to our understanding of the habitat use of marine mammals in this unique icy area," the team says.

Fetching moored instruments

Among Oden's most important tasks is the retrieval of four underwater moorings that were deployed last year when the Oden cruise came to the region.

Cruise leader Lubbad reports that the ship arrived at the location of mooring 2 on Wednesday, 21 August in the evening. The researchers sent a signal to the mooring so that it would release and float to the surface, which it did. But much to the disappointment of the scientists, the mooring was without its attached instruments.

"The most likely scenario is that the mooring was dragged by an iceberg and that snapped the line," Lubbad said. A new mooring was deployed at the location to collect another year's worth of ice and sea current data.

On Thursday morning, 22 August, Oden arrived at the location of mooring 3. "The ice conditions were OK but we had slightly bad visibility and quite some swell," Lubbad said in an email. But after a 5-hour effort, the group was able to retrieve the mooring with its package of instruments intact and deploy a new one.

Follow the floes

Although the cruise has seen some big swells and low visibility, researchers have been able to use the helicopter onboard the ship to spend four hours scouting icebergs and deploying ice trackers on the bergs.

The ice trackers will stay on the bergs for a number of months so that researchers can study how these big icebergs move over space and time.

The ice engineers also have two high-resolution near real-time satellite images that they were sent that they can use in combination with information from the helicopter flights to "ground-truth" the satellite information.

In this case, "ground-truthing" an iceberg means using a remotely piloted aircraft system (RPAS) to make a three-dimensional image of the iceberg, including its size and thickness. At the same time, researchers use a remotely operated underwater vehicle (ROV) to collect the same information about the underside of the iceberg. This kind of work allows researchers to better interpret the images on the satellite pictures.

Ice station progress

The weather conditions have also allowed the researchers to conduct an "ice station," during which a range of ice measurements are made to assess ice thickness, friction and other properties that help engineers refine their models.

These ice stations take more than a day to complete. Lubbad reports that the plan is to end the ice station with a ridge ramming test, in which the Oden powers into an ice ridge. An ice ridge forms when two ice sheets are pressed against each other and consists of accumulated pieces of broken ice, so that its total thickness is much greater than that of the original ice.

"These ice ridges typically produce the highest loads on structures,"

Lubbad said at the start of the cruise. "Knowing how thick these ridges are, how fast they drift and how frequent they are is very important for the design of ships and floating structures."

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