

WHOI scientists partner with Rhode Island fishermen to understand rapid changes in Gulf Stream-dominated east coast shelf waters

By CarolAnne Black

In 2011, oceanographer Glen Gawarkiewicz sat in the back row at a National Science Foundation (NSF) public hearing about the upcoming installation of a vast and long-term ocean monitoring system, called the Ocean Observatories Initiative Pioneer Array (Pioneer Array). The chosen location, right off the coastal waters of New England, meant the array could interfere with fishing and shipping, and there was concern that the science generated by the array could be used to force fisheries closures. The people whose livelihoods depend on this ocean region were at the hearing and they meant to be heard. “There was a very crowded room in the public library in New Bedford,” recalls Gawarkiewicz, “and there were some contentious moments.” He was sitting next to a woman he hadn’t yet met, and Gawarkiewicz remembers one of them said to the

other, “There’s got to be a better way than this.”

That day, Gawarkiewicz, Associate Scientist at Woods Hole Oceanographic Institution (WHOI), had been sitting next to Peg Parker, the then Executive Director of the Commercial Fisheries Research Foundation (CFRF), a non-profit private foundation based out of Rhode Island that works to involve fishermen in the science used to manage their industry. The two decided to stay in touch.

Not long after the public hearings, the NSF decided there should be negotiations between the Pioneer Array scientists and representatives from the commercial fishing industry to determine how the Pioneer Array could be altered to minimize multi-use conflicts. For four four-hour sessions, Gawarkiewicz, Parker, researchers and industry representatives met

Oceanographer Glen Gawarkiewicz (right) and inshore scallop fisherman Mike Marchetti look over an RBRconcerto CTD and an iPad aboard the F/V Mister G offshore of Rhode Island.



to discuss possible alterations. Gawarkiewicz explains that Parker had to walk a tight line, because “there were people in the industry saying ‘this is going to lead to closures,’ and other people saying, ‘No, no, the ocean is changing. We need to learn about this.’”

On the very last day of negotiations, three of the fishermen approached Gawarkiewicz. “[They said,] ‘actually, we learned a fair amount talking to you guys about the ocean out here, and we want to let you know there’s very warm water out on the edge of the continental shelf, and there’s 5-knot currents that are tearing up all the lobster pots. What’s going on out there?’” Gawarkiewicz told the fishermen he would get back to them in a couple of days. Then he went digging.

“I found a drifter trajectory that ran right along the edge of the Gulf Stream and right up by the continental shelf. It was 2 m/s. 4 knots. It entirely corroborated what the fishermen were saying. It was really remarkable.” The north wall of the Gulf Stream, Gawarkiewicz found, was 200 km north of its normal trajectory.

To understand what was happening on the shelf, where profound changes and much of the fishing were taking place, they needed to fill the data gap onshore of the Pioneer Array. Then came their chance.

In 2013, there was an opportunity to pitch ideas to one of America’s largest independent foundations, the MacArthur

Foundation. Gawarkiewicz, Parker, and Anna Malek Mercer – a CFRF staff member who would become its Executive Director after Parker retired in 2015 – saw how they could work together. They proposed a Shelf Research Fleet, for which the CFRF had expertise. Malek Mercer explains, “Over the past few years we’ve worked to develop what we call the Research Fleet approach. That’s what we are taking here with the Shelf Research Fleet. What that looks like in practice is fishermen ... actually doing or assisting with the research themselves.”

The fishermen, who work on the continental shelf off of Rhode Island, would collect CTD data inshore of the Pioneer Array’s moorings, and Gawarkiewicz would use the data to understand the ocean dynamics and the effects on the fisheries. The MacArthur Foundation wanted the project to be a vehicle to build relationships and help local people deal with the consequences of climate change. “That,” says Gawarkiewicz, “was just perfect for us and CFRF.”

Gawarkiewicz overlaid six boxes on a map of the shelf, with the goal of one CTD cast per week in each box. The team of ten fishing vessels was equipped with iPads and CTDs. “We identified the RBR*concerto* as the best instrument for that. Having that wireless download capability was the absolutely crucial thing. When you think about the guys out there in 15 to 20 foot seas, they don’t want to be fussing with connecting wires on the deck.”

CFRF Executive Director Anna Malek Mercer trains fishermen in collecting CTD data, uploading the data wirelessly to their iPads, and viewing the profiles instantly.



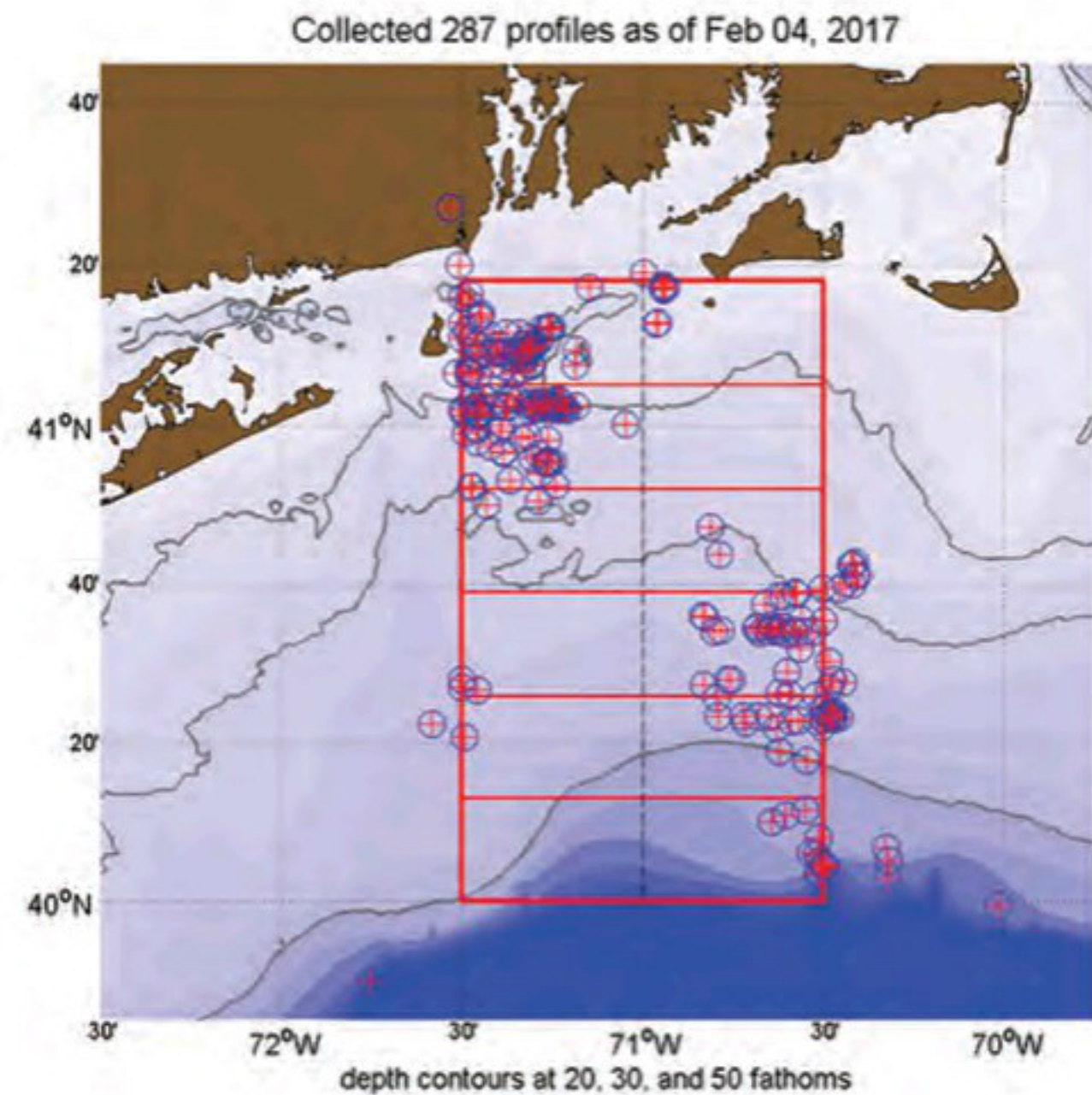
Data Collection and Processing

In October 2014, CFRF launched its Shelf Research Fleet. “One real benefit to the Ruskin [software] and RBR*concerto* system is that you can immediately view that water column profile that you retrieved,” says Malek Mercer. She explains that some fishermen use the temperature and salinity profiles on the spot to decide where to fish.

“One of the big science questions,” says Gawarkiewicz, “is, when we get Gulf Stream water at the edge of the continental shelf, for example the warm and salty intrusions, how far onshore do they go?” He’s already beginning to be able to answer that question.

“We’re seeing a lot of these bottom intrusions of warm salty water and they’re very important because they may carry nutrients onto the continental shelf. We’ve found they can go 60 to 80 km onshore. They bring entirely different kinds of fish.”

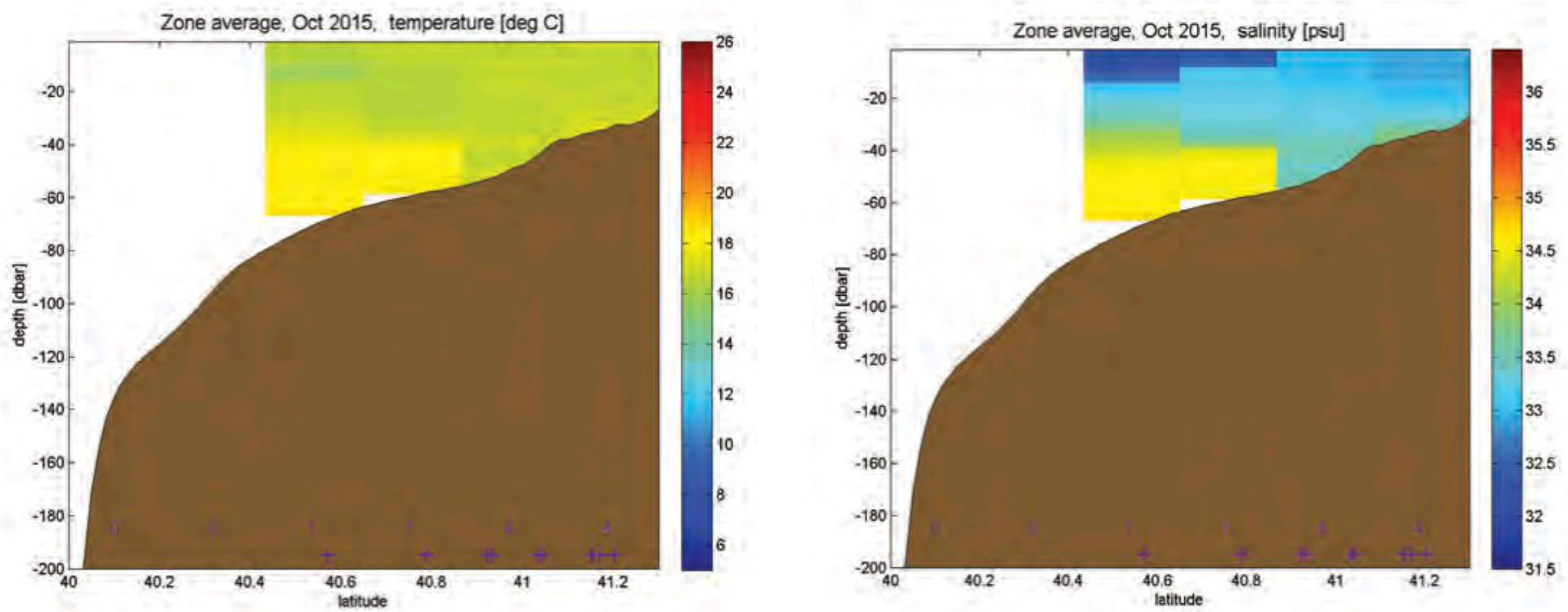
“What’s going on now is that it’s warming at such a remarkable rate that the types of fish they’re catching are different, and some of them are not allowable south of New England yet. This is very important to document the temperature changes so that you can say, ‘Oh, we need more black sea bass quota now, because we’re catching them all the time, but we’re not allowed to sell them all.’ So it’s a very interesting time in terms of fisheries management, because the [species] ranges are changing so much.”



A map of the continental shelf south of New England showing the boundaries of the six boxes for CTD data collection. Circles with crosses indicate the locations of individual profiles. Between November 2014 and January 2017, the Shelf Research Fleet collected 287 vertical profiles. The southernmost bin overlaps with the Ocean Observatories Initiative Pioneer Array.

Anna Malek Mercer (standing), Glen Gawarkiewicz (left) and fishermen meet to discuss data, oceanographic conditions, and implications for fisheries.





Cross-shelf sections of temperature and salinity on the continental shelf south of Rhode Island, showing warm salty slope water intruding onto the shelf. Data is averaged temporally over October 2015 and spatially within each of the four boxes closest to shore. Numbers at the bottom of the plots indicate number of profiles in each box and crosses indicate the latitude of individual profiles.

One of Gawarkiewicz's favourite parts of the project has been his twice-yearly meetings with the fishermen. He says he talks for fifteen minutes and the remaining nearly two hours is filled by questions. "These guys ask me very hard questions. And the data that the fishermen have collected is absolutely a part of that discussion." Reflecting on those talks, Gawarkiewicz says, "I feel like it's a great privilege to have those meetings and hear back from the fishermen."

The relationship has become such that when the fishermen see something unusual, they share their observations with Malek Mercer and Gawarkiewicz. "They have been out there, not only every day, but every day for decades," says Malek Mercer. "The changes that we talk about theoretically, they're experiencing every day. Bringing that perspective into the science is a priority of the Foundation."

For Gawarkiewicz, this project has had a profound effect on his research. "They haven't changed my science in a small way. They've changed it in a big way, because I'm much more aware of what's going on right now. As scientists, we typically are working with experimental data from two years ago and really trying to get the last detail of understanding out of that. It's exciting to get an email saying, 'Hey, look at George's Bank right now. Something really weird is going on. We've just had a big scallop mortality event,' and then be able to say, 'Oh, from the sea surface temperature imagery, I can tell there

was just a big warm core ring there. How shallow did it get?'"

Gawarkiewicz says they are planning peer-reviewed publications as well as a publication on the Research Fleet approach for later in 2017. The MacArthur grant has run its course, and the team was fortunate to find funding for the next two years through the local van Beuren Charitable Foundation. "The important thing is to keep collecting the data because we're in a time of very rapid change," says Gawarkiewicz. They have also applied for NSF funding to use the Pioneer Array data in conjunction with the shelf data to study bottom intrusions and nutrient delivery on the shelf.

Lobster fisherman Mark Sweitzer has been involved with CFRF's projects for many years, and his vessel is part of the Shelf Research Fleet. Sweitzer says, "The main thing that I've taken away from it is a positive feeling that science and government and fishermen can work together to try to come up with better fishing regulations and better fishing practices."

Relating his experience with the conceptual ivory tower, Gawarkiewicz is direct: "I don't think that scientists realize how damaging that is, the ivory tower. You really have to engage with the world. You have a responsibility in a democracy really to help your fellow citizens out. Especially on a planet that's changing so rapidly. That's something I really do firmly believe."