

GULF OF MAINE RESEARCH INSTITUTE

2019 Annual Report



**Gulf of Maine
Research Institute**

Science. Education. Community.

Our Vision



The Gulf of Maine Research Institute's mission is to pioneer collaborative solutions to global ocean challenges. Without a doubt, the most pressing challenge of the 21st century is climate change. One of the challenges with climate change is it seems so overwhelming that it's hopeless, that we can't do anything about it, and the fact is we can.

We need to encourage long-term climate thinking while taking short term immediate steps in the face of enormous uncertainty.

In the short-term, you'll see us bringing local communities together to understand the impacts of climate, in their harbor, in their community. You'll see us educating adults about the nature of the climate challenge and what they can do about it locally at the state level and federally. And you'll see us working with the seafood industry, to encourage them to source local seafood and reduce the carbon footprint of the fish we eat.

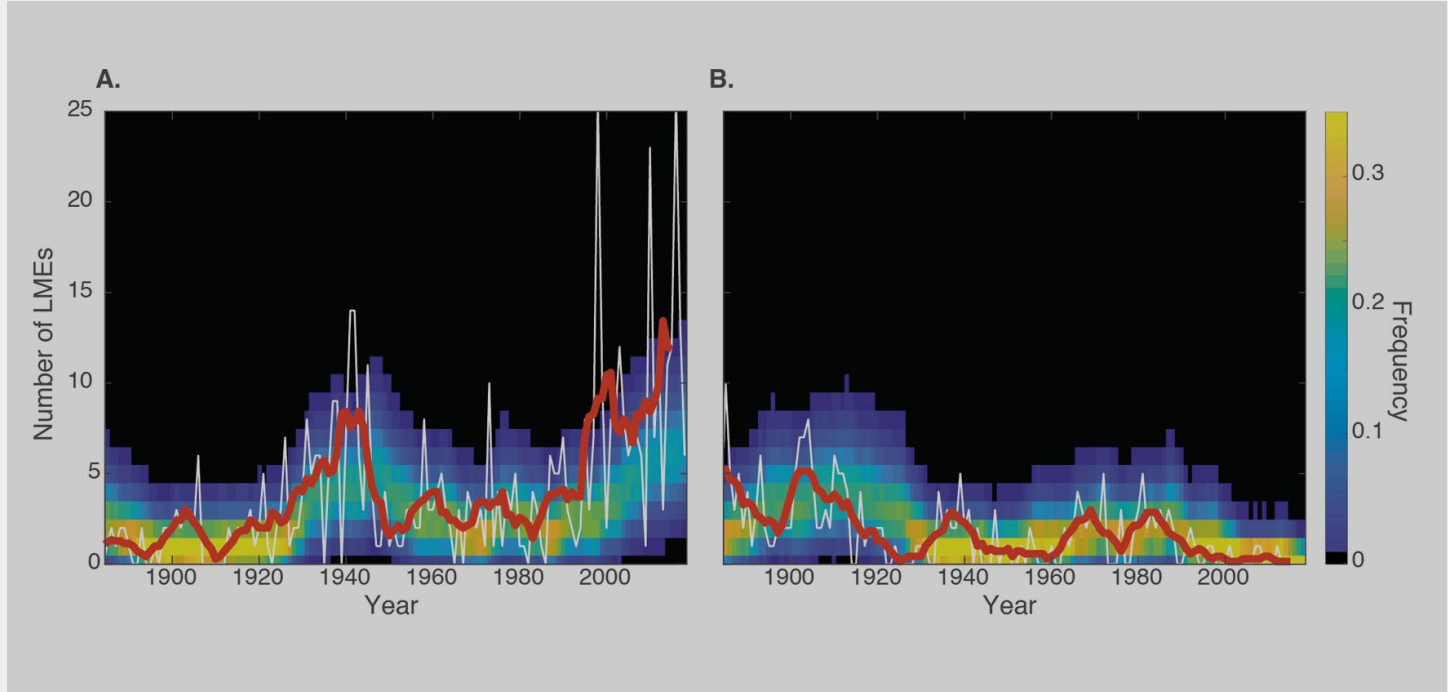
I hope that we can give our kids the tools, the modeling expertise, the ability to understand data, the ability to understand and make sense out of the noise in social media to put their finger on the nature of the climate challenge and climate opportunities and navigate these things over the course of the 21st century.

These are the things that make a community work in the face of a changing ocean.

The moment to tackle climate change is now. Our commitment is that our staff, our scientists, our educators, our community and seafood experts will work with communities up and down the New England coast to help them understand their climate challenge and what they can do about it.

— Don Perkins, GMRI President/CEO

New Study Reveals 'Surprising Surprises'



New Study: Ocean Temperature 'Surprises' Becoming More Common. Researchers highlight need to account for climate change in marine planning.

Main picture above: Frequency of surprising ocean temperatures. **A.** Number of LMEs (annual=white and 5-year smoothed=red) with an annual temperature 2SD above the mean of the previous 30 years. The shading indicates the probability of a specific number of surprises in each year after accounting for the trend. **B.** Same but for cold events.

A study published by GMRI scientists and collaborators in 2019 shows how **marine ecosystems around the world are experiencing unusually high ocean temperatures more frequently than researchers previously expected.** These warming events, including marine heatwaves, are disrupting marine ecosystems and the people who depend on them.

Chief Scientific Officer Dr. Andrew Pershing led the study, which is entitled “Challenges to natural and human communities from surprising ocean temperatures” and published in the Proceedings of the National Academy of Sciences (PNAS).

As part of this new research effort, Dr. Pershing, whose research previously identified the Gulf of Maine as one of the most rapidly warming ecosystems in the global ocean, looked at similar warming trends around the globe.

Dr. Pershing and his colleagues examined 65 large marine ecosystems from 1854–2018 to identify the frequency of surprising ocean temperatures, which they defined as an annual mean temperature that is two standard deviations above the mean of the previous three decades.

The researchers identified these “surprises” all over the world, including the Arctic, North Atlantic, eastern Pacific, and off of Australia. Moreover, these warming events occurred at nearly double the rate the scientists expected.

New Study Reveals 'Surprising Surprises' (continued)

“Across the 65 ecosystems we examined, we expected about six or seven of them would experience these ‘surprises’ each year,” explains Pershing. “Instead, we’ve seen an average of 12 ecosystems experiencing these warming events each year over the past seven years, including a high of 23 ‘surprises’ in 2016.”

The study explores the associated impacts of these warming events on both natural and human communities.

In natural communities (e.g. coral reefs, fish, plankton, etc.), new species that prefer warmer conditions can often replace cold-loving species that suffer when an ecosystem warms. In gradually warming ecosystems, the changeover of species should be able to keep pace, according to the study. However, in ecosystems that are experiencing change much faster, these natural communities are expected to suffer reductions in both biomass and diversity.

An increase in ocean “surprises” also affects humans. **The researchers explored the challenge rapid ecosystem changes pose to people making decisions about ocean resources.** As the planet continues to warm, ecosystems and human communities will adapt to the changing conditions. However, according to the scientists, it is unclear whether such adjustments will keep pace as the climate trends accelerate.

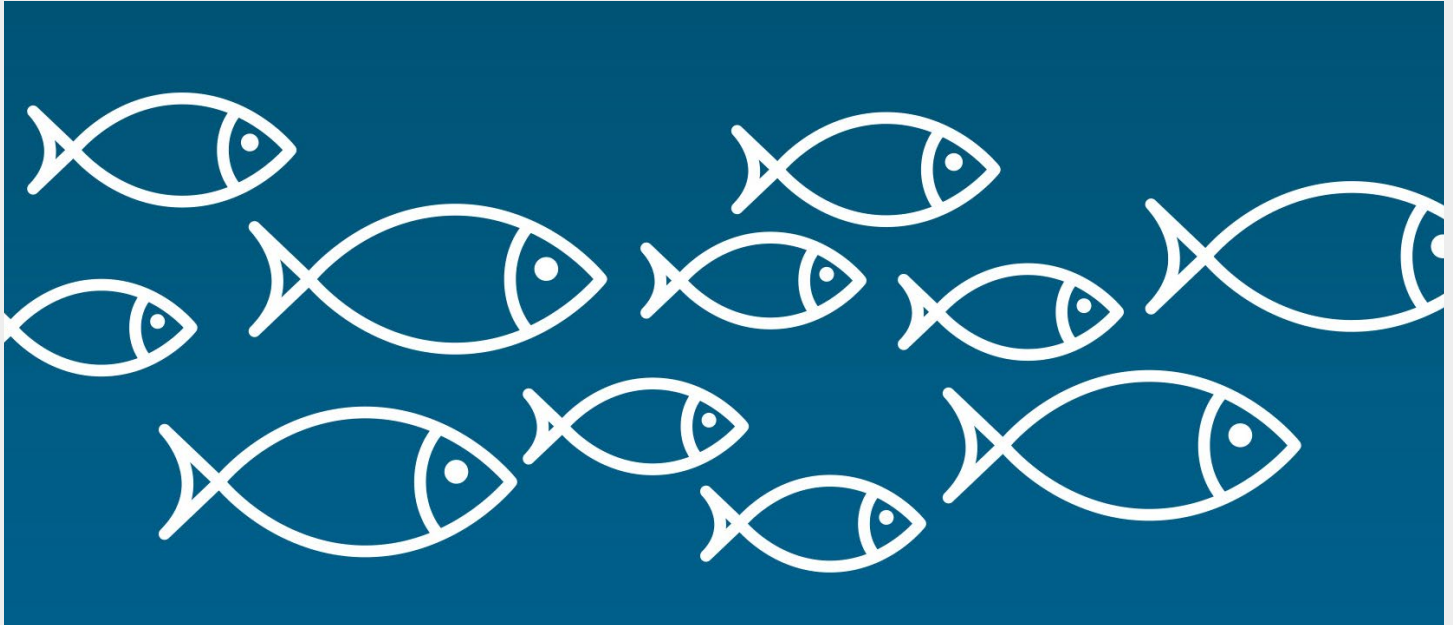
As part of the study, the research team compared two distinct community decision-making strategies. Using an economic model, they compared forward-looking decisions based on climate trends to the results of decisions made only on historical experiences. They found forward-looking decisions fare much better as the rate of warming increases.

According to the study, many marine ecosystems are already warming fast enough to apply this decision-making framework.

“We are entering a world where history is an unreliable guide for decision-making,” says Pershing. “In a rapidly changing world, betting that trends will continue is a much better strategy.”

As the incidence of these extreme warming events continues to rise, the results of this study highlight the importance of using climate projections and other predictive tools to make decisions about the future.

Big Data, Big Opportunity for Climate & Fisheries



Our collective ability to accurately assess and forecast fish abundance is critical to the biological and economic sustainability of the Gulf of Maine.

In the past, fisheries managers and fishermen alike have relied on fisheries data to help them understand fish abundance, species mix, and location. However, rapid warming in the Gulf of Maine requires the integration of climate, oceanographic, ecosystem, and fisheries data to understand how climate change will influence these factors.

As part of a new research project, a working group led by GMRI Research Scientist Dr. Lisa Kerr will explore new ways to integrate climate and fisheries data to make more accurate predictions about commercially important species.

The project is one of only 43 in the nation to be selected for funding as part of the National Science Foundation's Convergence Accelerator program, which applies a Silicon Valley business accelerator model to science.

"The Convergence Accelerator program asks us to merge data and ideas from different disciplines to solve a problem of national importance," said Dr. Kerr. "Our case is that the U.S. makes million-dollar decisions about fisheries every year, but those decisions are based on only a fraction of the data."

This multi-institution collaboration involves external partners from Rutgers, Cornell, and NOAA, as well as a mix of GMRI researchers and community team staff. The project team is also working with fishermen, managers, and seafood businesses in the region to better understand industry needs.

"As waters warm, we know fish populations are going to respond," said Dr. Kerr. "The more accurately we can predict this behavior, the better we can support the fishermen and fisheries managers who rely on good data to make decisions."

This project is part of our new climate center, which leverages our interdisciplinary expertise to identify solutions to local, regional, and global challenges related to ocean warming.

Big Data, Big Opportunity for Climate & Fisheries (continued)

Convening Climate Experts

Last April, GMRI scientists hosted a modeling workshop for over 30 leading climate, oceanography, socio-economic, and fisheries experts. The group convened to discuss a question at the forefront of fisheries management: How do we account for climate change?

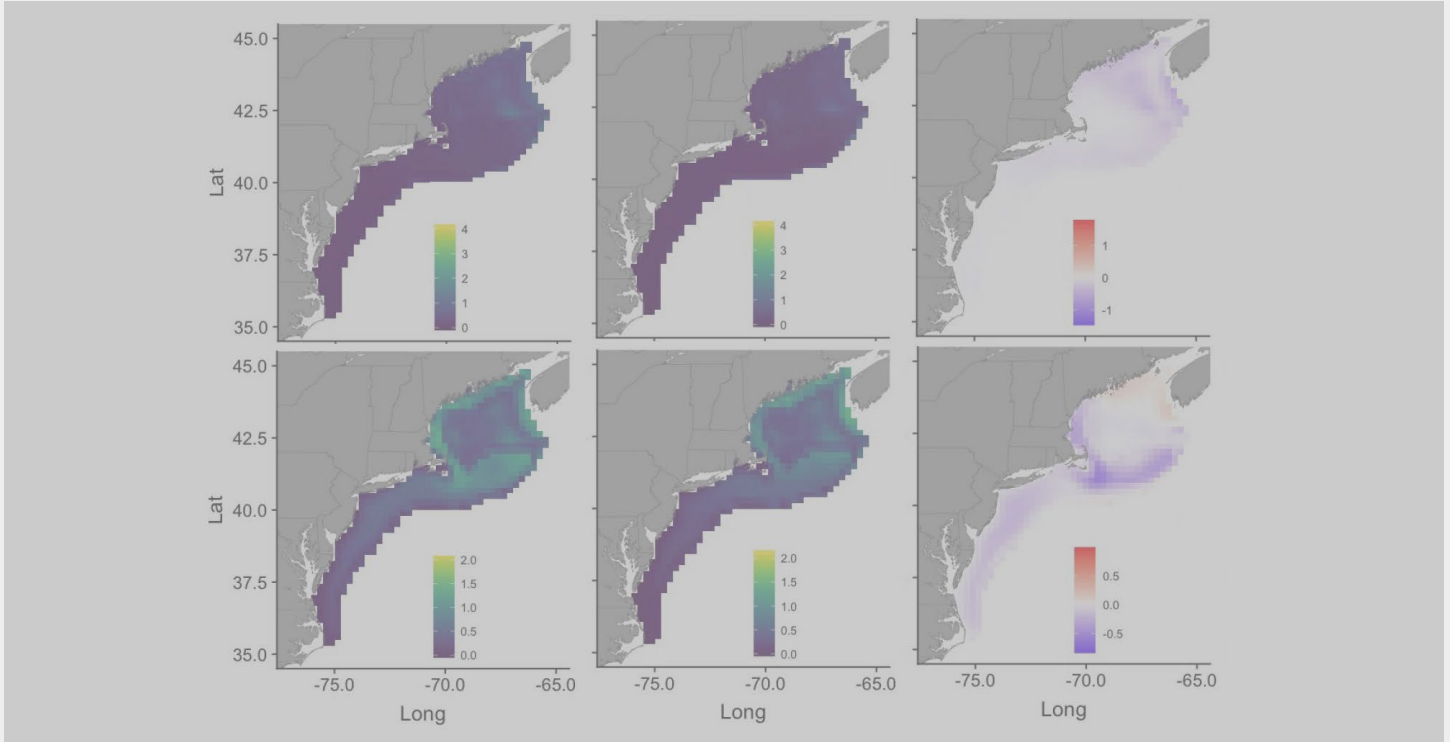
Dr. Lisa Kerr, who chaired the steering committee for the workshop, discusses the group's work:

“In the years since we first observed that the Gulf of Maine is warming faster than almost any other part of the global ocean, we've focused much of our research at GMRI on understanding the impacts of warming on our fisheries. Warmer water causes species shifts and productivity changes, challenging our fisheries management system to adapt to a 'new normal.'

We also know our peers are looking at similar questions, so we called them together for a meeting to talk about our individual research and how we might combine our efforts to address the grand challenge of managing fisheries in a changing climate. Together, we discussed ways to link our otherwise-siloed models of climate impacts, regional oceanography, fish populations, and humans.

Overall, the meeting was an encouraging beginning to an exciting collaboration. Next, we'll share our ideas with fisheries stakeholders in the region to solicit their feedback on the science they need to inform better decisions in a changing Gulf of Maine.”

Climate Updates and Adaptation



This year, Dr. Kathy Mills and a team of collaborators continued their ongoing work exploring vulnerabilities and responses of Northeast U.S. fishing communities to shifting species.

Ocean waters on the Northeast U. S. continental shelf have warmed rapidly in recent years, and climate models project this warming will continue.

Associated changes in species distributions and productivity are already affecting fishing communities, as they face declines in traditionally-fished species and the appearance of new species in their fishing areas.

The local impacts of these changes depend on the nature and rate of ecosystem change, patterns of dependence on marine resources, and adaptation capacity and choices. As part of this project, Dr. Mills and her team use climate projections to drive species models as a basis for conducting port-scale assessments of social-ecological vulnerabilities to climate-related species changes.

Results of this assessment provide insights into relative vulnerability of fishing communities from Maine to Virginia. In addition, the research team uses fishery-dependent data to evaluate how fisheries are already responding to species shifts and conduct interviews with fishermen and municipal officials to identify adaptation options of interest as changes continue in the future.

Finally, Dr. Mills and her team are considering a suite of adaptation scenarios within economic models to assess the extent to which different adaptation approaches may buffer impacts of species changes and create new opportunities for fisheries in specific communities.

Climate Updates and Adaptation (continued)

Recent progress on the project includes:

- Completing ecological analysis that describes and projects species distribution and relative biomass throughout the Northeast U.S. Large Marine Ecosystem under future climate change conditions.
- Incorporating the ecological analysis results into a coupled ecological-economic model to evaluate economic impacts of species change.
- Developing community reports to highlight current conditions, projected changes, and potential adaptation opportunities and challenges for four focal communities: Stonington, Maine, Portland, Maine, New Bedford, Massachusetts, and Point Judith, Rhode Island.
- Meeting with members from each of these communities to discuss our findings and learn more about how community members are thinking about and planning for potential climate-driven changes.

Ultimately, this information will provide a foundation for decision-making and climate adaptation planning at community and regional scales, as well as insights into policy and institutional needs to support the resilience of fishing communities in the context of climate change.

New Accessibility Features, Recognition for LabVenture



Making LabVenture Accessible

Last year, we launched an all-new LabVenture experience, including updated content and state-of-the-art technology. After a little more than a year and 14,000 students served, our education team is excited to roll out key upgrades to improve the program's accessibility.

The scale and complexity of the LabVenture experience required deep thinking about the needs of students with visual, hearing, or motor impairments. With the assistance of our original design partner, Upswell, we're implementing new features for these users, including a virtual universal keypad, a screen reader, and audio delivery improvements.

"The accessibility implementation supports the premise of equity at the heart of LabVenture," said Upswell Partner Armando Manalo. "Our goal is to facilitate scientific collaboration among all users, including those with visual and hearing impairments."

One example of these accessibility improvements is the sonification of data — using custom soundscapes to indicate change over time, just as we would use a traditional graph to do so visually. After several rounds of prototype testing and staff training, the team launched the new accessibility features in January 2020.

"We're committed to making the best science, climate, and data learning available to Maine middle schoolers," said Leigh Peake, Chief Education Officer. "Universal access has long been a standard the LabVenture program strives for. This is an exciting first step toward fulfilling that promise for students with disabilities."

New Accessibility Features, Recognition for LabVenture (continued)

Showcasing LabVenture on the National Stage

Last March, our all-new LabVenture program was honored as a finalist for the SXSW EDU Learn by Design competition in Austin, TX. The SXSW EDU® Conference & Festival fosters innovation in learning by hosting a community of optimistic, forward-thinking, purpose-driven stakeholders.

GMRI Chief Education Officer Leigh Peake traveled to the conference to showcase LabVenture alongside project partner Upswell.

“It was so rewarding to have LabVenture in the national spotlight at a conference that celebrates the best of the best in learning design,” said Peake. “To share the stage with other amazing learning projects was truly inspiring.”

Modeling Change: A LabVenture Experience for Adults



Over the last decade, the Gulf of Maine Research Institute's LabVenture program has provided hands-on science learning to over 150,000 Maine middle schoolers. During that time, these students' parents and other adults have always asked, "When can I do LabVenture?!"

This year, for the first time we rolled out a LabVenture experience specifically developed for the public.

Modeling Change is a 90-minute exploration of past and future ecosystem change in the Gulf of Maine. Participants looked forward and back at the impacts of ocean warming in our bioregion through the lens of two key species: lobsters and black sea bass.

In addition to the state-of-the-art technology in our Cohen Center for Interactive Learning, the event also included a facilitated discussion with our program staff.

Starting in 2019 and continuing into the new year, we hosted 12 sessions of Modeling Change — serving over 350 total attendees.

Ecosystem modeling is a way for us to understand the relationships between species and their environment, and help us to project what the Gulf of Maine will look like in the future. Guests experienced the power of this approach first-hand.

This experience was made possible with funding from Jane's Trust Foundation.

An Update for Sea State



Last summer, we relaunched Sea State, our series featuring expert speakers on topics central to the Gulf of Maine ecosystem and economy.

Since 2006, we've invited scientists, seafood experts, fishermen, and others to lead these important conversations. After a brief hiatus as we rebuilt the Cohen Center for Interactive Learning for the all-new LabVenture experience, we're continuing that tradition with some notable updates.

Along with the physical changes to the space, we're updating the learning experience for attendees to make it less formal and more interactive. That means we'll break from the traditional lecture style to incorporate more small-group discussion and other interactive learning strategies.

Here are some other important changes:

- Repeat sessions: In the past, we've featured a series of separate presentations from guest lecturers. Now, we're offering several instances of the same presentations and group discussions to help make the discussions accessible to a larger audience. That means you'll likely want to choose one session per series, rather than attending them all.
- Internal and external speakers: Rather than relying entirely on a single speaker, we're featuring a GMRI staff voice alongside one of our many partners — including fishermen, aquaculture farmers, scientists, fisheries managers, educators and others. We hope to provide a useful framework for understanding important issues related to the Gulf of Maine and some perspective from the partners we engage with on those issues.
- Reception with refreshments: Guests can now enjoy complimentary refreshments during a brief reception just before the program begins. We hope attendees will take advantage of this opportunity to connect prior to the event.
- Tickets for sale: We're asking for attendees to purchase tickets for \$8 ahead of time, or \$10 at the door. The price of the tickets will help pay for an improved space and program experience.

An Update for Sea State (continued)

This year, we hosted two separate Sea State series. First, we invited our community to join a discussion of Maine's aquaculture landscape. Local mussel, oyster, and kelp farmers shared their perspectives on this growing industry alongside our staff experts.

In our second Sea State series, we hosted a conversation about how individuals can support a healthy Gulf of Maine ecosystem and economy by choosing and eating more local seafood. Over the course of three repeat sessions, our staff and seafood partners shared success stories from businesses that are empowering consumers to choose seafood they can feel good about.

Our Impact: Gulf of Maine Seafood



Our Sustainable Seafood Program advances economic and ecologic sustainability in the Gulf of Maine. We work with industry leaders across the supply chain to build market demand and empower consumers to find and buy Gulf of Maine seafood. Here's a snapshot by the numbers of what we have accomplished in the past year.

Partnering with the Supply Chain

MUSSEL FISHERY IMPROVEMENT PROJECT

8 **supply chain companies** participate in this effort to improve the science and management of wild mussels in Maine: Acadia Aqua Farms, Bristol Seafood, Cape Cod Shellfish Company, Euclid Fish Company, Hannaford Supermarkets, J.P.'s Shellfish, Maine Shellfish Company, and Moosabec Mussels.

GULF OF MAINE RESPONSIBLY HARVESTED PARTNERS

11
seafood processors
providing regional
seafood to:

2
large foodservice
companies (Sodexo,
The Abbey Group)

1
major distributor
(Sysco)

175
universities, schools,
and hospitals

Our Impact: Gulf of Maine Seafood (continued)

Partnering with the Supply Chain

CULINARY PARTNERS

27 **restaurants** committed to always having *Gulf of Maine Responsibly Harvested* seafood on their menus. New partners include David's Restaurant, O'Oysters, and Shade Eatery at Higgins Beach Inn.

SUPPORTING RETAILERS

5 **U.S. grocery chains owned by Ahold Delhaize**, all of whom we are assisting with sustainable seafood sourcing: Food Lion, Giant Food, Giant/Martin's, Hannaford, and Stop & Shop.

HANNAFORD'S LOCAL SEAFOOD PROGRAM

26 **Regional companies** are committed to supplying Hannaford's *Local* seafood program.

20-25 **Local seafood items** consistently carried by Hannaford.

Our Impact: Gulf of Maine Seafood (continued)

Increasing Market Demand

12%

Increase in *Gulf of Maine Responsibly Harvested* seafood sold by Sysco Northern New England to their 3,000+ customers in ME, NH, and VT in 2019.

8%

increase last year for Hannaford's *Local* seafood sales which continue to rise year over year.

100%

sourcing of *Gulf of Maine Responsibly Harvested* fresh white fish achieved by every UMaine Sodexo dining hall, making these campuses Champions in our program.

>\$96M

***Gulf of Maine Responsibly Harvested* seafood sold** by partners since 2011.

Consumer Awareness

130+

people who attended the 2019 Seafood Celebration at GMRI.

30+

seafood team speaking engagements in 2019. We shared stories about our business partners at a range of conferences in the past year: Conservation Alliance for Seafood Solutions Annual Meeting, New England Farm to Institution Summit, Vermont Healthy Food in Healthcare Conference, Wild Blueberry Association Wild Foods Tour, and more.

2

focus groups conducted with New Mainers in Portland and Lewiston to better understand their consumption habits and access to seafood.

New Initiative

19

fishing and supply chain businesses interviewed for a USDA planning grant, which resulted in the comprehensive report: "Barriers Preventing New England Finfish from Entering the Market and How to Overcome Them." Outcomes also included two guides to direct sales for fishermen in Maine and Massachusetts, and a financial resources guide for fishing and seafood businesses. Next steps will include a focus on improving seafood quality across the region.

Collaborations Fuel Aquaculture Progress



With support from a wide network of collaborators, our Aquaculture team advanced three important projects this year, including a workforce development strategy, an entrepreneur development program, and a commercial oyster farm partnership.

Maine Aquaculture Workforce Development Strategy

In partnership with the Maine Aquaculture Association and Educate Maine and funded through the FocusMaine partnership, the Gulf of Maine Research Institute led development of a strategic roadmap for Maine aquaculture workforce development called the Maine Aquaculture Workforce Development Strategy.

We contracted with a team of four Scottish consulting firms to conduct the analysis, who brought deep international experience and knowledge of aquaculture development and workforce solutions and an objective perspective.

Direct input from Maine's aquaculture industry — including established and prospective land-based operations, marine producers, service providers, and supply chain companies — formed the base of the analysis. GMRI helped orient the consultants to Maine's aquaculture industry and education landscape by facilitating one-on-one meetings, co-developing surveys, and conducting interviews.

The consultants interviewed or surveyed 62 businesses, including 15 meetings. In addition, the consultants met with representatives of 17 of Maine's education or training institutions and surveyed another 33. The GMRI project team also convened a steering committee of 30 representatives from various Maine education and training institutions, who provided critical feedback throughout the project.

The final strategy document, which outlines a path for leveraging existing resources in Maine and anticipating how workforce needs will change as the industry develops over time, will be public in late 2020.

Collaborations Fuel Aquaculture Progress (continued)

Aquaculture Accelerator

Through the FocusMaine partnership, GMRI has again partnered with the Maine Center for Entrepreneurs (MCE) and Maine Aquaculture Association (MAA) to develop and administer an intensive 15-week aquaculture-themed entrepreneur development program to further our shared goal of creating aquaculture jobs in Maine.

The program, called Aquaculture Top Gun 2020, is adapted from the core curriculum of MCE's established Top Gun entrepreneur development program, which teaches business fundamentals and provides one-on-one mentoring to early-phase businesses. This new model for sector-specific Top Gun programs stems from our highly successful prototype Aquaculture Top Gun program in 2018.

In fall 2019, the program development team met regularly to tailor the Top Gun core curriculum to the unique challenges faced by aquaculture businesses and leverage networks to recruit aquaculture business experts as presenters and mentors. Eight businesses were selected through a competitive application process and the program officially kicked off in January 2020.

Commercial Oyster Demonstration Farm Partnership

In 2018, we partnered with the Quahog Bay Conservancy (QBC) on a commercial oyster demonstration farm to generate and outsource the real-world financial data of scaling an oyster farm to commercial size. Our goal is to foster small-business success by open-sourcing detailed financial information about the real-world costs, revenues, profits, and losses of a commercial-scale oyster farm, which are otherwise not available due their proprietary nature. Our previous efforts focused on building a well-rounded team, which now includes Jeff Auger of Mook Sea Farm and Margaret Williams of PGM Accounting and increasing QBC's sea farm size to a commercial scale so the financial information is legitimate.

In 2019, after navigating a rigorous lease application process and being issued a lease by the Maine Department of Marine resources, the demonstration farm grew to 12 acres between two growout sites. We made significant headway in developing the farm operations plan to maximize efficient use of the two sites, and 600,000 baby oysters were seeded in late summer. Concurrently, we began to develop the accounting and data collection systems that will form the basis of the future financial outputs of the project.

Supporting Regional Fisheries



Our Fisheries Technical Assistance Program (FTAP) provides a range of technical, convening and innovation services to New England's commercial fishing industry to promote the long-term prosperity of local fisheries and fishing communities. In 2019, the program team made progress across the major initiatives conducted in support of these goals.

Electronic Monitoring

To comply with federal regulations, fishermen in the Gulf of Maine are monitored by fisheries observers — people who ride along with fishermen to collect catch data. There are several challenges associated with human observers, including safety and cost.

In recent years, the Gulf of Maine Research Institute and fishermen partners have pioneered a new technology called electronic monitoring (EM) — a system of cameras and computers mounted onboard fishing vessels.

As a result of the efforts of our program team and their partners, EM programs within the region have grown tremendously in the past year, and regional legislation, known as Amendment 23, is poised to approve EM as monitoring tool in the Northeast Groundfish fishery in the upcoming year.

The Maximized Retention EM Model

The Gulf of Maine Research Institute has spent the last two years developing the Maximized Retention EM Model. This model is targeted at high-volume, offshore vessels in the New England Multispecies Groundfish Fishery, and is designed to improve accountability and decrease monitoring costs for a subset of the groundfish fleet for whom electronic monitoring was previously inaccessible. Participating vessels are exempt from minimum size requirements for allocated groundfish species and instead must retain fish they would otherwise be required to discard (dead) at-sea. EM is used as a compliance tool to ensure all groundfish are landed and, rather than recording discards at-sea, all allocated fish are accounted for on shore by a dockside monitor. As a part of this program, GMRI is also pioneering novel technology solutions to reduce the cost, logistic and catch handling burdens of EM, improve data transmission time, and build EM system and data utility for participants in the Maximized Retention project.

Supporting Regional Fisheries (continued)

In our second year of piloting the Maximized Retention program, our project team has monitored over 170 fishing trips, providing critical data to NOAA, the New England Fishery Management Council, and groundfishermen to develop program standards and a framework within which to operate an EM program for high-volume fishing vessels. Now, the program is preparing for the upcoming fishing year, in which we intend to double the program capacity and introduce new fishing operations as the next step toward implementing a Maximized Retention EM program for high volume groundfish vessels in New England. Ultimately, by successfully scaling and streamlining the program, we will prepare the Maximized Retention model, and the bodies which govern it, for implementation and adoption as a monitoring tool for the wider groundfish fleet with the approval of Amendment 23.

Thanks to our partners at Integrated Monitoring, Cvision AI LLC, The Sustainable Harvest Sector, New England Marine Monitoring, Blue Harvest Fisheries, NOAA, and participating captains and crews.

Funders include The National Fish and Wildlife Foundation and the Gordon and Betty Moore Foundation.

Implementing AI in Video Analysis

Increased participation in Electronic Monitoring programs means more video data to process. That's why we're working with machine learning experts to make EM programs scalable. Automation of visual imagery analysis has progressed at an amazing rate in the last decade. Many common tasks can now be fully automated, and automation is even used to enhance human performance of difficult tasks.

Instead of relying on humans to watch the video generated onboard, we're exploring how computers could identify fishing activity directly from EM video footage. Due to the nature of the fishing operations on board the high-volume vessels in the Maximized Retention program, fishing trips are longer, vessels onboard more catch, and larger quantities of video are produced than in other EM programs. We are therefore partnering with CVision AI and Integrated Monitoring to develop machine learning algorithms which identify important activities on the decks of Maximized Retention fishing vessels. By developing such tools, we will reduce the time and cost of human video analysis.

However, the Gulf of Maine Research Institute is not alone in this initiative. Many fisheries stakeholders in New England and across the country are actively pursuing machine learning as a solution to prohibitive human review, data transmission, and storage costs of video analysis. So, on January 23, 2020 we collaborated with partners CVision AI and New England Marine Monitoring to host a workshop entitled "Incorporating Machine Learning into Northeast EM programs." The workshop convened EM project stakeholders, AI specialists, NOAA staff, and data specialists to focus on the potential uses of machine learning in current and future programs, identify regional priorities, and discuss the pathway for incorporating AI into video analysis. Overall, 42 fisheries and EM technologies stakeholders participated in the workshop.

Supporting Regional Fisheries (continued)

Together, these participants identified the following priorities for implementing AI into current and future EM protocols:

1. As a region, we must clearly define what “moving forward” means, and deliberately chose which EM tasks are prioritized for automation.
2. In the near term, the most promising reduction in video analysis time and cost is through developing activity recognition (AR). Developers should focus on the progression of AR and build confidence in those models.
3. Clear algorithm performance standards must be defined. As a region, we should first document and define a baseline standard, and then determine “what is good enough” for algorithm performance.
4. We must develop a process for submitting and approving new innovations in automatic analysis or processing of EM data.
5. A clear and realistic timeline needs to be developed for implementing machine learning goals.

Our program team has also leveraged its experience designing EM programs to help others create electronic monitoring systems suited for automated or semi-automated video analysis by publishing (with our partner CVision AI) a new design manual. The manual focuses on aspects of EM programs or systems that can make or break automation capabilities. It presents a broad range of information to guide industry groups, governments, or EM vendors considering or currently developing automated EM programs, and provides technical detail for groups which have experience in automated EM programs and an interest in the lessons learned from New England.

Thanks to our partners at Integrated Monitoring and CVision AI.

Funders include The National Fish and Wildlife Foundation and the Gordon and Betty Moore Foundation.

Using EM Systems as Research Platforms

As a result of our partnership with groundfishermen in our EM programs, fishermen throughout New England are bringing forward new collaborative research ideas. One such idea was to modify an Ultra-Low-Opening Trawl (ULOT) net, previously developed by GMRI Research Scientist Steve Earys, to further reduce unintended bycatch of Atlantic Cod while fishing for flatfish species such as yellowtail flounder or grey sole.

The fisherman who proposed this idea is a participant in the Maximized Retention program and our team saw an opportunity to test the EM system onboard his vessel as a data collection platform for scientific research. While the fisherman conducts commercial trials of the modified net, we collect data on catch, fishing effort, net handling and performance, and the duration of certain fishing activities using the EM video and electronic reporting inherent to the Maximized Retention program. Normally, collecting this data would require the deployment of a research technician, additional on-board sampling, and copious note taking and reporting.

By utilizing and establishing the effectiveness of an EM system as a data-collection platform for scientific research, we hope this project will demonstrate the potential for EM systems to be used not only for fisheries monitoring, but also to advance our capacity to collect data for fisheries research.

This work is funded by NOAA's Bycatch Reduction and Engineering Program, and includes partners at The Nature Conservancy and The Massachusetts Division of Marine Fisheries.

Supporting Regional Fisheries (continued)

Reviewing the Catch Share Program

In 2010, the implementation of a catch share management program in New England's groundfish fishery sparked dramatic changes in every aspect of the industry. This program introduced a market-based approach to the fishery, in which the total allowable catch of groundfish stocks was allocated amongst fishing cooperatives called sectors. To augment their initial allocation, sectors and their members can lease or trade allocation from other sector fishermen, ideally, building a portfolio that balances target and constraining stocks.

In 2019, the New England Fishery Management Council (Council) launched its first review of the Northeast Multispecies catch share program. As part of that process, the Council commissioned the Gulf of Maine Research Institute to conduct a series of port meetings to solicit public comment about the groundfish sector management system. These meetings provided a forum for stakeholders to share their perspectives, experiences, and on-the-water observations of changes to the fishery and to their communities since the implementation of the sector management system.

Our team hosted nine port meetings, in: Ellsworth ME, Portland ME, Portsmouth NH, Gloucester MA, Plymouth MA, Hyannis MA, New Bedford MA, Narragansett RI, and East Hampton NY, between July 18 and August 21, 2019. We heard a wide range of industry comments including the relative merits of the catch share program compared to previous management systems, challenges such as increased costs, decline of port infrastructure, and consolidation of the groundfish fleet. We also heard suggestions to promote a prosperous future in the regional groundfish industry. Our Fisheries Technical Assistance Program plans to use comments from the industry to identify and pursue future initiatives and provide increased support to our local fisheries.

We reported preliminary results in a presentation to the Council in its September meeting, and the final report will be published by the Council in April 2020. Our presentation and report may be found through the Council's webpage.

This work was commissioned by the New England Fishery Management Council. Thanks to all those who attended and participated in public port meetings.

New: Ocean Business Accelerator



The Gulf of Maine Research Institute is establishing an Ocean Business Accelerator — a portfolio of mission-based for-profit ventures. The Portland-based marine nonprofit, which remains independent, objective, and non-partisan, announced the new initiative in 2019.

The Ocean Business Accelerator will complement the organization’s existing nonprofit programming by supporting the development of mission-driven business ventures and partnerships that will leverage private sector market opportunities.

The Ocean Business Accelerator will draw on institutional knowledge to advance business ideas, attract investment, and lead partnerships that will contribute to the New England marine industry’s economic health and development. Each mission-driven business venture within the Ocean Business Accelerator will be incorporated initially as a wholly-owned subsidiary and developed to support the long-term ecologic and economic health of the Gulf of Maine bioregion.

“This is another way for us to support the Gulf of Maine ecosystem and the communities that depend on it to earn a living,” said CEO/President Don Perkins. “We understand the social, cultural, and financial importance of a strong marine economy — and this Ocean Business Accelerator is another tool for us to offer support.”

After conducting a national search, GMRI hired its longtime Chief Development Officer, Blaine Grimes, as its new Chief Ventures Officer to lead this initiative. Grimes, who has substantial private sector experience prior to joining GMRI, will be focused on mission-driven investment and business development in the Gulf of Maine bioregion.

“After 14 years of supporting our non-profit mission by building philanthropic support, I’m excited to explore new ways to further our mission,” said Grimes. “We’re focused on identifying and advancing market-based solutions to the challenges we’ve identified through years of research and work with community and industry partners.”

GMRI is currently pursuing opportunities for several mission-driven business ventures with internal and external partners. The organization plans to share details for each of these mission-driven business ventures as they make progress within the Ocean Business Accelerator in the coming years.

Funding to launch this initiative was provided by a mix of private philanthropic gifts and a \$150,000 grant from the Maine Technology Institute.

New Climate Center Announced



In September, we announced the launch of a new interdisciplinary center focused on solutions to local, regional, and global challenges related to ocean warming.

Over the course of the last decade, scientists from the Gulf of Maine Research Institute have led a body of research that identified the Gulf of Maine as one of the world's fastest-warming ocean ecosystems.

As has now become widely known, GMRI scientists previously found that over the last 30 years, the Gulf of Maine warmed at a rate of 0.06°C per year (0.11°F per year) — faster than 99% of the global ocean, and more than three times the global average.

Now, we've announced the launch of a new interdisciplinary center focused on solutions to local, regional, and global challenges related to ocean warming. By creating a new virtual center within the organization's existing Commercial Street lab in Portland, we will leverage our unique mix of science, education, and community expertise to provide forward-looking leadership.

“We've spent the last decade identifying warming trends and associated challenges in our bioregion,” said CEO/President Don Perkins. “We'll spend the next decade identifying solutions to some of these challenges and helping coastal communities adapt to a warmer future. Furthermore, we know the solutions we develop locally will be relevant to other communities around the world as they grapple with similar challenges.”

In addition to regional warming trends, the new climate center builds on the our scientists' recent global research, which reflects the need for communities to make forward-looking decisions in the face of change.

“For generations, people have made decisions based on their past experiences,” explained Chief Scientific Officer Dr. Andrew Pershing. “Rapid warming means the past is unreliable for predicting the future, requiring a paradigm shift in how we make decisions.”

New Climate Center Announced (continued)

Major climate projects are already underway. In the last year, GMRI has raised and deployed more than \$2 million in federal and national foundation funding on projects that contribute to the resiliency of communities throughout the Gulf of Maine.

Examples of the early vision of the center in action include:

- **Convening International Experts:** In November, we cohosted the Gulf of Maine 2050 International Symposium to bring ocean leaders from across New England and Maritime Canada together to synthesize environmental, economic, social, and institutional perspectives on coastal climate resilience.
- **Helping Fishermen Adapt:** Research Scientist Dr. Kathy Mills is leading a suite of collaborative projects exploring how fish abundance and distribution will change in a warming ocean. Her team is translating that data into port-specific economic vulnerability assessments throughout the Northeast and is working with communities to identify climate-resilient fishing strategies for the future.
- **Driving Climate Ready Fisheries Management:** Research Scientist Dr. Lisa Kerr is leading an interdisciplinary, multi-organization team to explore how fisheries management strategies will perform in a changing climate. Her team will host interactive workshops for both fishermen and fisheries managers in Portland and other fishing communities. Together, the group will contribute to the development and testing of climate-informed fisheries management strategies.
- **Preparing Communities for Sea Level Rise:** Science Education Program Manager Gayle Bowness is leading interactive programs to raise awareness and draw new audiences into important conversations about sea level rise. She teams with municipal leaders to assemble relevant resources, tools, and data visualizations to improve community understanding of expected sea level rise and local planning for impacts associated with coastal flooding.
- **Educating the Next Generation of Ocean Stewards:** Chief Education Officer Leigh Peake and her team have completely reimaged our long-running LabVenture program, which now serves a climate-focused science experience to thousands of Maine middle schoolers each year and will soon expand to engage adult learners.

In the coming months and years, new funding and expanded partnerships will magnify the impact of the new climate center, which will support climate-ready fishery management, aquaculture business planning, community adaptation, seafood supply chain innovation, and analysis and advice on mitigation policy options.

“We have a unique mix of oceanographers, ecologists, economists, and data scientists who specialize in predicting and contextualizing changes in the marine environment,” said Perkins. “But, unlike most research labs, our scientific perspective is balanced by decades of experience delivering high-impact education programs and convening diverse groups of marine stakeholders to solve complex problems. This integrated approach prepares us to tackle the challenge of supporting real-world climate decisions as part of this new center.”

Community Plans for Gulf of Maine 2050



In November, the Gulf of Maine Research Institute, along with the Gulf of Maine Council, the Huntsman Marine Science Centre, and a host of regional and international partners, invited leaders from across New England and the Maritime Provinces to convene in Portland, Maine for the Gulf of Maine 2050 International Symposium.

The Gulf of Maine 2050 International Symposium brought together multiple science disciplines, natural resource managers, municipal planners, representatives from marine industries, community and business leaders, NGOs, and the philanthropic community. The workshop offered an unprecedented opportunity to synthesize a diverse mix of environmental, economic, social, and institutional perspectives on coastal climate resilience, and collaborate to act on emerging challenges and opportunities.

“Communities around the Gulf of Maine are grappling with some of the fastest changes in temperature, acidity, and sea level of anywhere in the world,” said Chief Scientific Officer Dr. Andrew Pershing. “What does that mean for our ecosystem? What does it mean for us? That’s what this conference was all about.”

The event kicked off with special keynotes to set the global and local context for the week. Plenaries on subsequent mornings featured scientific experts and practitioners to explore local implications of the next 30 years of warming waters, rising seas, and ocean acidification. The packed program also included climate adaptation presentations, collaborative workshops, and poster sessions.

In advance of the symposium, a team of experts developed drafted scientific scenario papers to increase our understanding about how the key drivers — warming waters, sea level rise and precipitation, ocean acidification — are expected to impact conditions in the Gulf of Maine over the next 30 years.

These scientific scenarios informed the interdisciplinary work at the symposium where we will explore how potential changes related to climate and other factors could impact the Gulf of Maine environmental, community, and economic sectors in the future.

After an inspiring and highly productive week focused on promoting a resilient Gulf of Maine, Rob Stephenson of Fisheries and Oceans Canada delivered closing remarks for the symposium, telling the audience, “We encourage all to build on the knowledge and ideas from this meeting to work together, show leadership, and take action in promoting solutions for the Gulf of Maine and beyond!”

Fiscal Year 2019 Financial Overview

Effective January 1, 2018, Gulf of Maine Research Institute (GMRI) changed its fiscal year end to June 30. Therefore, the comparative analysis looks at July 1, 2017 – June 30, 2018 vs. July 1, 2018 – June 30, 2019.

Gulf of Maine Research Institute (GMRI) had a breakeven fiscal year ended June 30, 2019. We had another successful year, with continued delivery of core programs and 2% growth in total expenses, when compared to the previous twelve months.

Science, Education, and Community programs are funded primarily by federal grants, foundation grants, and individual contributions. Revenue was up \$3,000,000 when compared to the previous twelve months, primarily arising from increases in federal and foundation grants.

Fundraising and community relations activities are funded by unrestricted contributions. Most administrative costs are allocated as overhead to program and development costs, in compliance with federal cost guidelines. The balance of administrative expense is funded by income from administrative services contracted to our subsidiary.

GMRI's wholly owned, non-profit subsidiary, Gulf of Maine Properties Inc. (GMPInc), owns and operates GMRI's facilities. GMRI rents 85% of the total space in the building and the remaining space is rented to other tenants.

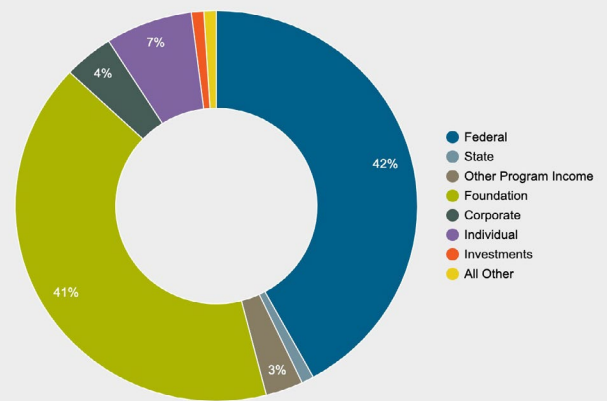
GMRI consistently receives unqualified opinions from external auditors in our financial and federal compliance audits. We also have a long-standing audit history of not receiving Management Letter comments on any material financial weaknesses. Our 2019 external audit was no exception.

Most of the growth in our net assets is in endowments and reserves. We maintain our laboratory facilities in A-class shape. We have completed a major renovation to our Cohen Center Interactive Lab.

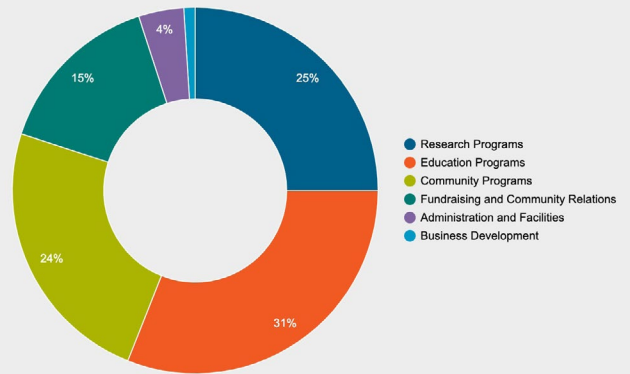
During Fiscal Year Ending June 30, 2019, GMRI launched a wholly owned, for-profit subsidiary, Gulf of Maine Sashimi. We anticipate launching a second wholly owned, for-profit subsidiary, New England Marine Monitoring, during Fiscal Year 2020.

Meanwhile, GMRI continues to grow its national and international reputation as a marine research institute, a leader in citizen science education, and a technical resource for the fishing industry.

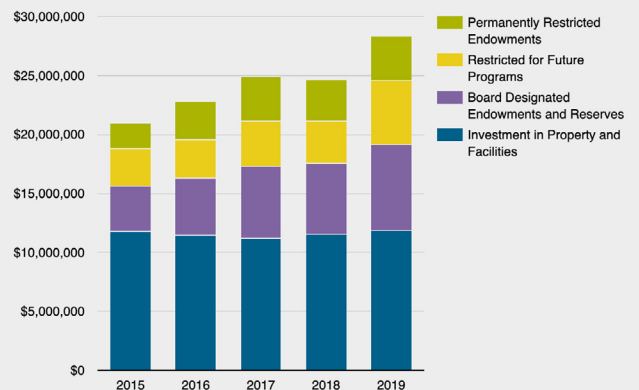
Revenue: \$14,478,077



Expenses: \$10,550,656



Total Net Assets



We are all honored to carry out the important work entrusted to us by the 850 individuals, businesses, and foundations who gave to GMRI between July 1, 2018 and June 30, 2019. **We wouldn't be able to do what we love without you.**

Wind Rose Society Gifts



We are grateful to the following members of the Wind Rose Society for their gifts between July 1, 2018 and June 30, 2019. Wind Rose Society members lead the way in helping GMRI protect our ocean, sustain vibrant coastal communities, and prepare the next generation for active citizenship.

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