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force | Research Highlights

Swimming Through a Hurricane: Tracking Fish Through the World's Fastest Tides

As new tidal energy devices are expected in Minas Passage over the next few years, new research is aimed at understanding potential risks tidal devices may pose to fish.

Research partners that include FORCE, Ocean Tracking Network at Dalhousie University, the Mi'kmaw Conservation Group, Acadia University, Marine Renewables Canada and a number of Mi'kmaq and local fishers have begun work on a "risk assessment program" – or RAP – to gauge the probability that fish will encounter a tidal device.

"The first years of activity around tidal energy in Nova Scotia focussed on building the facility to plug tidal devices into the power grid," says Tony Wright, general manager of FORCE. "Now, our main focus is marine science."

Tidal energy holds significant potential to reduce emissions and meet climate change targets. Part of understanding its potential involves accurately assessing any potential risks that tidal devices may pose to the marine ecosystem – particularly to fish.

"Working with others, we're building a tool to assess the risk of fish interaction before a tidal device even goes in the water. That's how we get this right," says Wright.

The RAP project is building a high-resolution radar network to map currents, eddies, and waves in the Minas Passage. All these features affect the distribution of fish. At the same time, the RAP team is gathering the largest fish data set on fish movement in the Bay of Fundy, analyzing hydroacoustic tagging data for multiple species.

"Once we combine these two data sets, we'll be able to estimate, for the first time, the probability that a fish will encounter a turbine," says FORCE science director Dr. Dan Hasselman.

Sturgeon tagging, September 2021 (Photo: N. Winkler)

Why are fish being tagged?

RAP is building a fish "atlas" of the Bay of Fundy, using existing acoustic telemetry fish-tagging data, for nine different species. The species are selected based on expected availability, conservation concern or value to commercial, recreational, and Mi'kmaq fisheries. Five of the species will have new tags, with the goal of using the new data to verify the accuracy of the atlas.

RAP fish tagging is being conducted by the Mi'kmaw Conservation Group, Acadia University, Dalhousie University, and a number of Mi'kmaw and local fishers, mostly in the Minas Basin and adjacent tributaries. *(Continued)*

(Tracking Fish, continued)

How does acoustic telemetry work?

Acoustic telemetry involves using sound (acoustics) to relay information across space (telemetry). Researchers implant acoustic transmitters (tags) in the fish they study. Each tag emits a unique pattern of sound pulses that are heard and understood by underwater tracking stations (receivers). These pulses are recorded by the receiver as the ID code for that individual fish, along with the date and time that it was detected.

Which fish species are tagged?

The program is tagging five species with a total of 111 individual tags: 50 Alewife, 26 American shad, 10 Atlantic sturgeon (double-tagged with 69 and 180 kHz tags) and 15 Spiny dogfish.

What do I do if I catch a tagged fish?

Take note of the TAG number on the external tag. This is the fish's ID number in the study. If possible, get a close-up picture of the tag number, measure the fish, and take note of the location where it was caught. Then either:

- Release the fish safely with the tag intact so it continues to provide data to the study (after recording the tag number, catch location and size), or
- Return the tag to the MCG after you harvest the fish.

Whether you choose to release the fish or harvest it, please contact Joe Beland at the MCG (**jbeland@mikmawconservation.ca**; **902-890-6237**) to report the location of catch and tag number. You'll be asked to provide your name and a mailing address so that a $50 gift card can be provided in appreciation of you releasing the fish, or harvesting it and returning the tag.

Tracking Lobster in Minas Passage

As part of FORCE's ongoing research, the science team is working on a baseline lobster study to help measure any effects tidal energy devices may have on the marine ecosystem.

"We're using a series of experimental traps to capture lobster for data collection," says FORCE Science Director Dan Hasselman. "We're assessing the health and size of the lobsters, tagging them, and then releasing them back to the ocean to track their journey. We're taking a lot of samples – which will help improve the overall quality of our baseline data for lobster."

The study is being conducted in three sites in and around the FORCE demonstration area in the Minas Passage: impact, near control, and far control.

"In each site, we deploy three traps for a 24-hour period before hauling them back up at low-water slack tide," says Dan. "That's nine traps total, and we're repeating the study eight separate times. It should give us a fairly robust statistic for lobster abundance in the fall."

Lobster tagging, September 2021 (Photos: N. Winkler)

FORCE Starts Collecting Real-time Data

Cabled sensor platform (Photo: D. Hasselman)

As part of FORCE's continuing efforts to improve environmental data from the Bay of Fundy, FORCE is deploying a large cabled platform in the Minas Passage and sharing that data online with the Canadian Integrated Ocean Observing System (CIOOS).

"We're putting down a platform on the sea floor and connecting it to a cable to that will give us real time data," says Chuck Taylor, a field researcher at FORCE. "This takes our acoustic monitoring to the next level."

"We're using hydrophones that listen for harbour porpoises sound in the water: calling, singing, chirping…'clicking'," continues Taylor. "With a cabled platform, the instruments will be powered all the time. We'll be able to triangulate their sound to get a very accurate picture of their location, in real time, over longer periods. It's just improves our overall marine mammal monitoring capacity."

FORCE's subsea environmental observatory is a cabled platform that allows for power and two-way communication between the sea and FORCE's onshore facility, using hydrophones, ADCP, an optical camera, and subsea lights to bring real-time data shore.

Taylor says: "Normally, we would put ocean instruments out in the water remotely with no connection. We can't be sure if they're even collecting data, or be sure of the quality of the data, until we recover the instruments. And because they run on battery power, we can only leave them out for a limited time window. Adding a cable takes our ocean sensors to the next level."

The project is part of a larger research project called Vitality that is led by Pisces Research Project Management, and funded by the Ocean Supercluster. Vitality is bringing key ocean data to CIOOS – a national online platform for sharing, discovering and accessing ocean data in Canada. CIOOS provides data to researchers, government agencies, coastal communities, ocean industries, First Nations, and non-governmental organizations.

Dr. Joel Culina, FORCE's physical oceanographer, adds: "Our partnership with CIOOS and Pisces and others is all about sharing ocean data broadly. We hope it can yield meaningful and unforeseen new science discoveries, and not only within the field of tidal energy research."

Says Taylor: "My family is originally from Parrsboro: I spent summers up there with my grandparents. It's like my second home. I've been watching the FORCE project since I was a kid. So it's really cool to now be a part of it. I would really love to see more industry in Parrsboro, and for us to be part of the climate solution."

By the Numbers: Monitoring

Since 2016, FORCE has completed:

- Over 560 hours of hydroacoustic fish surveys
- Over 5,000 'C-POD' marine mammal monitoring days
- Bi-weekly shoreline observations
- 49 observational seabird surveys
- Four drifting marine sound surveys and additional sound monitoring, and
- 11 days of lobster surveys

Learn more at **fundyforce.ca/document-collection**

PROFILE:
Dr. Louise McGarry
Ocean Scientist, FORCE

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Fundy Ocean Research Centre for Energy

Dr. Louise McGarry is an important member of FORCE's ocean science team. Louise earned her Ph.D. at Cornell University, and specializes in using hydroacoustic techniques to investigate the behaviour and distribution of marine organisms.

How did you first get into hydroacoustics?

Before going to grad school in ocean science, I lucked into a job with a dream team of scientists on a boat in the Gulf of Maine, using hydroacoustics to map copepods – the food that Right Whales eat. Copepods are so small that, to find them, you need to use acoustic instruments with really high frequencies – in other words short wavelengths that don't travel very far. We did the mapping using five upward-looking and five downward-looking frequencies, so 10 transducers. It's amazing what we can figure out with sound. We, as humans, are so visually oriented. And vision doesn't work so well in the ocean because light doesn't travel very far. We can use this amazing technology to try to answer questions in the ocean that we can't get at any other way.

When it comes to hydroacoustics and tidal energy, it's an incredible challenge. Because the water is so turbulent, there's a tremendous amount of air that gets entrained into the water. This turbulence complicates the interpretation of hydroacoustic data, because it's very difficult to tell the difference between the sound coming off an air bubble versus the sound coming off the swim bladder of a fish. At a tidal energy site in Maine, we found that the entrained air happens most dramatically at the most important part of the tide cycle – on flood tide – when the fish predators arrived indicating that there were plenty of fish available. It's a huge challenge, but it's also what makes this work so interesting: how do we figure this out?

What drew you to tidal energy?

Tidal energy is aimed at the big societal questions. I'm grateful to be playing a role in advancing our efforts to move away from fossil fuels while helping to protect the ecosystem. That, personally, for me is what I'm trying to do. And the fact that I get to do this super geeky work is just fun. I'm using echosounders – basically highly engineered, scientifically calibrated "fish finders" – to help understand the distribution of fish at the FORCE site, and how that changes over the seasons, as different species migrate through the Minas Passage. And from that, help to understand how the presence of the tidal energy devices might affect the fish. Hydroacoustic technology measures time and intensity...which means nothing...until we can turn it into something that's biologically meaningful. Turning data into something that helps us better understand the world: that's the part that I really love.

Photo: K. Ballard