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A New Kind Of Hunt

Inuit Hunters Use CastAway CTDs to Gather Data Under Hudson Bay Ice

By Steve Werblow

Inuit hunters check data on the built-in LCD screen of a SonTek CastAway-CTD on the ice in Hudson Bay.

The hunters recognized the changes. A shot seal would usually float, buoyed by its blubber atop the dense saltwater of Canada's Hudson Bay. Now the seals were sinking below the surface before the hunters could reach them. Polynyas, the open patches of sea surrounded by ice, were freezing over with brittle, clear ice, often with little warning. Beluga whales were being trapped beneath the floes, cut off from their surfacing holes. Arctic eiders, the diving ducks whose down is a source of warmth and commerce for the Inuit, were trapped on the ice, dying like flies.

Joel Heath began traveling to the isolated Belcher Islands of eastern Hudson Bay in 2002, when he arrived to begin his Ph.D. research on how animals survive on winter ice. Eiders, which stay in the area all winter long and serve as an indicator species for the health of the ecosystem, quickly captured his attention. Then the people who have been linked for generations to the eiders did, too.

"I became interested in the cultural story," said Heath. "That got me interested in doing the documentary 'People of a Feather'. I went from the more pure academic interest to concern for the communities."

What Heath saw concerned him deeply. Hudson Bay water is typically about as saline as seawater, with 30 parts per thousand (ppt) salinity. However, a massive plume of freshwater was flowing beneath the ice, lowering the salinity of the upper 25 m of Bay water to 25 to 26 ppt. The hunters of Sanikiluaq and their neighbors in the small communities ringing the southeastern Hudson Bay had front row seats to a massive ecological disturbance—quite literally, a sea change.

Reversed Cycle

Heath's first winter on the ice in 2002 coincided with a landmark agreement between the Cree people of Quebec, the federal government and the government of Quebec that permitted the completion of the second phase of the James Bay Project. The massive hydroelectric venture, begun in the 1970s, was already one of the largest hydropower systems in the world. By the end of construction on phase two, it would include eight hydroelectric generating plants and divert many of the rivers in eastern Canada to drain through the mouths of the Rupert River and the La Grande—just off the Belcher Islands.

What's more, the dam releases that drive the hydroelectric turbines don't follow the ebb and flow of the region's normal hydrological cycle.

"Electrical demand is highest in the winter," Heath explained. "Usually we'd have flooding, our highest flows, in

The CastAway-CTD is highly portable—users can measure salinity (through conductivity), temperature and depth by lowering and raising an instrument roughly the size of a softball. The user's manual fits on a single sheet of paper. In a dazzling example of citizen science, Inuit hunters from five Hudson Bay communities are gathering data on a massive plume of freshwater that is changing their environment. The Arctic Eider Society is coordinating the effort and amassing results to find solutions to the challenges facing people and wildlife in the region.

the spring. The hydrological cycle has been reversed. Rivers have been rerouted, and it all comes over to southeast Hudson Bay."

Freshwater freezes at a higher temperature than saltwater does. The ice it forms is clear and brittle, which means freshwater floes behave differently than sea ice, interfering with normal flow patterns. And freshwater freezes more quickly than sea ice does, which is why whales can find themselves caught in the ice, as they did in 2013 when more than 70 belugas were trapped under a shrinking hole and mauled by polar bears.In 2011, Heath released "People of a Feather" to raise awareness of the challenges faced by the residents of the Belcher Islands. That year, he also established the Arctic Eider Society as a foundation for fundraising and a focal point to study the science and community impact of the changing water. Working with the local communities, Environment Canada, University of Manitoba and other stakeholders, he set the course for a sweeping study of water and ice across the region.

CastAways: Citizen Science

Heath began by enlisting members of the community of Sanikiluaq to help take samples of ice and water. In 2014, he outfitted five small communities with CastAway-CTDs, softball-sized instruments that measure conductivity, temperature and depth of the water, and trained a cadre of hunters how to use them and upload their data.

Today, about two dozen hunters from the Inuit communities of Sanikiluaq, Kuujjuaraapik, Umiujaq and Inukjuak and the Cree village of Chisasibi prowl the ice not just with rifles but with CastAways and sample jars. In the winter of 2014 to 2015, the hunters and several students working with the Arctic Eider Society conducted more than 100 measurements. Heath's goal for 2015 to 2016 is to top that.

The CastAway-CTD is made by SonTek, a Xylem brand, and houses a thermistor, pressure sensor and conductivity cell in a rugged PVC case. The instrument requires no user calibration or pump—users simply lower the instrument into the water on a line and pull it back up. The CastAway's 5-Hz sampling rate ensures high-resolution data collection, referenced for both time and location by its built-in GPS. Users can easily review their data on the instrument's built-in LCD screen.

For a robust scientific instrument, the CastAway-CTD is remarkably easy to use—everything a user needs to know about collecting data, viewing the readings and downloading files from its onboard memory fits on a single sheet of paper in the CastAway's lunchbox-sized carrying case.

"Training is pretty easy," Heath said. "People are pretty competent with that kind of stuff, and it's a pretty straightforward interface. We spend a day with the hunters on the ice, going to different spots and trying them out. By the end of the day, they've got it."

SonTek donated two of the CastAways to the Arctic Eider Society to aid in the group's work. SonTek Product Manager Isaac Jones said Heath and his team of citizen scientists provide an inspiring example of how stakeholders can harness the power of data.

"Joel's work with the communities of the southeast Hudson Bay demonstrates the power of local people to tap into today's mobile technology and bring us all out onto the ice to understand the phenomena they're seeing in their environment," said Jones. "We're proud that the Arctic Eider Society selected CastAway-CTDs for its important mission, and glad to be able to contribute to its efforts. The work of the hunters with our CastAways doesn't just represent some

"The work of the hunters with our CastAways reminds us how science and tradition unite to help us understand even the most challenging ecosystems."

of the most extreme deployments of the technology—it reminds us how science and tradition unite to help us understand even the most challenging ecosystems."

Throughout the winter, hunters pick up their community CastAways as they head out onto the ice.

"We've tried to set it up so we have hunters in each community going out in different directions on the ice once a week," Heath said. "We have up to two trips per week [from each community]. We pay the hunters to be going out. They can do their subsistence hunting, too. Young people are also going out with them to learn about traditional knowledge and subsistence."

Science and Tradition

The traditional knowledge of the local hunters is an integral part of the Arctic Eider Society's approach to science. Heath and students from the University of Manitoba avidly study how hunters read the ice for information on weather and conditions and how they track wildlife through the winter.

They also ask hunters to interpret time-lapse footage Heath shoots on the ice, looking for insight into changes in the freezing and breakup cycles of the floes. Aerial photography provides landscape-scale perspective on the ice and wildlife populations, and video shot on the ice and below it yield insight into feeding patterns and energy requirements for the eiders and other wildlife wintering in the harsh—and changing—environment.

Measuring currents with acoustic Doppler profilers allows Heath and his team to chart water flow patterns. Detailed water quality monitoring measurements—time-series data from a moored continuous monitoring platform, as well as grab samples of water and ice cores taken by hunters in their travels—provide a more thorough look into the sources of the freshwater in the Bay, including dissolved oxygen, dissolved organic matter and other parameters.

Heath said analyzing the oxygen isotope O_{18} in water and ice samples indicates that the freshwater is not the product of melting ice, but rather of inland water. He hopes analysis of other isotopes will someday allow scientists to track individual water samples back to their original river sources.

The collision of space-age instruments and age-old hunting routes is accessible to researchers, policymakers and science buffs online. Each of the hunters on the data gathering team has a Facebook-style profile on www.arcticeider.com. Visitors to the site can click on sampling locations for a look at each hunter's data, sort data by a number of factors, or share pictures or charts on social media. Teachers can tap into the Arctic Eider Society's educational curriculum and stream time-lapse footage from the ice into their classrooms. And visitors can take a street-view virtual tour of the ice using Google Maps, which conducted the first-ever mapping of remote sea ice from the community of Sanikiluaq in the winter of 2014 to 2015.

Starting Here

Beyond the top-notch website and award-winning documentary film, Heath and the Arctic Eider Society are working to bring together regulators and stakeholders to focus on solutions for one of Canada's most overlooked regions—a way to balance society's need for power and the need to repair a severely damaged ecosystem.

Heath is campaigning for a new approach to energy management that could store and distribute James Bay Project power in step with the hydrologic cycle. It's a massive vision, and it will require deep understanding of a complicated ecosystem.

"Hudson Bay has been significantly understudied compared to other parts of Canada," said Heath, who combines his on-ice experience with his credentials as a Fulbright Scholar and Visiting Chair in Arctic Studies at the University of Washington to focus attention on the isolated Belcher Islands.

With the help of dedicated hunters and five palm-sized CastAways, Heath is working to literally turn the tide.

"First we look at the physical oceanography," he said. "Then we have a basis to build on the biological side." **ST**

Steve Werblow is a freelance writer based in Ashland, Oregon. He covers agriculture, resource industries and water issues and has written for Everything About Water, Industrial Environmental Technology, Brisbane Times, Australian Geographic, Process and Control Engineering, Hydraulics and Pneumatics, Industrial Water World, Marine Scientist *and more.*

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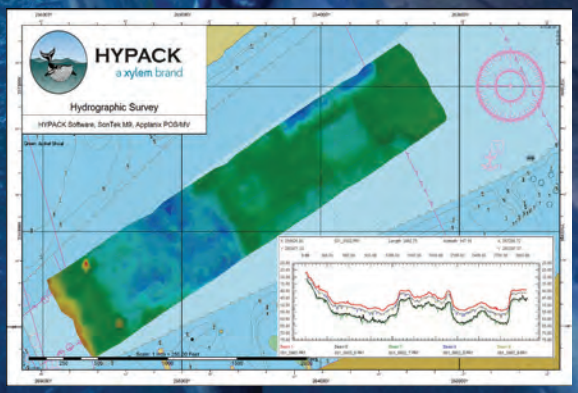

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