



# National Sea Grant American Lobster Initiative



## **Regional Research & Outreach Summit**

February 12-13, 2024

Portland Regency Hotel & Spa

Portland, ME

### **Monday, February 12, 2024**

**8:00 am Breakfast & Registration Table Open**

**9:00-9:30 am Welcome**

**Dr. Gayle Zydlewski**, Director of the Maine Sea Grant Program, welcomed attendees to the second National Sea Grant American Lobster Initiative (ALI) Regional Research & Outreach Summit. She expressed gratitude for the community's resilience in organizing the event despite the challenges posed by COVID-19. Dr. Zydlewski highlighted the ALI's origins in the Lobster Research Collaborative, an effort led by Maine Department of Marine Resources, and the continued support for the ALI from Congress. She acknowledged Dr. Amalia Harrington's leadership in bringing together researchers, extension specialists, partners, and the regional steering committee in organizing this event. Dr. Zydlewski recognized the ongoing support of Sea Grant programs across the region and emphasized the ALI's focus on funding research and extension to address knowledge gaps and increase industry resilience. She mentioned the 31 funded research projects and highlighted the extension work, including the Collaborative Chats webinar series, interactive web-based StoryMaps, and Fishermen's Round Table discussions. Dr. Zydlewski thanked everyone involved and looked forward to hearing results and next steps. **Senator Susan Collins** of Maine provided a video message expressing support for the National American Lobster Initiative.

**Dr. Amalia Harrington**, Marine Extension Associate at Maine Sea Grant, also welcomed attendees to the ALI Summit, especially those new to the network. She highlighted the 31 research programs and regional extension efforts focused on environmental change. Dr. Harrington thanked sponsors and acknowledged the support and input from the Regional Steering Committee and Sea Grant partners in shaping this year's program. She provided an overview of the agenda, encouraged attendees to talk to new people, and mentioned additional discussion spaces within the larger venue. Dr. Harrington encouraged attendees to share feedback throughout the meeting verbally, through sticky notes, and/or following the event through the upcoming survey to continue to improve the ALI Summit's programming.

**9:30-10:30 am Plenary: Overview of Change in the Region**

**Dr. James Ammerman**, New England Interstate Water Pollution Control Commission – *Long Island Sound: Hypoxia, climate change, and the loss of lobsters*

In his keynote address, Dr. Ammerman discussed the 1999 lobster die-off event that occurred in western Long Island Sound, leading to collapsed landings. Potential causes included pathogens, hypoxia, water quality issues, fishing pressure, and exposure to pesticides and metals. Despite initial suspicions regarding insecticide spraying for West Nile virus, subsequent analyses in 2016 found no connection to the die-off. Lobster abundance remained low in Connecticut and Rhode Island following the event. Long Island Sound, characterized by its east-west orientation and complex freshwater-saltwater mix, faces ongoing challenges such as hypoxia, exacerbated by nitrogen inputs. Efforts to address nitrogen pollution through wastewater treatment plant upgrades have seen success, but rising water temperatures due to climate change threaten these gains and contribute to declining lobster populations. Monitoring indicates increasing bottom water temperatures and declining dissolved oxygen levels in Long Island Sound, impacting lobster habitat. The decline in lobster abundance is attributed to these environmental changes, with regional drivers likely playing a significant role. Storm-induced freshwater inflows and thermal stress are additional factors

affecting Long Island Sound's ecosystem. While cooler, higher-salinity areas offer some hope for lobster habitat, significant challenges persist in reversing the decline in lobster populations.

**Dr. Nick Record**, Bigelow Laboratory for Ocean Sciences – *Gulf of Maine climate update: Knowns and unknowns in a changing Gulf*

Dr. Record works at the intersection of oceanography and social science, with a focus on finding solutions and paths forward through partnerships worldwide, applying a data justice lens, and emphasizing community building. In his keynote address, Dr. Record discussed a variety of changes occurring within the Gulf of Maine region, focusing on observations (the “knowns”), predictions (the “sort-of knowns”), and ocean surprises (the “unknowns”). In the Gulf of Maine, lobster landings in Maine have increased over time, but are now possibly declining. Knowns in the changing Gulf include rapid warming in the Northeast, impacting currents and primary production. The Gulf of Maine transect time series shows a drop in phytoplankton production around 2008, affecting the food chain. The rate of production of *Calanus* spp., an important part of the larval lobster diet, has declined in the eastern Gulf of Maine but has persisted in the western Gulf. To date, we have not yet observed the declines in *Calanus* spp. that are predicted by various climate models. The North Atlantic is experiencing a totally unprecedented marine heat wave with sea surface temperatures warming drastically and with warming in the deep water bringing temperatures back toward the long-term mean in 2024. Climate projections (the sort-of knowns) for 2100 indicate the highest warming in the deep waters of the Gulf of Maine, with varying degrees of surface temperature warming and decreasing salinity in most models. Projections for bottom water suggest warming in all locations with a mix of increased or decreased projections for salinity depending on location. Lobster predictions vary, with some models predicting increases in Canadian waters but declines elsewhere. Ocean surprises, such as marine heatwaves and harmful algal blooms, are expected to continue, with evidence suggesting an increase over time. Forecasts for marine heatwaves are becoming available, offering insights into future conditions. Local physics play a significant role in these surprises, and monitoring efforts, like the NERACOOS buoy in the Northeast Channel, are crucial for understanding and predicting changes in the Gulf of Maine.

**10:30-10:45 am Break**

**10:45-12:00 pm Panel Discussion: Industry Observations of Ecosystem Change**

This panel discussion included lobster industry representatives from across the Northeast. This panel was designed to complement the plenary presentations and discussion by asking industry to share their perspectives of change on the water. The goal was to help meeting attendees gain a better understanding of the kinds of changes lobstermen have experienced, and to better connect their knowledge with the ALI.

Panelists:

- **Lanny Dellinger**, Lobsterman, Newport, RI (via Zoom)
- **Beth Casoni**, Executive Director, Massachusetts Lobstermen’s Association
- **Scout Wuerthner**, Sales Manager, Lobster Division, Inland Seafood
- **Curt Brown**, Lobsterman & Biologist, F/V Lil More Tail, Ready Seafood, Cape Elizabeth, ME

Discussion:

*What changes have you observed, and how has it changed how you have conducted your business?*

**Curt** highlighted the impact of recent severe storms on infrastructure and emphasized the need for improved infrastructure, noting significant investments in wastewater infrastructure on the Canadian side. He stressed the importance of buoy data for monitoring, but also highlighted the need for more research. **Scout** noted the emergence of shell disease in the early 2000s and the challenges of getting companies to invest in building more wharfs due to storm damage. **Beth** observed a positive change in the fishing community in Massachusetts, with an increased willingness to engage and be part of the solution. She mentioned collaborations with various organizations and appreciated the response from researchers to



investigate priority issues. **Lanny** highlighted the enormous impact of nitrogen reduction and his work with Conor McManus (Rhode Island Department of Environmental Management). He also noted his witness to temperature changes, recalling the presence of tarpon in Narragansett Bay and off Block Island.

*Have you observed any positive changes?*

**Lanny** noted the entry of sea bass and emphasized the importance of swift management decisions to capitalize on new species opportunities. **Beth** observed the lobster fishery shift from a 12-month to a brief season due to right whale closures, with Massachusetts successfully adjusting fishery size to match resources. **Scout** highlighted positive collaboration between scientists and fishermen, particularly on aquaculture. **Curt** mentioned Maine's significant increase in lobster landings, with a booming eastern part of the state and the positive trend of menhaden moving east in summer, which helps with bait challenges.

*What are the primary research questions related to lobster in a changing environment that you have?*

**Beth** raised concerns about the impacts of ocean acidification on lobster larvae. **Curt** highlighted the need to understand the first month of larval phases better, particularly how temperature, diet, and acidification impact them, noting observations of lobster larvae in a mackerel gut. **Lanny** emphasized the need for faster movement towards ecosystem management, considering the predation dynamics affecting lobsters. **Scout** discussed the challenges of warming waters, including difficulties in obtaining flood insurance for wharfs and planning due to lower lobster volumes. **Curt** also mentioned the difficulty of keeping lobsters cold in holding tanks, emphasizing the need for investments in cold water tanks to ensure healthy lobsters for shipping.

*Are there other ways folks in this room can help get the industry involved in the research?*

**Beth** emphasized the importance of industry newsletters and state agency listservs for effective communication. **Heidi Henninger** (NOAA, Northeast Fisheries Science Center) described industry representatives as "professional naggars" in a positive light, suggesting that direct communication from one person can be more effective than disseminating information through multiple channels.

*Have folks from Maine seen behavior changes in how people are fishing differently?*

**Curt** discussed observing a shift from inshore to offshore lobster fishing and noted the complex interplay between effort, costs, and prices affecting fishing dynamics. **Kathleen Reardon** (Maine Department of Marine Resources) mentioned a significant drop in dealer transactions in 2022 compared to the peak in 2016, attributing this to factors like longer fishing sets and fishermen choosing not to fish. **Beth** suggested letting gear soak longer and spending more time on overnight trips as strategies fishermen in Massachusetts are using.

*Is there a hopeful signal in the price given the trading relationship between the United States and Canada?*

**Scout** noted that as prices go higher, more of Maine's lobsters have to be processed, which can lead to shutting down more of the processed lobster market and taking people out of the market for some products. **Beth** mentioned that Massachusetts has data for the last three decades, showing that prices haven't changed much, with lobsters selling for \$4.50 per pound in the 1990s and \$4.83 per pound last year. **Curt** added that despite the rapid increase in supply, the price per pound hasn't decreased dramatically, which speaks to the industry's ability to develop new markets. He emphasized the industry's nimbleness in adapting to new markets and products, highlighting the need to stay diverse to avoid lobster being taken off menus, as it can be challenging to reintroduce it once removed.

*When you're thinking about longer-term decisions, like what will help the industry through the next decade, how can science help make those kinds of decisions? What is the missing information industry needs?*

**Beth** emphasized the need for infrastructure dependability and reliability for future assurance in the industry. She also highlighted ocean acidification and future settlement as significant questions. **Scout** echoed these sentiments from the processing side, noting that investing in new processing facilities and fully staffing them year-round is challenging without certainty over supply. **Curt** discussed the importance of improving understanding of juvenile life stages through surveys in deeper water and offshore to enhance predictive and planning capacity, particularly regarding inshore/offshore dynamics. He also noted that the term "migrating" is a misnomer, as there hasn't been a drop in landings in the western part of the state, where there is still very cold, deeper water. **Curt** emphasized the need for clearer communication and resisting the temptation to simplify complex issues for headlines or media. **Beth** advocated for tagging studies to understand how lobsters are moving between southern New England and the Canadian Maritimes, emphasizing the importance of collaborative research. **Lanny** agreed on the importance of tagging studies and called for more collaborative research efforts in the industry.

*Data from the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) show that the deeper water is warmer than the surface water. Is there any research right now looking at settlement in deeper water?*

Yes, Andrew Goode at the University of Maine is currently exploring this issue.

*Are Curt and Scout (and their companies) diversifying outside of lobster?*

**Scout** mentioned that there is probably not enough diversification happening outside of lobster in the industry. He noted that the current infrastructure is geared towards lobster, and mentioned that the crab and lobster fisheries used to be more aligned, but the shrimp fishery is now gone. **Curt** added that their operation is currently 99.9% focused on lobster, but he sees potential for other species like green crab. However, processing green crabs is challenging. He mentioned that high-pressure processing could be a suitable method for processing crabs, but due to concerns over water and wastewater resources, running tumblers to process crabs in the off-season might not be feasible. **Ben Conniff** (Luke's Lobster) also noted that new technology is needed for wastewater treatment to process new species, such as crab. **Dustin Delano** (New England Fishermen's Stewardship Association), commented that the fishery has changed significantly over the past two decades, with fishermen now staying offshore year-round. While they were able to successfully shift from inshore to offshore fishing, they have since lost the ability to enter other fisheries, which has made diversification more challenging. There is a significant need for more research in deeper waters to understand new opportunities. It has been frustrating for fishermen to see changes in regulations, such as increasing the minimum gauge size, despite observing more juveniles than in many years. **Dustin** is no longer lobstering full-time because he wants to be part of the conversation around preserving the fishery. He emphasized the importance of increasing surveys and collaboration with researchers, particularly through a collaborative research-focused foundation. He also expressed a desire to encourage the next generation to get into the fishery, noting that our current knowledge about the fishery is minimal considering its size. **Curt** also highlighted Maine's strong history of collaborative research and emphasized the need to double down and invest in it. He believes there is still much to learn on both sides, with researchers and fishermen having valuable insights to share and learn from each other.

*How do we reach industry members who are reluctant to get involved in research collaboration? What can we (scientists) do better?*

**Beth** noted that younger fishermen are showing more interest in research collaboration, which is a positive development. **Lanny** mentioned that while there are quite a few people interested, it takes a lot of time to get involved, such as attending meetings and engaging with scientists. He emphasized that when scientists listen to fishermen's input, it helps improve trust between the two groups.

*What are panelists observing about the impacts of the recent storms on fishing activities in the coming season?*

In Massachusetts, **Beth** noted that coastal areas have undergone gentrification, resulting in the loss of small harbors. Larger harbors, however, have received infrastructure investments, which helped mitigate the impact of recent storms. **Scout** reported significant damages to docks in the Downeast, Maine, region, with buildings being insurable but wharfs rarely insurable. **Marissa McMahan** (Manomet) highlighted concerns about gentrification and the vulnerability of private working waterfront infrastructure in Maine as well. **Lanny** commented that the impact of storms remains to be seen, but suggested there may even be some habitat improvement as a result. Overall, there is recognition that recent storm impacts are not solely natural but also influenced by economic factors.

**12:00-1:00 pm**            **Lunch**

**1:00-2:30 pm**            **Panel Discussion: Collaborative Science – Challenges & Benefits**

This panel discussion included a combination of industry representatives and researchers that have experience working on collaborative research projects related to lobster. It built upon the previous panel by discussing how to work across the science-industry boundary to address questions about lobster in a changing environment. The goal of this panel was to highlight successful examples of collaborative science and to provide the ALI network with a better understanding of how to engage across groups.

#### Panelists

- **Damon Frampton**, Lobsterman, F/V Vivian Mae, Portsmouth Lobster Company LLC, Portsmouth, NH
- **Al Eagles**, Lobsterman, F/V Catherine Ann, Newport, RI (via Zoom)
- **Lanny Dellinger**, Lobsterman, Newport, RI (via Zoom)
- **Curt Brown**, Lobsterman & Biologist, F/V Lil More Tail, Ready Seafood, Cape Elizabeth, ME
- **Kevin Staples**, Marine Resource Scientist, Maine Department of Marine Resources
- **Megan Amico**, Gear Researcher, NOAA Northeast Fisheries Science Center

#### Discussion:

*Please share your name, your home port or institutional affiliation, and a brief description of the kinds of collaborative projects you are/have been involved with related to lobster.*

**Curt** discussed the Deepwater Settlement Project, which began in 2016 with Rick Wahle (University of Maine). This collaboration involves all levels of the supply chain and focuses on filling collectors with rocks to monitor settlement variability by depth and region. Industry funding from Red Lobster Restaurant, Cranberry Island Coop, and Ready Seafood has helped sustain the project. **Lanny** and **Al** highlighted the importance of scientists listening to fishermen's advice in settlement survey work. **Al** has been involved in collaborative research for 35 years, including crab research, collector studies, and wind farm-related research. **Kevin** mentioned that he works on gear-related research in Maine, while **Megan** is involved in collaborative gear research projects and based in Woods Hole, Massachusetts. **Damon** shared he is a fisherman from Portsmouth, New Hampshire, and has been involved in a variety of collaborative research projects since 1995.

*How did everyone get involved in collaborative research, and why do they do it?*

**Damon** enjoys his work and learns something new every time. **Curt** first got into research with the Gulf of Maine Research Institute team off of Cash's Ledge and has since continued on various projects, emphasizing the mutual learning process. **Lanny** got involved in the collector survey after meeting Rick Wahle (University of Maine), and finds the opportunity to make observations and share them directly with researchers valuable. **Al** was first approached by a marine biologist at Rhode Island Department of Environmental Management 35 years ago and has been interested in lobsters and their habitats since childhood. He finds the work enjoyable and values the data's importance to the industry. **Megan** got involved through experiments with oyster aquaculture in lobster pounds and became a fisheries observer,

appreciating the fishermen's knowledge. **Kevin** pitched his research question to the University of Maine for his graduate studies, aiming for a positive impact on his community and working with industry colleagues to refine his questions.

*Working with the collaborative research teams, what have been some of the challenges of this work?*

**Damon** said that he finds working with Josh Carloni (New Hampshire Fish and Game) and his team entirely positive and without any challenges. **Curt** highlighted the challenge of ensuring safety with new crew members on his vessel, but that hauling the collectors in fall and witnessing the results of hard work is the most rewarding. **Lanny** mentioned the difficulty in getting buy-in from some scientists for new ideas but noted improved outcomes like reduced lost gear when they're implemented. **AI** hasn't faced any significant challenges in his collaborative work, having had consistently positive experiences. **Kevin** struggles with finding industry members willing to collaborate, especially on controversial topics like ropeless gear and trackers, and managing fatigue among volunteers. **Megan** shares Kevin's challenge in finding collaborators for alternative gear issues but finds reward in seeing some individuals successfully using ropeless gear after collaborative research efforts.

*How can those setting up collaborative research studies do things differently to make the work attractive to industry participants?*

**Damon** advocated for engaging younger fishermen and new faces in the industry, highlighting their flexibility. **Curt** built upon Damon's comments to emphasize the importance of loving the work and being part of something bigger. He sees the Maine Apprenticeship Program as a valuable opportunity to tap into younger fishermen to get them involved. **Lanny** observed a lack of younger people in the industry in southern New England, indicating a "graying of the fleet" as a challenge to getting younger fishermen involved. **AI** also noted a negative perception of the state agency among some younger fishermen, suggesting a need to work with those already interested. Megan stressed the importance of education and networking, suggesting that events like these (the ALI Summit) are beneficial for spreading awareness. **Kevin** also shared that he believes in the need for grassroots ownership of the industry's future, emphasizing the importance of incentives and compensation. He also highlighted the social barriers to participation. Overall, the panel thought that engaging younger generations, addressing challenges such as negative perceptions and lack of data, and advocating for grassroots involvement and compensation for industry members' time was the best way to try and make collaborative research more attractive to industry.

*In thinking about the social barriers to getting involved in some kinds of collaborative research (e.g., gear testing), are there opportunities to align the motives, rationale, and benefit between biological research questions and gear testing? That is, are there ways or ideas of how to partner to align research questions with the collaboration, to help get over the social barriers?*

**Curt** suggested incorporating new gear into current collaborative research to test it, citing his collector study as an example. **Megan** agreed with the idea and mentioned ongoing efforts to test new gear, like using receivers in Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) surveys. However, **Dustin Delano** (New England Fishermen's Stewardship Association) highlighted the difference between testing alternative gear and on-demand gear. He is concerned that on-demand gear could lead to significant changes, expenses, and uncertain success, potentially eliminating a large part of the fleet. **Beth** also expressed concerns about using on-demand gear, citing worries about overfishing and the impact on ecosystems and communities. She also mentioned the need for monitoring, particularly regarding right whale issues. **Kevin** suggested that doubling up on different types of research might shrink the pool of participants and emphasized the need to troubleshoot gear challenges well in advance. **Lanny** stressed the importance of industry input in collaborative research and noted that ropeless gear may not be economically viable yet. **Beth** then added that developing new technology takes time and that the industry should be involved in the process. These points illustrate a complex discussion around the use of new gear

in research, highlighting concerns about economic viability, ecological impact, and the need for industry involvement in technology development.

*What are the common messages we need between industry, management, researchers, and those working in-between? How do we help bridge these gaps?*

In general, the panel stated that industry engagement and involvement is and will be crucial for success, but there are some hesitations to get involved in collaborative research. **Alexa Dayton** (Maine Center for Coastal Fisheries) advocated for inviting innovation and new ideas, not just testing existing models, and suggested asking fishermen and youth for their input. **Al** emphasized the need to reframe the relationship with enforcement agencies as willingness to listen to fishermen, highlighting a new generation of managers. **Beth** stressed the importance of thanking the industry for their efforts and acknowledged the challenges they face in adapting to changes. **Kevin** noted the challenge of defending anecdotal information without data and highlighted the importance of testing ideas with data. **Heidi Henninger** (NOAA Northeast Fisheries Science Center) shared an example of successful engagement with the industry in developing the Jonah crab fishery, emphasizing the importance of engaging fishermen from the outset. **Kathleen Reardon** (Maine Department of Marine Resources) advocated for a shift away from using boats as mere data collection platforms, emphasizing the need for respectful partnerships with industry. Another audience member highlighted the fear within the industry about losing control of collected data and the importance of building trust. **Damon** shared frustrations about not being listened to, especially regarding safety issues, emphasizing the need for balance and knowing when to stop pushing for change. These points underscore the importance of respectful engagement, listening to industry concerns, and building trust to facilitate successful collaboration between researchers and industry members.

**2:30-2:45 pm**                      **Break**

**2:45-4:15 pm**                      **ALI Research Updates: Social Science & the Lobster Industry**

**Dr. Joshua Stoll**, University of Maine – *Assessing spatial, temporal, and socio-demographic characteristics of the Maine lobster fishery (2008-2022)*

Co-authors: Theresa L.U. Burnham, Joelle Kilchenmann, Tracy MacKeracher, Christina M. McCosker, & Erin Summers

Dr. Stoll's presentation outlined the socioeconomic indicators for the Maine lobster industry and the approach taken to build a foundation for long-term socioeconomic modeling while addressing short-term research priorities. The approach includes centering partner needs, investing in collaboration, and supporting student training. The objectives for this recent and ongoing effort are to describe trips, fishing season length, and catch per unit effort (CPUE) over time and compare the results to prior estimates for the Maine lobster fishery. Initial findings revealed a decrease in trips over time, changes in the ratio between license class types, and variations in CPUE by zone, with a notable increase in Zone B. Dr. Stoll also mentioned that initial results suggest far less effort than currently described in the literature. Despite the latitude for Maine's lobster fleet to fish when it wants, it has adjusted to become comparatively efficient compared to the Canadian fleet, particularly during peak catch periods. Dr. Stoll stated that building long-term monitoring programs enables real-time responsiveness to data needs. In response to a questions regarding the mismatch of home addresses and home ports, Dr. Stoll shared that over time, harvesters are moving off the coast leading to potential consequences for not living in the community they fish when it comes to decision-making. There was also a question about the need for more applied research at University of Maine despite poor incentives for faculty, and interpreting the implications of stable effort per catch on the resource's catchability. Overall, these findings and questions suggest a nuanced understanding of the Maine lobster industry's dynamics and efficiency, highlighting areas for further research and potential policy implications.

**Dr. Jonathan Grabowski**, Northeastern University – *The lobster industry’s observations and perceptions of black seabass and blue crabs in the Gulf of Maine*

In his presentation, Dr. Grabowski outlined his collaborative project exploring the impacts of climate change on fisheries in the Gulf of Maine (GoM), focusing on biological-ecological and socio-economic aspects. Recent years in the GoM have been very warm, prompting the study’s objectives: documenting industry observations of black sea bass and blue crabs; and assessing industry perceptions of range-expanding impacts and opportunities. The team conducted surveys in 2015 and 2021 to gather data on fishing effort, observations of black sea bass and blue crabs, and perceptions of range-expanding species. They had response rates to the surveys of 11% in Massachusetts and 10% in Maine. Initial findings show an increase in black sea bass abundance coinciding with warm periods, with varying seasonality across regions. Northern areas seem to be seeing them most of the year except winter, while Cape Cod south observes black sea bass year-round. Dr. Grabowski then explained how the team is exploring views from the dock through mental modeling and developing decision trees. Mental models were used to understand how fishermen perceive the impact of warming water on the fishery, and how they view adaptation and the future of the Maine lobster industry. The team also explored perceptions of drivers in the lobster fishery through the use of decision trees of explanatory variables. Fishers’ Ecological Knowledge (FEK) was highlighted as useful in detecting and mapping species range expansions, aiding in identifying concerns/risks, and building adaptive capacity. Questions raised include addressing survey fatigue by piggybacking on other social science efforts, investigating the impact of cunner on the fishery, and analyzing survey response rates to understand biases in the data. Further research efforts will investigate stress, social disruption, trust, and adaptive capacity in the lobster fishery.

**Dr. Adrian Jordaan**, University of Massachusetts Amherst – *Alternative bait development and future visioning in the New England lobster fishery: A story in collaborative and multidisciplinary research*

This presentation focused on a collaborative project designed to develop an alternative, locally-sourced bait for the Gulf of Maine American lobster trap fishery. The project team included industry partners from Neptune’s Harvest, the Massachusetts Lobstermen’s Association, and other lobstermen; food scientists and environmental conservation scientists at the University of Massachusetts, Amherst; graduate and undergraduate students; and other various stakeholders. In spring 2022, the team created a food science practicum to develop alternative bait prototypes and learn from industry partners. The following summer, the group focused on product optimization and scaling up. Students working on the project led community engagement efforts in summer 2022 using web-based surveys and interviews with 28 fishing vessels and three lobstermen. Partners also started conducting field trials in summer and fall 2022 at the Gloucester Marine Station, receiving initial feedback from industry that the prototypes fell apart too quickly. The following spring, team members developed a new food science practicum to reformulate the bait and to continue working with lobstermen to improve prototypes for additional field testing in fall 2023. Throughout this project, the team learned a number of valuable lessons, including the importance of listening and meaningful engagement with the industry, and the need to enhance the quality of alternative bait prototypes. Importantly, the students received real-world opportunities to work in applied science, and learned the benefits of in-person interactions. Moving forward, the team plans to publish their results, create "recipe cards" for bait alternatives, and conduct commercial fishermen field trials with reformulated bait.

**4:15-5:00 pm**

**Break/Set-up**

**5:00-7:00 pm**

**Poster & Networking Session**





**Tuesday, February 13, 2024**

**8:00 am Breakfast & Registration Table Open**

**9:00-10:30 am ALI Research Updates: (Re)Assessing Growth & Development in a Changing Environment**

**Dr. Alexander Ascher**, Woods Hole Oceanographic Institution – *A review of the lobster larval diet: Strengths and weaknesses of alternative approaches*

Co-authors: Carolyn Tepolt, Jesús Pineda, Richard Wahle, David Fields, Pete Countway, Curtis Morris, Emily Patrick, Caitlin Haley, Evelyn Layland, Jess Capista, & Tessa McCarthy

The speaker discussed data from two studies focusing on food limitation in *Calanus finmarchicus* and the concentration and condition in convergences. The team analyzed the data using three alternative approaches: microscopy, metabarcoding, and *Calanus*-specific real-time PCR (rtPCR). Microscopy data was gathered from 186 different guts, with scoring based on presence/absence and ranking at taxonomic levels (i.e., phylum, class, order, family, genus). They found that the larvae were eating a lot of arthropods, some crustaceans, and a good portion were also eating insects. Dr. Ascher mentioned a more specific diet analysis involving 100 dissections of stage I larvae where they identified mostly copepods by examining the mandibles that could be identified to the genus level. Although they identified about 95% of the diet that could be identified for stage I larvae, microscopy data was considered poor in linking contents and environmental factors when looking at individual guts. As such, they pursued metabarcoding, but this proved to be expensive with approximately 50% of the sequences failing. The *Calanus*-specific rtPCR approach was highlighted as providing results that could not be seen with the other two methods. Dr. Ascher stated that although plankton tow samples indicated that *Calanus* made up about 0.5% of the samples, they were found in 21% of the larval guts sampled, suggesting preferential feeding on *Calanus* by larval lobsters. Overall, this work demonstrates that microscopy works well to get a general idea of gut contents but has limitations. Moving to more data-rich approaches like metabarcoding or rtPCR is necessary for a more detailed understanding. During the discussion, Dr. Ascher mentioned that they did not observe evidence of cannibalism, but it was difficult to see with microscopy. They also noted that the data were too poor to observe other differences between sites or sample size.

**Dr. Benjamin Gutzler**, Wells National Estuarine Research Reserve – *Thermal impacts on behavior and physiology throughout lobster life history*

The speaker discussed several studies on the behavior and physiology of lobsters. The first focused on understanding temperature preference in adult female lobsters. To do this, they created a thermal gradient tank and observed movement patterns in 200 lobsters. They found that preferences varied with the season and ambient temperature, with lobsters liking warmer water in summer and cooler water in winter. The speaker noted that lobsters preferred slightly warmer water after recently extruding eggs, but slightly cooler water while they are egg-bearing. The speaker clarified that temperature preference is not the same as thermal stress, which occurs at much higher temperatures. In a second experiment, the team evaluated swimming performance and energy stores of stage IV lobsters to better understand factors that may lead to a good egg clutch. Their work demonstrated that thermal stress and poor diet could increase egg attrition, while better diets resulted in slower drop-off in nutritional condition, even with thermal stress. They also found that warmer water reduced postlarval swimming activity, but nutritional condition was unaffected. Finally, the speaker presented work mapping settling habitat. They shared preliminary data showing maps of Gulf of Maine settling habitat and the distances and likelihood of reaching settling habitat based on water temperature. The speaker indicated that swimming is an important behavior for larvae and that warming conditions will continue to be a challenge for lobster reproduction. During the discussion, Dr. Gutzler mentioned that the trials of egg extrusion took place in July and August and that they controlled for



Maine's Land Grant and Sea Grant University  
One of Maine's public universities



the size of females during the temperature preference trials. They also discussed plans to run transport models over multiple years and to look at differences in the point of origin of hatching in future studies.

**Drs. Jesús Pineda & Carolyn Tepolt**, Woods Hole Oceanographic Institution – *Abundance and biology of lobster larvae in coastal convergences*

Co-authors: Sarah Zuidema, Victoria Starczak, Phil Alatalo, & Sara Shapiro

Dr. Pineda began the presentation by discussing their research on plankton and flotsam accumulation in convergences, which are rich foraging habitats for lobsters. The team conducted nine cruises in July-August 2021 and identified 15 convergences. These were sampled for spatial organization and minimum length, and the team found that surface material occurrence is not necessarily evidence of active physical convergence. Sampling methods included cross-convergence measurements, net tows, and photographing live postlarvae, with survival experiments conducted in the lab. They also measured flotsam volume, collected zooplankton, and identified them to groups. Postlarval density was higher inside convergences compared to outside, with recent work indicating that stage I lobster larvae and other taxa are also more abundant in convergences. They noted an interesting exception: no evidence of a difference in the presence of fish eggs inside versus outside the convergences, likely due to fish eggs having no positive buoyancy or swimming behavior. Surface hydrography patterns across convergences affected taxa type and density, with larval lobster density varying by region. Dr. Tepolt discussed the team's current project, which aims to resolve the hydrographic structure between, as well as inside and outside of, convergence microhabitats; to compare the diets and prey fields of larvae in and outside of convergences; and to test whether color can be used as an indicator of recent convergence occupancy, stress, and condition. The team also seeks to understand regional circulation and larval supply processes. During the discussion, the presenters clarified that convergences form and disperse over a span of hours and then reform, and that the strength of the convergence can be quantified using current velocity measurements.

**Jesica Waller**, Maine Department of Marine Resources – *Testing and developing non-invasive female maturity assessment methods and protocols for the American lobster*

The presenter discussed efforts to estimate the size (via carapace length) at maturity and explore easier, faster methods for size estimation in the future. They emphasized the importance of understanding female size at maturity for spawning stock biomass and growth. The primary method for determining maturity is ovary staging, which is reliable but requires large sample sizes and is time-intensive. In a project conducted in 2018-2021 and funded by Maine Department of Marine Resources (DMR), researchers focused on testing the viability of other methods, such as correlating vitellogenin levels with ovary stage. The project involved lab measurements, dissections to examine ovary variability, and image analysis of oocytes, cement glands, and setogenic staging. Results from this initial study showed a coastwide decrease in size at maturity over 25 years. Their current objectives include investigating non-invasive maturity assessment methods and creating instructional materials. In this collaboration with Dalhousie University, the team aimed to develop antibody-based methods for vitellogenin detection and quantify total protein as a potential marker for maturity. They are comparing these methods with existing lab techniques and plan to analyze more samples to establish a correlation between vitellogenin quantity and maturity. The team is also updating instructional materials with new photos and collaborating with Dr. Natalie Hold (Bangor University, Wales) on new lab protocols.

**10:30-10:45 am**      **Break**

**10:45-12:00 pm**      **ALI Research Updates: Impacts of Ecosystem Change on Ecological Interactions**

**Xiangyan Yang**, Stony Brook University – *Updates from the Chen Lab*

Co-authors: Cameron Hodgdon, Noah Hunt, Robyn Linner, & Yong Chen

Part 1: *Using and individual-based model to test alternative management measures under multiple climate regimes for American lobster stocks*



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One of Maine's public universities



This presentation outlined a study focusing on the two American lobster stocks in the Gulf of Maine/Georges Bank and Southern New England, which is experiencing recruitment failure, regions. The study aimed to understand how the projected lobster population could change with climate change considering key life history parameters. It also explored potential management changes to improve outcomes. Findings suggest that the Gulf of Maine lobster population is more influenced by legal size restrictions and harvest amount, while climate change has a greater impact on the amount of lobster landed. The model developed can simulate management actions under various climate change scenarios for these stocks.

*Part 2: Could sea surface temperature (SST) replace bottom temperature (BT) in lobster habitat suitability index models?*

This presentation outlined a comparison between two programs, Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) and Optimum Interpolation Sea Surface Temperature (OISST), in terms of their spatial CV and temporal CV. The study found that sea surface temperature (SST) is capable of representing the spatial and temporal variance of bottom temperature (BT; via eMOLT) in areas where lobsters are present. The study also focused on habitat suitability index (HSI) models, creating suitability index curves for each variable and generating HSI maps based on these curves. The study expected the SI curves generated by the two data sets to be very similar and almost overlap in the spring. Maps developed using both BT and SST showed that OISST overestimates in some areas of the middle of the Gulf of Maine. During the discussion, the presenter mentioned that they had not yet looked at spatial patterns in residuals but considered it a good idea. They also discussed other data sources for describing lobster habitat suitability, mentioning that they had looked at salinity but found its variability too high to be useful.

**Rebecca Peters**, Maine Department of Marine Resources – *Who's eating juvenile lobsters? An evaluation of lobster predation in the Gulf of Maine using stomach content analysis*

This research project is focused on identifying predators of juvenile lobsters and understanding the relative importance of different predator species. Current data on lobster predators primarily comes from NOAA's Northeast Fisheries Science Center (NEFSC) Bottom Trawl Survey, but this has the potential to miss predation on juvenile lobsters. This study analyzed stomach contents from the Maine-New Hampshire Inshore Trawl Survey and the Eastern Gulf of Maine Sentinel Survey to address this gap. The presenter indicated that potential predators that were targeted in sampling efforts included Atlantic cod, Atlantic halibut, Atlantic mackerel, red hake, and white hake. Stomachs were collected from 2021-2023 and processed at the Maine Department of Marine Resources (DMR) lab. Preliminary results from 1,006 stomachs collected showed that lobster predation was relatively low, with only 12 lobsters found and most less than 50 mm carapace length. The Index of Relative Importance (IRI) was used to assess the importance of lobster predation compared to other prey items in the predator's diet. Lobster IRI was low for most species, except for Atlantic cod, where it ranked fifth in importance at 7.6%. The study concluded that American lobster predation ranked low in all species except cod, but work is ongoing. During the discussion, the presenter mentioned the team's future research directions, including examining the impact of predation on lobsters from the lobster's perspective and standardizing IRI data based on survey information about faunal assemblages in the tow areas. There was also interest in exploring stomach contents from the ventless trap survey and estimating the dietary breadth of predators in terms of physical size.

**Dr. Andrew Goode & Everett Rzeszowski**, University of Maine – *Climate impacts on ovigerous lobster behavior and the downstream effects on larval dispersal and settlement*

This presentation described work to examine the impact of climate change, particularly warming, on lobster distributions and the lobster fishery. Warming in the region has been attributed to the northward shift of the Gulf Stream, impacting water masses that enter the Gulf of Maine. Warm water intrusions have increased in frequency with shifts in the Gulf Stream. This warming trend coincides with changes in the lobster fishery, including a dramatic uptick in landings until 2016, followed by a recent downturn. To understand the mechanistic controls of lobster population success or failure, the study looked at critical aspects of the

lobster life history affected by climate change. Larval particle tracking using the NECOFS model was employed to assess larval connectivity, focusing on how incorporating climate impacts to larval mortality and other parameters impacts larval connectivity. The research integrated multiple approaches, including studying female distributions, modeling female spawning stock biomass (SSB) distribution, and analyzing reproductive phenology. Female abundance started to decline in 2016. Modeling female SSB distribution using two-stage GAMs showed changing female distributions. The study also looked at the presence/absence and catch per unit effort (CPUE) of lobsters, highlighting higher presence and CPUE in specific regions and depth ranges. Reproductive phenology analysis showed consistent start times but variable duration and termination, related to thermal conditions. The study emphasized the importance of population-level plasticity in controlling reproductive phenology dates. Trophic influences and settlement regulation were also examined, with findings indicating complex interactions influenced by climate change. The study's conclusions suggest changes in habitat suitability indices in the central Gulf of Maine, shifting reproductive phenology, and trophic dynamics related to regional *Calanus* spp. patterns. During the discussion, the presenters addressed the rationale for selecting the spring trawl survey due to its proximity to larval release.

**12:00-1:00 pm            Lunch**

**1:00-2:45 pm            Revisiting Research Priorities**

Presenters & facilitators:

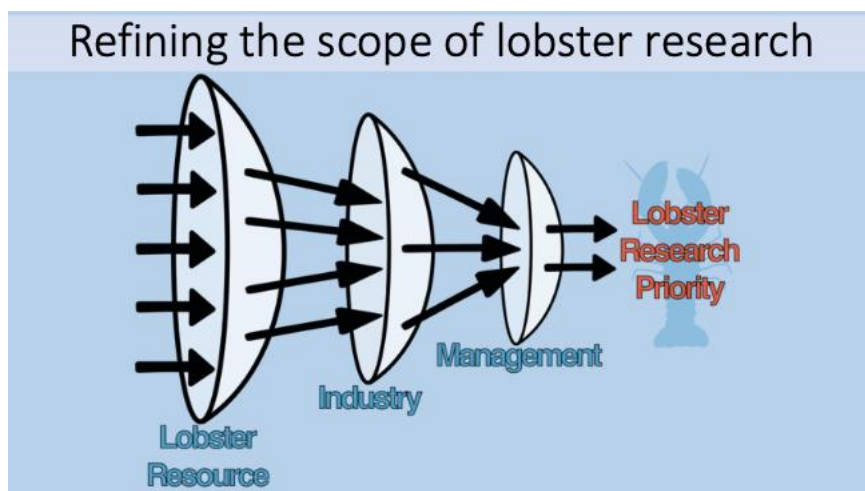
- **Dr. Heather Glon**, Lobster Research Biologist, Maine Department of Marine Resources
- **Dr. Amalia Harrington**, Marine Extension Associate, Maine Sea Grant
- **Dr. Gabriela Bradt**, Aquaculture & Fisheries Extension Specialist, New Hampshire Sea Grant

Panelists:

- **Dr. Joshua Stoll**, Associate Professor of Marine Policy, University of Maine
- **Kathleen Reardon**, Lobster Fishery Biologist, Maine Department of Marine Resources
- **Dr. Jason Goldstein**, Research Director, Wells National Estuarine Research Reserve
- **Dr. Marissa McMahan**, Senior Director of Fisheries, Manomet
- **Everett Rzeszowski**, Graduate Student, University of Maine

The focus of this session was to build upon the *Lobster Research Roadmapping Workshop* that Drs. Glon and Harrington co-organized and facilitated on September 29, 2024, at the Maine Department of Marine Resources (DMR) Burnt Island Education Center. The impetus for that workshop was to address the recent turnover and staff changes across research faculty, industry partners, and DMR within the lobster research realm. Given the number of institutions involved in this space and the ever-changing landscape of ocean uses, policy, and the physical environment, the organizers convened a group of 24 individuals from a diversity of research fields to identify research needs, potential roadblocks to collaboration, and potential solutions. Dr. Harrington provided an overview of the activities conducted at the previous workshop, including two breakout sessions focused on identifying research and data gaps, as well as a group discussion on how to break down barriers to enhance collaborative efforts. Workshop attendees also provided input on potential solutions to the challenges and gaps identified, including dataset standardization, improving data access, enhancing research communication, facilitating research-industry communication, and securing funding to support this kind of work. Other actionable items suggested at the ALI Summit included the possibility of an annual workshop to sustain collaboration; generating additional opportunities to bring diverse perspectives together; providing support to foster relationships through effective communication; and creating flexible opportunities for industry involvement in research efforts. For additional details and notes from the *Lobster Research Roadmapping Workshop*, please review this document ([click here](#)).

The next topic presented during this session was an exploration into how the lobster research community thinks about setting priorities for ourselves and the wider community. At the 2022 ALI Summit, Dr. Glon helped co-organize a plenary session on, *Lobster Research in Support of Management Objectives* that resulted in conversation around creating synergy between research and the stock assessment process and encouraged attendees to think about how their research could/should inform management to build resiliency in the community and beyond. Building on that conversation and the fall workshop, Drs. Glon and Harrington developed a conceptual diagram (see below) to help step through and refine our collective research priorities that frames them using an industry perspective that is also grounded in management goals. The goal of this component of the session was to discuss how the community passes research ideas through the industry and management lenses to narrow our vision, refining the approach without getting tunnel vision, to identify a relevant and timely research priority. It is important to note that although some individuals sit clearly within one lens, others sit both within and between other lenses given the nature of their work.



Most scientists sit in the lobster resource lens, with ideas forming out of curiosity and funding opportunities; however, the roles of individual researchers may shift when they are involved with industry and management, highlighting the interconnected nature of their work. This lens is primarily focused on how we approach studying lobster as a species and lobster as a fishery. Many in the room approach research from the individual lobster or population level, such as studying life history, development, disease, distributions, or behavior, while others approach their research from the social angle, looking at the fishery and interactions with human dimensions. Once research questions are developed, they can then be passed through to the next lens via connectors, such as Sea Grant extension professionals, the Lobster Institute, state organizations, and/or fishing associations. The next lens, that of industry, focuses lobster resource questions by providing real-world context for research. It helps to ground scientific findings in practical applications, and requires work to build trust between researchers and industry stakeholders. The connectors facilitate partnerships between industry and researchers to develop projects that support industry needs. The final lens, that of management, helps to further refine research goals that will produce usable products to support efforts like the stock assessment. Involving individuals from the management sector provides context on possible applications of the research products to facilitate our understanding of the resource while supporting the long-term sustainability of the industry. Taken together, these lenses help guide research efforts towards addressing the needs of the lobster industry, fostering collaboration, and ensuring that research outcomes are effectively translated into management actions.

Before moving into the panel discussion, **Jesica Waller** (on behalf of Dr. Glon) provided a brief overview of DMR's research priority setting. DMR works with a number of partners on collaborative research efforts

around lobster, but they also carry out their own projects, especially when the work involves confidential data. DMR is focused on research that impacts policy and industry. Regarding the upcoming changes to the gauge size and policy surrounding North Atlantic right whales, DMR is interested in exploring what the changes are in the lobster population in response to fishery and climate changes: what measurable biological impacts on the population will increasing the legal size have that are communicable to industry members? How do changes to the fishery footprint based on whale policy affect the distribution or relative spatial density of lobster? On the fishery side, DMR is also involved in gear research, but is also interested in the feedback that will continuously occur between policy changes, effort, and abundance. How have any potential shifts in lobster in response to fishery changes affected the fishery both in behavior or economically? DMR is involved in parallel research efforts between lobsters and whales, as well as emerging research based on scenario planning for the future. There is a desire to better understand the changing dynamics of effort, impact to catch, behavioral changes in the fishery, and the lobster population as a whole. Finally, DMR cannot promise access to confidential data, but strongly encourages anyone who wants to get involved with research of this type to get in touch with the Department.

The final component of this session included a panel discussion focused on understanding the perspectives and experiences of various individuals involved in lobster research, management, and industry engagement. Regarding perspectives and roles within the lenses, **Kathleen** shared that she plays multiple roles depending on the day, including involvement in lobster resource monitoring, providing data to the industry, interpreting data for researchers, and engaging in policy discussions. **Jason** shared that he primarily operates in the research and management realm, but emphasized the importance of touching on other lenses represented by the lobster resource and industry. As a student, **Everett** shared that he focuses on the lobster resource but has had opportunities to interface with both management and industry. **Marissa** engages with both the lobster resource and industry, drawing from her background in the commercial lobster industry and having family connections in the industry. Finally, **Josh** shared that he engages with state priorities at the University of Maine, works with graduate students on collaborative research, and focuses on social and economic dimensions.

When the panel discussed the topic of engagement and collaborations, many discussed the importance of listening, building trust, and having honest conversations as essential elements. Several highlighted that the process of engagement involves two-way communication, again emphasizing the importance of trust, active listening, and finding common ground among groups. Successful engagement requires an investment of time to hear from others and to build relationships, with transparency being paramount. Finally, the group discussed the process of project development, highlighting that collaborative research involves co-developing research questions, refining project scope, and building on existing ideas and relationships.

**Dr. Bradt** provided an overview of the role of extension and outreach. Within the Sea Grant network, the primary role of extension is to effect change via evidenced-based, scientific information by facilitating connections across different groups. This often involves translating research findings back to end-users in a way that is accessible and fosters honest dialogue, meeting people where they are and adjusting the language and approach as needed for each group. The group discussed some challenges to collaborative research, including hurdles associated with networking and securing funding. Building relationships for projects, even those that may not receive funding, is seen as valuable but time-consuming. It is also important to develop projects that align with industry priorities, and the group emphasized that early engagement with industry partners is crucial to ensuring relevance and success. The group also touched on the fact that engagement is not a finite process, but rather one that requires ongoing and long-term investment beyond the timeframe of specific projects to maintain relationships and meet expectations. Overall, the discussion highlighted the importance of collaboration, trust-building, and effective

communication in lobster research and management, with an emphasis on the diverse perspectives and roles involved in addressing complex challenges in the industry.

**2:45-3:00 pm**                    **Break**

**3:00-4:00 pm**                    **The Future of Collaboration in Lobster Science**

**Christina Cash**, Interim Director, University of Maine's Lobster Institute

In this session, Mrs. Cash provided an overview of the history and mission of the Lobster Institute (LI), highlighting several key points regarding collaboration in lobster science. Founded in 1987 by Dr. Bob Bayer, the LI focuses on fostering collaboration and communication in support of a sustainable and profitable lobster industry across both the United States and Canada. Since its inception, the LI continues to play a crucial role in bringing researchers, industry members, and other stakeholders together through efforts such as the US-Canada Lobster Town Meeting. The LI is involved in various research projects, including the Navigating the New Arctic (NNA) grant focusing on the impacts of arctic melt on lobster, climate change, ocean models, lobster life history, and economic impacts on the lobster fishing industry. They are also working on a Lobster Proprietary Data Project, which aims to gather data to inform marine spatial planning and offshore wind development. The LI also has a rich history of collaborating closely with commercial fishermen on projects like the Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program, where sensors are deployed on lobster traps to gather environmental data. This collaboration is crucial for addressing data gaps and supporting industry needs. Student involvement is a major component of the LI's mission, and it places a significant emphasis on involving students in their projects. They are bringing on more students to support initiatives like eMOLT and the American Lobster Settlement Index (ALSI) programs. The LI currently has 23 affiliated faculty members and is expanding its network beyond the University of Maine. They are welcoming researchers from other institutions to join as affiliated faculty to strengthen collaboration. Finally, Mrs. Cash shared how the LI provides communication and outreach services for the wider lobster community. The LI provides regular updates through emails like "Lobster in the News," which highlight relevant news, research funding opportunities, and job openings in the field. She also emphasized the importance of building trust through MOUs and networking to expand the reach and impact of the LI. Overall, the LI plays a crucial role in facilitating collaboration and advancing research in the field of lobster science, with a focus on supporting industry and addressing key challenges facing the lobster fishing industry.

## List of Poster Titles and Presenters:

*Building confidence: Developing a method to reduce barriers to entry and incorporate fishermen in data collection*

**Everett J. Rzeszowski**<sup>1</sup>, Damian Brady<sup>1</sup>, Kathleen M. Reardon<sup>2</sup>, Heidi Henninger<sup>3</sup>, and Joshua T. Carloni<sup>4</sup>

<sup>1</sup>University of Maine, Darling Marine Center; <sup>2</sup>Maine Department of Marine Resources; <sup>3</sup>NOAA Northeast Fisheries Science Center; <sup>4</sup>New Hampshire Fish and Game

*Do lobster larvae released over the Gulf of Maine and Georges Bank subsidize the lobster stock off southern New England?*

**James Churchill**<sup>1</sup>, George Cowles<sup>2</sup>, Robert Glenn<sup>3</sup>, Richard Wahle<sup>4</sup>, Tracy Pugh<sup>3</sup>, and Burton Shank<sup>5</sup>

<sup>1</sup>Woods Hole Oceanographic Institution; <sup>2</sup>University of Massachusetts Dartmouth; <sup>3</sup>Massachusetts Department of Marine Fisheries; <sup>4</sup>University of Maine; <sup>5</sup>NOAA National Marine Fisheries Center

*Determining the impacts of windfarm-associated noise pollution on stress in the American lobster (Homarus americanus)*

**Andria K. Salas**<sup>1</sup>, Julien Bonnel<sup>1</sup>, T. Aran Mooney<sup>1</sup>, N. David Bethoney<sup>2</sup>, and Michael Long<sup>2</sup>

<sup>1</sup>Woods Hole Oceanographic Institution; <sup>2</sup>Commercial Fisheries Research Foundation

*Exploring economic insecurity and wellbeing in Nova Scotia's lobster fishery*

**Tracy MacKeracher**<sup>1,2</sup>, Joshua Stoll<sup>1</sup>, and M. Aaron MacNeil<sup>2</sup>

<sup>1</sup>University of Maine; <sup>2</sup>Dalhousie University

*In hot water? Investigating how temperature, molting, and lobster stocks affect current and future risk of epizootic shell disease in American lobster*

**Melissa M. Rocker**<sup>1</sup>, Reyn M. Yoshioka<sup>1</sup>, Kirsten E. Johnston<sup>1</sup>, Nick R. Record<sup>1</sup>, Heather E. Glon<sup>2</sup>, Kathleen M. Reardon<sup>2</sup>, and Maya L. Groner<sup>1</sup>

<sup>1</sup>Bigelow Laboratory for Ocean Sciences; <sup>2</sup>Maine Department of Marine Resources

*Navigating the New Arctic Lobster Network: Rapid Arctic change and its implications for fishing communities of the wester North Atlantic*

**Chris Brehme**<sup>1</sup>, Christine Beitz<sup>1</sup>, Damian Brady<sup>1</sup>, Eric Chassignet<sup>2</sup>, Amanda Dickes<sup>3</sup>, Joaquim Goes<sup>4</sup>, Helga Gomes<sup>4</sup>, Katherine Mills<sup>2</sup>, Joshua Stoll<sup>1</sup>, Michael Stukel<sup>2</sup>, Marco Tedesco<sup>4</sup>, Kanae Tokunaga<sup>2</sup>, and Xiaobiao Xu<sup>2</sup>

<sup>1</sup>University of Maine; <sup>2</sup>Florida State University; <sup>3</sup>Gulf of Maine Research Institute; <sup>4</sup>Columbia University

*Overview of on-demand fishing progress in the U.S. Northwest Atlantic lobster fishery: A collaboration*

**Megan Amico**<sup>1</sup>, Eric Matzen<sup>2</sup>, Henry O. Milliken<sup>2</sup>, Heidi Henninger<sup>1</sup>, Brian A. Galvez<sup>2</sup>, Vincent Artigues<sup>1</sup>, Rob Martin<sup>1</sup>, and Marc Palombo<sup>1</sup>

<sup>1</sup>Integrated Statistics in support of NOAA Fisheries; <sup>2</sup>NOAA Fisheries, Northeast Fisheries Science Center

*StoryMap Collection: A fishery in a sea of change*

**Stephanie Murphy**<sup>1</sup>, Jennie Rheuban<sup>1</sup>, and Simonne Dodge<sup>2</sup>

<sup>1</sup>Woods Hole Oceanographic Institution Sea Grant; <sup>2</sup>University of Miami

*The CFRF Lobster-Jonah Crab Research Fleet: Addressing data needs through collaboration*

**Noelle Olsen**<sup>1</sup>, Linus Stoltz<sup>1</sup>, and David Bethoney<sup>1</sup>

<sup>1</sup>Commercial Fisheries Research Foundation



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- Dr. Conor McManus, Rhode Island Department of Environmental Management
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