

Focus On Fisheries:

FLATFISH FORAYS

Investigating Atlantic Halibut Movements

Working collaboratively with commercial fishermen, researchers deployed electronic tags on Atlantic halibut to track their movements.



chang lu

BY WILLY GOLDSMITH

If you had asked a New England groundfisherman a decade or two ago how often he caught halibut, you'd probably have gotten a quizzical look or maybe a snide comment—something along the lines of, "Alaska's a pretty far steam from here."

Following intense overfishing in the 1800s, Atlantic halibut were akin to unicorns in the Gulf of Maine and on Georges Bank during the 20th century. They were rare enough, in fact, that in the 1980s and 1990s, fishermen endearingly called catching one “a gift from God.” These days, however, from Cape Cod up to Downeast Maine, angler encounters with the world’s largest flatfish

are anything but fantasy, though I can’t say the same about the odds of landing the 200-pounder that inhales the haddock you’re reeling in.

Increased halibut catch rates haven’t been limited to recreational anglers. Despite strict regulations, commercial landings have steadily risen in New England over the last 15 years, and now average a few hundred thousand pounds annually



TIM TOWER

Angler Rodney Worley took this impressive 83.5-pound halibut while fishing aboard the *Bunny Clark* out of Ogunquit, Maine.



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(NOAA 2019). To the northeast, Canada's harvesters are experiencing a true halibut boon, where the fishery, fully recovered from overfishing, has been certified as sustainable by the Marine Stewardship Council since 2013. A longline-survey-based index of abundance as well as catches have steadily increased since the late 1990s, and Canadian fishermen—primarily longliners—landed nearly 3,600 metric tons in 2018 (SAI Global 2019). For context, that's over 30 times more than American fishermen landed in 2017 (the most recent data available).

While there is reason for cautious optimism in New England, a major question is still unanswered: To what extent is there connectivity between halibut populations in New England and Canadian waters? Unlike Canada, the U.S. lacks a dedicated halibut longline survey, and this paucity of data contributed to the rejection of the 2015 stock assessment, while a subsequent data-poor "Plan B" stock assessment suggested a recovering but still-overfished stock (Rago 2017, NEFSC 2019). A better understanding of halibut stock structure in the U.S., especially regarding whether "our" fish come from the same population as Canada's, is needed to inform management strategies. For example, connectivity could imply that the catch limits to which New England's fishermen are beholden are artificially low because they are based on the assumption that U.S. halibut are their own isolated population.

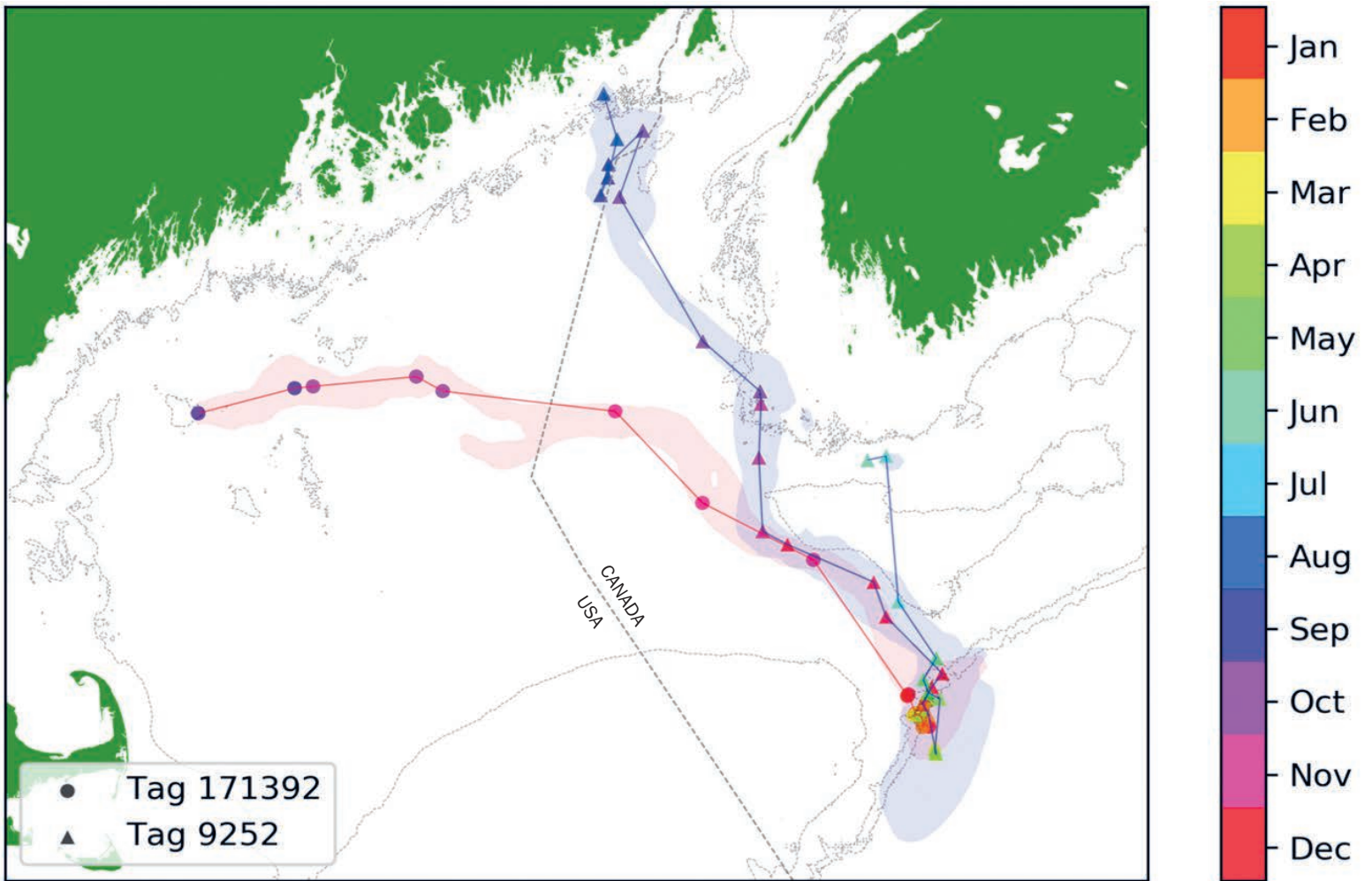
To gain insight into this question, The Nature Conservancy (TNC) partnered with the University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST) and Maine's Department of Marine Resources (DMR) to track Atlantic halibut movements in U.S. waters using electronic tags.

Halibut as Oceanographers

The team used two types of electronic tags to gather the information necessary to estimate halibut movements. Pop-up satellite archival tags, or PSATs, were programmed to record depth, temperature, acceleration, and light level at regular intervals for 9 to 12 months before popping off the fish, floating to the surface, and transmitting their data and location via satellite. Data storage tags, or DSTs, collected similar information, but because they don't automatically detach from the fish, they must be recaptured by fishermen in order to collect the data.

During 2017 and 2018, the team deployed PSATs on halibut while collaborating with commercial fishermen east of Cape Cod and on Platts Bank, located about 40 miles southeast of Portland, Maine.

"Because halibut are a relatively rare-event species, it wasn't logistically or financially feasible to



This figure shows the most likely movements of two halibut tagged on Platts Bank (red) and off Maine (blue) during 2017-2018. Even with the uncertainties associated with each tag track (the red and blue areas surrounding each line), these fish clearly appeared to converge on the Canadian side of the Northeast Channel in the middle of the winter, possibly to spawn. The grey dotted line shows the boundary between U.S. and Canadian waters (the Hague line).

have a scientist on every trip,” explained Dr. Steve Cadrin, a professor at SMAST and a collaborator on the study. “Instead, our colleague Crista Bank trained the fishermen to do the tagging themselves,

a great example of industry collaboration that made this study possible.” Scientists with Maine DMR, who had tagged halibut with both PSATs and DSTs off the Downeast Maine coast from 2007-2017,

contributed their data to the study as well.

So, how does one translate a bunch of temperature and depth information into a geographic portrayal of a fish’s movements? The logic is

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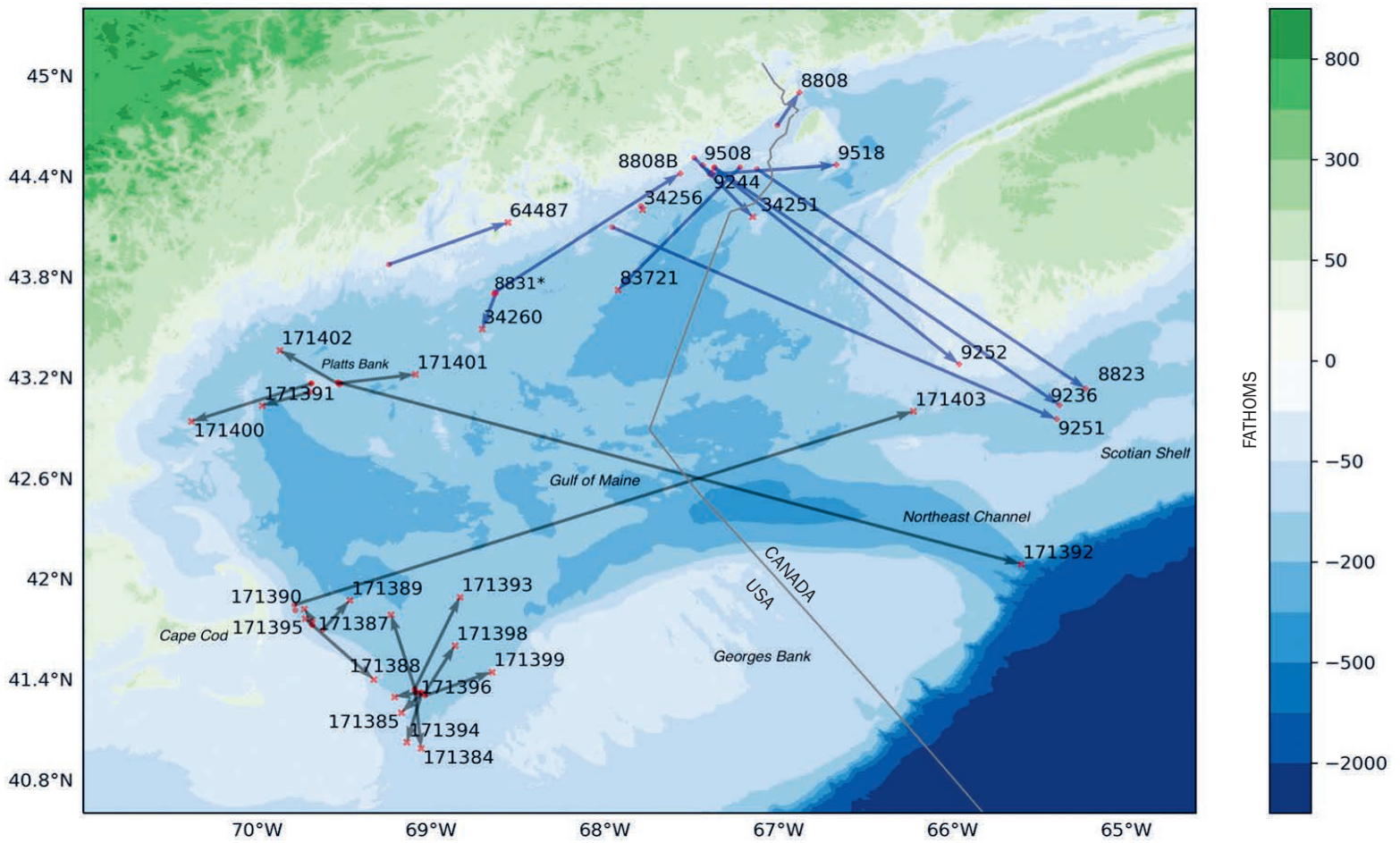
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This figure shows the locations of tagging and recapture/pop-up for halibut tagged by the Maine Department of Marine Resources (blue arrows) and The Nature Conservancy in conjunction with UMass Dartmouth's School for Marine Science and Technology (black arrows). While this figure shows only the start/end locations for each fish, the researchers found that over half of the tagged halibut traveled across the Hague line (grey line) into Canadian waters at some point during tag deployment.

straightforward, even if the modeling wizardry behind it is not.

“We essentially compared a map of bottom temperature and bathymetry for the region with the depth and temperature from each tag,” said

Dr. Chang Liu, the lead researcher on this project, which he completed as a PhD student at SMAST. Expanding on a method he pioneered with Atlantic cod, Liu examined the tag data to identify days of low halibut swimming activity, when the fish

was largely resting on the bottom. “We found the maximum depth—analogue to bottom depth—for each low-activity day along with its associated temperature and compared it with spatial depth-temperature data from SMAST’s Northeast Coastal Ocean Forecasting System,” Liu explains. “By combining this information with the tag deployment and recovery location, we could estimate a fish’s daily position within a few dozen miles.”

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Spying on Spawning via Satellite?

Overall, the research team estimated the movements of 25 halibut ranging in size from 31 to 58 inches (about 100 pounds) based on data collected from 15 PSATs and 10 DSTs—6 deployed off Cape Cod, 4 on Platts Bank, and 15 off Downeast Maine. While the PSATs were programmed to be on the fish for up to a year, the halibut proved adept at “shedding” the tags; many detached and began transmitting only a few weeks to a few months after deployment, meaning the researchers had less time over which to track movements. Many of the fish tagged with DSTs, meanwhile, were at large for a year or more before being recaptured.

So, what did they do, and where did they go? Half of the fish exhibited what the researchers call “home range” behavior, never moving more than 50 miles from where they were tagged, even over several months. But, others undertook long-range seasonal migrations, with one fish traveling over 1,000 miles during the tag’s 14-month deployment. Fish spent most of their time in 200 to 800 feet of water, although a few ventured to depths of more than 3,000 feet.

While only 10 of the deployed tags stayed on halibut for over a month, the team was surprised to find that 13 fish—over half of the sample—traveled from U.S. to Canadian waters, primarily to the eastern Gulf of Maine and Scotian Shelf south of Nova Scotia. In fact, two thirds of the fish tagged in Maine made it to Canada.

“Because we had so few long tagging durations for fish off southern New England, it’s hard to draw any conclusions about them,” said Chris McGuire, Marine Program Director for the Nature Conservancy in Massachusetts, noting that only one fish tagged off Cape Cod and one tagged on Platts Bank traveled to Canadian waters. “They simply didn’t have much time to go anywhere.”

Liu’s geolocation work also uncovered a surprising potential love story that unfolded in the Northeast Channel, a deep trough that separates the Scotian Shelf from Georges Bank.

“We observed one fish tagged off Maine and another fish tagged on Platts Bank meeting on the Canadian side of the Northeast Channel in the middle of the winter,” said Liu. “Both of these fish were mature, and we know that halibut spawn in deep water during the winter, so it’s likely that these fish traveled there to reproduce.” The evidence of fish tagged in U.S. waters traveling to Canada to spawn is certainly eye-opening. It’s also worth noting that the tag deployment end locations from these two fish were over 50 miles apart. Without Liu’s ability to trace each fish’s movements during tag deployment, the unfolding romance would not have been detected.



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Kohl Kanwit poses with a 75-pound Atlantic halibut that was caught on a commercial vessel using a longline off Jonesport, Maine.

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Chris Bartlett from the University of Maine Cooperative Extension in Eastport, Maine, tags and releases a halibut that was captured on a commercial fishing boat.

Where to Go Next?


As with most field-based science, the conclusions of this study are a bit uncertain due to low sample sizes, challenges associated with tag duration, and diverse movement behaviors among the tagged fish. Nevertheless, some key takeaways and directions for future research stand out.

“We saw fish moving from all three tagging locations into Canadian waters,” explained Cadrin. “I think this further strengthens the case for considerable halibut connectivity between the U.S. and Canada, and possibly transboundary management,” he added, though he mentions the need for further confirmatory testing through more tagging and other methods, such as genetics. Another important finding was the lack of overlap in movements between fish tagged off Cape Cod and on Platts Bank, suggesting the possibility of finer-scale sub-population

structure within the Gulf of Maine.

“It also was a big deal for us to see that geolocation for halibut works off New England,” said McGuire, referring to Liu’s innovative approach to tracing halibut movements. His “halibut-as-oceanographers” methodology opens the door to better snooping on halibut behavior in both U.S. and Canadian waters, as well as for better estimating movements of other electronically tagged species.

This research is part of a growing body of work to better understand halibut biology and population health in New England. McGuire is the principal investigator for a federally funded halibut project that not only includes the tagging research discussed here, but also a large-scale biological sampling effort with commercial fishermen to investigate halibut age and growth, reproductive biology, and population structure—the latter through

genetic methods this time. And, Cadrin has worked with the New England Fishery Management Council and Maine DMR to develop a more data-rich halibut index of abundance in Maine waters using longline catches rather than sparse trawl data. Stay tuned for future updates on the state of the science—and the state of the fishery—for these behemoth bottom-dwellers. In the meantime, double-check those knots the next time you head out bottom fishing ... a barndoor halibut could be your next bite! 

Story Source:

- Liu, C., Bank, C., Kersula, M., Cowles, G.W., Zemeckis, D.R., Cadrin, S.X., and C. McGuire.
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