



**NOAA
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NOAA SCIENCE ADVISORY BOARD REPORT ON THE REVIEW OF THE COOPERATIVE INSTITUTE FOR THE NORTH ATLANTIC REGION (CINAR)

PRESENTED TO THE NOAA SCIENCE ADVISORY BOARD

JULY 26, 2023

External review of the Cooperative Institute for the North Atlantic Region (CINAR)

Woods Hole Oceanographic Institution (lead), University of Maine, Gulf of Maine Research Institute, University of Massachusetts Dartmouth School for Marine Science & Technology, University of Rhode Island, Rutgers University, University of Maryland Center for Environmental Science, University of Maryland Eastern Shore



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**Submitted to the National Oceanic and Atmospheric Administration Science Advisory
Board**

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EXECUTIVE SUMMARY

The Cooperative Institute for the North Atlantic Region (CINAR) is a consortium of eight academic institutions formed to promote research, training, and outreach through collaborative research aligning with the National Oceanic and Atmospheric Administration (NOAA)'s mission.

A panel of independent experts was convened by NOAA to evaluate CINAR's performance. The Panel met at the Woods Hole Oceanographic Institution (WHOI) June 13-15, 2023, evaluating CINAR's performance relative to four topics: Science Planning, Science Review, Outreach, and Education/Workforce Development. The Panel was particularly interested in understanding how CINAR selects its research, how CINAR uniquely contributes to NOAA's mission, and how CINAR advances diversity, equity, and inclusion (DEI). This report reflects the panel's unanimous opinion about the strengths and opportunities that CINAR offers to NOAA.

Overall, the Panel is impressed and finds that CINAR provides great value supporting NOAA's mission and strategic priorities. CINAR produces high-quality scientific products beyond what NOAA can produce alone by leveraging additional grants from investigators and unique resources at member institutions. There is continuity between CINAR and NOAA beyond that of typical extramural grants. Close collaborations between CINAR researchers and NOAA staff ensure research stays relevant to NOAA program priorities. CINAR is also training the next generation of scientists through programs for students, postdocs, and early career scientists that help build strong understanding of how CINAR's research fits within NOAA's mission. Based on these findings, the Panel assigns an overall rating of "Outstanding" and provides three core recommendations, with additional secondary recommendations to further enhance CINAR's value embodied in the report:

- 1. Utilize untapped resources at member institutions by broadening participation and improving interactions between CINAR and NOAA.**

A small percentage of scientists from member institutions are participating in CINAR, leaving available resources and skillsets unused. The Panel encourages CINAR to expand collaborations and explore other opportunities to strengthen connections between all CINAR members and NOAA staff.

- 2. Expand research beyond short-term needs to be more proactive.**

Because CINAR has no unrestricted funds for research associated with its agreement, most projects focus on low-risk, short-term activities. A higher percentage of NOAA investment should be allocated for high-risk, high-reward multidisciplinary projects. CINAR can also be more proactive in seeking these opportunities.

- 3. Take advantage of opportunities to expand diversity outreach and integration.**

The Panel commends CINAR for its efforts to promote diversity in several programs, including its undergraduate internship program IN FISH. However, efforts can be

coordinated and expanded through opportunities such as enhancing diversity among principal investigators and better utilizing its minority-serving member institution.

INTRODUCTION

In 2019, the Cooperative Institute for the North Atlantic Region (CINAR) was established in response to a competitive selection process for a North Atlantic Regional Cooperative Institute to serve a critical function at the juncture of the interdependent global and regional observing systems in the North Atlantic Ocean and those of the Northeast U.S. Shelf Large Marine Ecosystem (NEUS LME). Cooperative institutes (CIs) are supported by an initial five-year agreement facilitated by funding from NOAA and is a long-term, collaborative partnership between NOAA and academic institutions. The consortium consists of eight academic institutions led by the Woods Hole Oceanographic Institution (WHOI) with the scientific expertise, facilities, and programs to support NOAA program priorities and strategic plans in the development of ecosystem-based approaches to research and management in the NEUS LME. The current CINAR expands on work of a previous CI under the same name that was established in 2009.

CINAR partner institutions

Woods Hole Oceanographic Institution
(lead)

Gulf of Maine Research Institute

Rutgers University

University of Maryland Center for
Environmental Science

University of Maryland Eastern Shore

University of Massachusetts Dartmouth –
School for Marine Science and Technology

University of Maine

University of Rhode Island

CINAR research activities are distributed across five thematic areas: 1) Sustained Ocean Observations and Climate, 2) Ecosystem Research, Observation, and Modeling, 3) Stock Assessment Research, 4) Protected Species Research and Recovery, and 5) Ecosystem-Based Fisheries Management. A sixth focal area on education and outreach was added to incorporate career training, education, and outreach efforts into CINAR activities. Through its research activities in these thematic areas, CINAR provides valuable research contributions, products, and tools that are relevant to NOAA's operations and priorities, specifically aligned to NOAA's mission to understand and predict changes in climate, weather, ocean, and coast, share knowledge and information with others, and conserve and manage coastal and marine ecosystems and resources.

A panel of independent experts was convened by NOAA to evaluate CINAR's performance after four years. The Panel met at the Woods Hole Oceanographic Institute (WHOI) June 13-15, 2023 and was charged with assessing CINAR's performance relative to four topics: Science Planning, Science Review, Outreach, and Education and Workforce Development. The Panel was particularly interested in understanding how CINAR solicits new ideas and involvement across the consortium, how CINAR uniquely contributes to NOAA's mission, and how CINAR advances diversity, equity, and inclusion (DEI) within marine science and the community served by its science. During the on-site review, the Panel attended presentations and seminars reviewing activities in these four topic areas.

This report reflects the panel’s unanimous opinion about the strengths and opportunities that CINAR offers to NOAA. Each chapter focuses on one of four topics of the review and includes strengths, weaknesses, and recommendations from the Panel. Appendices A and B contain a list of review panel members and the on-site agenda. Appendix C describes projects that the Panel identified as good examples illustrating CINAR’s value. Appendix D provides answers to the detailed charge questions that were asked of the Panel.

CHAPTER 1: SCIENCE PLANNING

CINAR research planning began with a proposal that was submitted and awarded by NOAA around five thematic research areas: 1) Sustained Ocean Observations and Climate, 2) Ecosystem Research, Observation, and Modeling, 3) Stock Assessment Research, 4) Protected Species Research and Recovery, and 5) Ecosystem-Based Fisheries Management. CINAR added a sixth focal area around education and outreach.

The Panel heard from representatives of multiple NOAA divisions during its review, including the Office of Oceanic and Atmospheric Research (OAR), National Marine Fisheries Service (NMFS), and National Ocean Service (NOS), which all shared a high degree of satisfaction with the direction of CINAR research. However, the Panel also heard from the presenters about the challenges that new faculty members and recently added consortium partner institutions face with forming connections with NOAA, suggesting that CINAR still has untapped opportunities to strengthen connections between NOAA agencies and partner institution staff.

Strengths

- Most CINAR member institutions have strong connections with OAR, NMFS, and NOS.
- Research projects are well-aligned with NOAA strategic priorities to “build a climate-ready nation” and “advance the new blue economy.”
- There are strong collaborations among CINAR institutions and NOAA, as well as the fishing industry and fisheries management.
- CINAR scientists are responsive and eager about the research.

Weaknesses

- CINAR leadership team is under-resourced, which limits the ability to plan and to lead proactively.
- Sustained observation work is not well connected with the ecosystems/fisheries work

Recommendations

Recommendation 1: Level-up the organization with regular meetings among Fellows and annual calls for workshops.

The Panel recommends the CINAR office to be more proactive in leadership and ask more from partners. The CINAR Council of Fellows, which consists of representatives from the eight

CINAR institutions, should meet on a regular basis to develop a high-level understanding of CINAR activities and create a vision for growth. CINAR has funded periodic workshops that have led to new projects – this can be formalized into an annual call to brainstorm and solicit project ideas.

Recommendation 2: Expand leadership capacity through increased Task 1 funding.

With only three part-time people in the CINAR office, there is limited bandwidth for leadership to take on new activities. The Panel recognizes that this will require new Task 1 and/or institutional returned indirect cost funding. NOAA agencies and CINAR partner institutions should be asked to think creatively about how they can free up funds to bolster CINAR activities. Partners could match indirect funds generated by CINAR or commit funding for student and postdoctoral fellowships, workshops, or activities to support emerging research areas. Collaboration and shared thinking are critical for strengthening the dedicated leadership and value of CINAR in the future.

Recommendation 3: Broaden connections between scientists and program managers.

CINAR works through collaborations between NOAA program managers and CINAR investigators. This creates a challenge for investigators who are new to CINAR and for new program managers. The CINAR office and the partner institution leads should play a more active role introducing new scientists to the structure of CIs and help them build stronger connections in NOAA. Similarly, the CINAR community and NOAA partners should make a more deliberate effort to familiarize NOAA program managers with CINAR and the value of working through CIs.

Recommendation 4: Better integrate sustained observations and fisheries in order to help build a “Climate Ready Nation.”

CINAR has tremendous strength in ocean observation and a community with deep knowledge of the physics of the North Atlantic. It also has a vigorous community of fisheries and ecosystem scientists. The Panel concluded after the research presentations that these two communities are not strongly linked. With the rapid pace of change in the northwest Atlantic, there is a critical need to understand and predict how physical changes impact the ecosystem. CINAR could contribute tremendous value to the nation by pioneering solutions to address the global challenge around management of living marine resources. To achieve this, CINAR should utilize expertise across all CINAR research themes, including education and outreach, to help build a “Climate Ready Nation.”

CHAPTER 2: SCIENCE REVIEW

CINAR investigators perform critical research across the five thematic areas that outline CINAR’s mission to provide a better understanding of the NEUS LME by advancing sustainable and beneficial management of its ecosystems and resources. The Panel heard from presenters about selected research projects and affirmed that CINAR research is high quality and relevant for adoption and use by NOAA. The Panel recognizes that the research can be better distributed

across CINAR’s thematic areas and the divisions of NOAA that participate in CINAR. Additionally, creating opportunities for CINAR partners to crosswalk the various areas of research would also benefit the program.

The Panel identified notable projects within CINAR programs that showcase the value of CINAR’s research, including the Argo float program, North Atlantic right whale management, ocean reference stations and sustained observations, fisheries in changing climate, and harmful algal bloom tracking and forecasting, which are highlighted in Appendix D.

Strengths

- The science supported by CINAR and presented during the review is high quality.
- CINAR science is relevant to NOAA’s mission and serves the nation well.
- CINAR science is innovative and generally adds expertise (as well as access to facilities and equipment) to NOAA’s portfolio.
- CINAR projects and researchers add capacity to NOAA’s expertise and allows for more to be accomplished.

Weaknesses

- There are few weaknesses associated with this topic. Any that were identified were covered in other topic areas. Recommendations are suggested in those appropriate chapters.
- Opportunities to build connections between research that encompass multiple themes (e.g., Ecosystem-based Fishery Management (EBFM) project data needs connect directly with knowledge and data from sustained ocean observation groups) are not fully developed and utilized.

Recommendations

Recommendation 1: Crosswalk research being done across member institutions.

The science being produced is unevenly distributed across the thematic areas and can benefit from crosswalking the research done across member institutions. This can perhaps be achieved through workshop coordination between the member institutions. It is important for all partner researchers to understand other research that is conducted across CINAR to prevent duplication of effort and capitalize on the strength of the multidisciplinary nature of CINAR.

CHAPTER 3: OUTREACH

CINAR’s outreach goals are to transition technology and knowledge to NOAA and diverse stakeholders. CINAR prioritizes engagement with NOAA researchers and managers and delivery of user-friendly data and products. The Panel heard from presenters about outreach programs including science and management workshops to improve the communication, trust, and collaborations between fishermen, CINAR scientists, and NOAA program managers.

Strengths

- Most CINAR research and associated products are clearly connected to NOAA, are being implemented and/or used by NOAA, and have a high societal value.
- Outreach programs such as the Marine Resource Education Program (MREP) integrate diverse stakeholders and end-users beyond NOAA.
- CINAR projects are innovative and emphasize open-source products and trainings that increase utility for a broad range of end-users.

Weaknesses

- There is variability in how research and associated products (i.e., raw data, synthesized data products, open-source code, training material, etc.) are hosted, shared, and accessed by end-users.
- When data are hosted on personal servers/pages, there is a risk of data loss if/when PIs leave CINAR.
- Outreach is largely PI-driven and is not systematic throughout CINAR.

Recommendations

Recommendation 1: Consider creation of a central location/hub for end users to easily locate and access CINAR data and products.

CINAR should explore the consolidation of data and products through a central portal that is user-friendly, regularly updated, and maintained long-term by the CI. Projects that have an existing data hub can be linked to the central location.

Recommendation 2: Coordinate with CINAR researchers and NOAA partners to make the data products/tools produced by CINAR more accessible to the public, and enhance NOAA's open-source tools community.

Recommendation 3: Utilize other NOAA outreach programs (e.g., Sea Grant, NERACOOS) to further CINAR outreach opportunities and reach.

Recommendation 4: Develop evergreen outreach tools such as informational videos to help train potential PIs within CINAR and the broader community about programs and opportunities at CINAR.

CHAPTER 4: EDUCATION AND WORKFORCE DEVELOPMENT

CIs help connect NOAA to universities and research institutes that are well-positioned to provide a strong pipeline of talented and diverse scientists from which it can recruit. This focus on educational and workforce development is recognized in an objective of the 2021-2040 NOAA Education Strategic Plan to engage youth and adults, particularly from underserved groups, with NOAA-related sciences through education and outreach opportunities. During the review, the Panel heard from panelists about CINAR's programs to train this workforce at the undergraduate, graduate, and postdoctoral levels, and support from NOAA helps expand this training through funding for educational programs and research.

Strengths

- CINAR developed multiple, high-quality training programs to support undergraduates (IN FISH), postdoctoral researchers (CINAR-SMAST fellowships), and early-career marine scientists (QUEST).
- Training programs emphasize DEI and use best practices for recruitment and retention.

Weaknesses

- DEI tracking and promotion is largely absent across CINAR programs, making it difficult to determine impact on NOAA and partner institutions' DEI goals.
- Achievement of education and workforce development goals is uneven across CINAR thematic areas and institutions. That is because CINAR research support for faculty is unevenly spread across individuals and institutions, which disproportionately benefits senior researchers with well-established programs and long-standing relationships with NOAA sponsors and programs.
- There is a significant gap in support for graduate students across CINAR thematic areas.

Recommendations

Recommendation 1: Improve coordination and integration across CINAR educational programs.

CINAR's existing education programs, while strong, are operated independently with little evidence of coordination. Better coordination among the programs could encourage sharing of best practices for DEI and enhance retention of program participants within marine science by providing stepping stones from one educational program to the next. The review panel notes the opportunity to enhance DEI through better coordination with the Living Marine Resources Cooperative Science Center at CINAR partner institution, University of Maryland Eastern Shore (UMES).

Recommendation 2: Enhance support for graduate education.

While there are education and training programs for earlier (i.e., undergraduate) and later (i.e., postdoc and early-career faculty) education stages, there are no comparable programs for graduate education across all CINAR thematic areas. CINAR provides uncoordinated ad hoc funding for graduate students since this funding can only come through research projects, and even this support is rare for Theme 1 due to the need to devote scarce resources to continual and significant instrument acquisition needs.

The Panel recognizes that current unrestricted Task 1 funds are insufficient, but highly encourages CINAR and NOAA to work together to fill the gap in graduate education through a dedicated graduate fellowship program or increased funding to research projects to hire graduate students. CINAR may also consider establishing a minimum salary policy for graduate student support to help ensure that salary is not a barrier for recruiting students from economically disadvantaged backgrounds.

Recommendation 3: Expand efforts to engage new PIs, especially those from underrepresented backgrounds in marine sciences.

Given the lack of unrestricted funds, the CINAR funding model relies on existing connections between university researchers and NOAA program managers. This could entrench historical inequality as younger and more diverse faculty cohorts are less likely to have had opportunities to build longstanding relationships with NOAA. CINAR can proactively prioritize DEI goals in supporting PIs. CINAR can also host a symposium focused on building connections between early-career scientists at CINAR partner institutions and NOAA program managers.

Recommendation 4: Strengthen connections with UMES within CINAR and with NOAA.

CINAR is unique among CIs in that one of its recently added partner institutions, University of Maryland Eastern Shore (UMES), is a historically black college and university (HBCU). This gives CINAR tremendous potential and responsibility to elevate scientists of diverse backgrounds at all career stages. UMES currently only receives a small amount of funding from CINAR, mostly through education programs as well as a CINAR QUEST fellowship for early career faculty. Strengthening connections and expanding research partnerships with UMES within CINAR and with NOAA should be a high priority. CINAR investigators should be encouraged and ideally incentivized to develop collaborations with investigators at UMES. Similarly, CINAR and NOAA leadership should ensure that UMES administration understands the value of being in a CI and encourage UMES to consider new faculty hires with specialties that are needed within CINAR. QUEST funding managed by CINAR could be an effective avenue to build capacity within UMES.

APPENDIX A. REVIEW PANEL MEMBERS

Dr. Stephen Weisberg (Chair), Executive Director, Southern California Coastal Water Research Project Authority

Steve is Executive Director of the Southern California Coastal Water Research Project Authority, with his research focus developing molecular tools to support environmental monitoring. He serves on the Governing Board and scientific advisory committees for several other organizations involved with development and adoption of new technologies.

Dr. Olaf Jensen, Associate Professor, University of Wisconsin-Madison

Olaf is an Associate Professor at the University of Wisconsin-Madison. His research on global fisheries sustainability has used stock assessment data to examine the relative effectiveness of different management approaches, the rebuilding time of overfished stocks, the effectiveness of marine reserves, and the impacts of climate change on marine fish and invertebrate stocks.

Dr. Karin Limburg, Distinguished Professor, State University of New York College of Environmental Science and Forestry

Karin is a Distinguished Professor at the State University of New York College of Environmental Science and Forestry. Her research has explored different fields, from watershed science to fisheries science, ecosystem ecology to ecological economics. Her current focus is on the impact of climate-driven ocean deoxygenation on fish and fish communities, as well as impacts of dams on ecological connectivity.

Dr. Andrew Pershing, Vice President for Science, Climate Central, Inc.

Andrew is the Vice President for Science at Climate Central and leads their climate science and climate change attribution work. He has led interdisciplinary research teams to study the impact of global warming on marine ecosystems in the northwest Atlantic. More recently, his work has focused on how climate trends interact with decisions that people make and on developing tools to rapidly assess the role of climate change in extreme events in the air and ocean.

Dr. Jason McNamee, Adjunct Associate Professor, University of Rhode Island

Jason is an Adjunct Professor at the University of Rhode Island and leads the Bureau of Natural Resources at the Rhode Island Department of Environmental Management. He has participated in stock assessment processes for a myriad of different species relevant to east coast fisheries. Additionally, he serves as the lead delegate for the state of Rhode Island on the Atlantic States Marine Fisheries Commission as well as having a long tenure on the New England Fishery Management Council's Scientific and Statistical Committee.

Dr. Kara Dodge, Research Scientist, New England Aquarium

Kara is a Research Scientist at the Anderson Cabot Center for Ocean Life, the research arm of the New England Aquarium. Her research focuses on management-driven needs for baseline data on threatened and endangered sea turtles to support their conservation and recovery efforts.

Dr. Francis Chan

Francis is an Associate Professor in the Department of Integrative Biology at Oregon State University and is the director of the Cooperative Institute for Marine Ecosystem and Resources Studies. His research is directed at understanding climate change impacts on coastal ecosystems.

APPENDIX B. REVIEW AGENDA



CINAR Science Review – Agenda

Day 1: Tuesday, June 13, 2023

Location: Virtual and in-person (WHOI, Clark 271)

Join Zoom Meeting

<https://whoi-edu.zoom.us/j/98250134608?pwd=bHlrWnpWZUtOU3JyTUNpdDErR2Vjdz09>

Meeting ID: 982 5013 4608

Passcode: CINAR-Sc23Passcode: CINAR-Sc23

Time	Agenda Item	Presenters
8:00	Continental breakfast in meeting rooms Review panel only (Clark 237) Other Participants (Clark 271)	
8:15	Closed session – review panel only (Clark 237)	
9:00	Welcome	Rick Murray, WHOI Deputy Director and Vice President for Research
9:15	Remarks from NOAA DAA <i>(Report out from Administrative review)</i>	Dr. Gary Matlock, NOAA CIAO
10:15	Break	
10:30	Overview of CINAR <i>30 min talk; 30 min for questions/discussion</i>	Don Anderson, CINAR Director

Time	Agenda Item	Presenters
11:30	CINAR Science Planning & Review CI & NOAA Perspectives <i>30 min for presentations; 30 min for panel questions and discussion</i> <i>Moderator: Don Anderson, WHOI</i>	Jon Hare, NOAA NEFSC David Legler, NOAA OAR David Kidwell, NOAA NOS
12:30	Lunch Closed session: Review panel only, Clark 237 (Box lunch) Other Participants, Clark 271 (Box lunch)	
1:30	Panel discussion with Partner Institution PIs <i>60 min discussion</i> <i>Moderator: Steve Weisberg, SCCWRP</i>	Partner Institution PIs
2:30	Theme IV Overview: Protected Species Research & Recovery <i>20 min talk; 10 min for questions</i>	Mark Baumgartner, WHOI Hauke Kite-Powell, WHOI
3:00	Theme IV Project Presentation: Health Assessment of North Atlantic right Whales (NARW): An Annual Survey in Cape Cod Bay since 2016 <i>12 min talk; 3 min for questions</i>	Michael Moore, WHOI
3:15	Break	
3:30	Theme III Overview: Stock Assessment Research <i>20 min talk; 10 min for questions</i>	Lisa Kerr, UMaine Graham Sherwood, GMRI
4:00	Theme III Project Presentation: Marine Resource Education Program <i>12 min talk; 3 min for questions</i>	Lauren O'Brien, GMRI Jonathan Labaree, GMRI
4:15	Panel deliberations	Closed session

Time	Agenda Item	Presenters
5:15	Adjourn	
6:30	Group Dinner CINAR PIs and Panel	

CINAR Science Review – Agenda

Day 2: Wednesday, June 14, 2023

Location: Virtual and in-person (WHOI, Clark 271)

Join Zoom Meeting

<https://whoi-edu.zoom.us/j/98250134608?pwd=bHlrWnpWZUtOU3JyTUNpdDErR2Vjdz09>

Meeting ID: 982 5013 4608

Passcode: CINAR-Sc23

Time	Agenda Item	Presenters
8:00	Continental breakfast in meeting rooms Review panel only (Clark 237) Other Participants (Clark 271)	
8:15	Closed session – review panel only (Clark 237)	
9:00	Theme I Overview: Sustained Ocean Observations and Climate Research <i>20 min talk; 10 min for questions</i>	Bob Weller & Al Plueddemann, WHOI
9:30	Theme I Project Presentation: Argo at CINAR <i>12 min talk; 3 min for questions</i>	Susan Wijfells, WHOI
9:45	Break	
10:00	Theme II Overview: Ecosystem Research, Observation, and Modeling <i>20 min talk; 10 min for questions</i>	Kathy Mills, GMRI Steve Lohrenz, UMass Dartmouth SMAST
10:30	Theme II Project Presentation: Spawning Dynamics of Cod in Southern New England Wind Energy Areas <i>12 min talk; 3 min for questions</i>	Steve Cadrin, UMass Dartmouth SMAST
10:45	WHOI Tour	
12:00	Lunch Closed session, Review panel only, Clark 237 (Box lunch) Other Participants, Clark 271 (Box lunch)	
1:00	Theme V Overview: Ecosystem Based Fisheries Management <i>20 min talk; 10 min for questions</i>	Joshua Stoll, UMaine Jeremy Collie, URI Gavin Fay, UMass Dartmouth SMAST

Time	Agenda Item	Presenters
1:30	Overview of CINAR Education, Training, and Workforce Development <i>10-15 min overview</i>	Don Anderson, Mindy Richlen, WHOI
1:45	Quest Fellow Presentation <i>7 min talk; 3 min for questions</i>	Genny Nesslage, UMCES
1:55	Quest Fellow Presentation <i>7 min talk; 3 min for questions</i>	John Weidenmann, Rutgers
2:05	Break	
2:20	Student/Postdoc Presentations <i>~5 min lightning talks; 15 min for questions</i>	Cole Carrano (UMassD) Jessie Kittel (UMassD) Lucy McGinnis (UMassD) Angelia Miller (UMassD) Samara Nehemiah (UMCES) Sarah Salois (UMassD) Valerie Watson (UMaine)
3:30	Inclusive NOAA Fisheries Internship Program (IN FISH)	George Liles, NOAA NEFSC
3:45	IN FISH Undergraduate Student Presentations & Mentor Perspectives <i>~5-7 min lightning talks</i>	Camille Cube (UMES intern) Lael Collins (UMCES intern) Mike Wilberg, mentor, UMCES Cori Kane, mentor, GARFO
4:15	Discussion with students	Students and Science Review Panel
5:00	Panel deliberations	Science Panel
5:30	Adjourn	
6:30	Dinner Science Panel only	

CINAR Science Review – Agenda

Day 3: Thursday, June 15, 2023

Location: Virtual and in-person (WHOI, Clark 271)

Join Zoom Meeting

<https://whoi-edu.zoom.us/j/98250134608?pwd=bHlrWnpWZUtOU3JyTUNpdDErR2Vjdz09>

Meeting ID: 982 5013 4608

Passcode: CINAR-Sc23

Time	Agenda Item	Presenters
8:00	Continental breakfast in meeting room, Clark 271	
8:15	Science Review panel executive session	Science Review Panel
10:00	Initial report back to CINAR <i>Preliminary findings and tentative recommendations</i>	Science Review panel
12:00	Adjourn	

APPENDIX C. EXAMPLE CINAR PROJECTS

North Atlantic Right Whale Management

North Atlantic right whales have been listed under the Endangered Species Act since it became law in 1973 and are a major focus at NOAA. The number of whales has declined precipitously over the last decade from 482 in 2010 to 340 in 2021, losing a staggering 26 whales per year on average to mostly human-caused mortality. NOAA includes right whales in their “Species in the Spotlight” campaign designed to focus resources on the most critically endangered species. Continued trauma, especially from vessel collision and rope entanglement, will mean extinction of the species in the next few decades unless much more aggressive measures are enacted and enforced.

CINAR has significant expertise to document the impacts of human-caused trauma, including the ability to recover, dissect and diagnose dead right whales and other marine mammals, and aggregate and rapidly deploy the necessary resources to do so. CINAR also has capabilities to conduct long-term assessment of living animals, including growth and physical and microbiome condition. This expertise has been applied to the critical task of documenting the decline of North Atlantic right whales for all stakeholders, including determining causes of death, bringing awareness of animal suffering, and connecting sub-lethal harm to declining reproduction. Without this foundational work, NOAA would be embroiled in endless debate about what is causing the right whale population to crash, and would be unable to make the case for more effective but economically costly measures to recover the species.

CINAR institutions include some of the best ocean engineering talent in the world, an area of expertise that is difficult for NOAA to attract and retain. CINAR PIs have leveraged this engineering excellence for a wide variety of applications associated with North Atlantic right whale research and conservation, including tag development, tag attachment mechanisms, drug delivery via remote injection, and instrument and software development for passive acoustic monitoring. The latter efforts have enabled CINAR to develop and deploy a network of buoys and gliders along the U.S. and Canadian east coast to conduct near real-time passive acoustic monitoring for North Atlantic right whales. Data from these autonomous platforms, including whale detections, recorded audio and environmental measurements, are shared with NOAA for archiving and wide use by students and NOAA scientists. Right whale acoustic detections determined in near-real time are also immediately shared with NOAA in support of the Slow Zones for Right Whales Program designed to alert mariners to the presence of right whales and advise them to slow to help avoid vessel collisions. NOAA colleagues rely on CINAR to provide the technology and operations to deliver these data so that they do not need to build this capacity.

Finally, CINAR PIs are working closely with NOAA partners to address fishing gear entanglements through the development of on-demand (aka ropeless) fishing methods, which have the promise to allow fishermen and right whales to coexist. The continued decline of right whales will be devastating for the lobster and crab industry, and the burgeoning political fight over fishery closures will put the Endangered Species Act itself in jeopardy. Finding a way to mitigate fishing gear entanglements through technological innovation has the potential to save right whales, the fishing industry, and a landmark piece of U.S. legislation.

Harmful algal blooms

Several projects on harmful algal blooms (HABs) are funded through CINAR, with significant benefits accruing to society and to NOAA. One project funds the US National Office for Harmful Algal Blooms that serves as a coordination and communications entity for the national HAB research and management program. There are multiple activities that the National HAB Office undertakes that could not be performed by NOAA, such as its administration of the Event Response Program that can provide immediate funding support for unexpected or unusual HAB events that need to be characterized and managed without delay. An example of the need for this type of rapid response is occurring at this writing in the Alaskan Arctic. As a result of the detection and real-time monitoring of a massive toxic HAB in the Bering Strait region last year (supported in part through separate CINAR HAB funding from OAR's GOMO (Global Ocean Monitoring and Observing) program), stakeholders in the region contacted NOAA asking for HAB early warning support in 2023, given their concern about the significant health risks to indigenous communities depended upon subsistence harvesting of many resources that can accumulate HAB toxins. Within a few weeks of the request, funds from the NOAA NCCOS program were made available through the Event Response Program to place an autonomous biosensor called the IFCB on the RV Sikuliaq for all of its cruise operations in the Bering Sea, Bering Strait, Chukchi Sea, and Beaufort Sea regions throughout the summer, 2023. These funds support the travel of a technician to maintain the instrument between cruises, as well as to monitor the instrument's output on a daily basis, leading to weekly (or more frequent) advisories to public health entities in the region.

The National Office also can be a voice for the academic HAB community, responding to requests from Congress for guidance and opinions that differ from or are independent of those from NOAA. For example, National Office Director Don Anderson has responded to requests from Congress for nine hearings and multiple briefings on HAB issues.

As mentioned above, the OAR GOMO program is supporting HAB research in the Alaskan Arctic through CINAR, motivated by rapidly increasing temperatures that are supporting the northward expansion of *Alexandrium catenella*, the causative organism for the human poisoning syndrome called paralytic shellfish poisoning (PSP). This project uses sophisticated biosensors like the IFCB as well as more routine sampling methods for detection and characterization of toxic HAB species on ships of opportunity working in the region. In 2022, one of these cruises documented the largest bloom of *A. catenella* ever recorded globally, leading to the issuance of multiple public health advisories during the cruise, preventing a potential public health disaster from the unexpected and massive outbreak. The development, testing, and purchase of the IFCB were all supported by funds from other federal agencies, with NOAA benefitting at an operational level at a very low cost.

Argo

As the dominant subsurface ocean observing system, Argo has revolutionized ocean and climate sciences by providing nearly-global real-time temperature and salinity observations over the upper 2000m. Presently NOAA does not have the expertise nor capability to operate the US Argo program, which comprises 50% of the global array. Through CINAR (and the US Argo consortium), NOAA has access to the deep expertise in float platforms and sensors that resides in our technical engineering and data expert teams. This allows us to test, prepare and operate floats efficiently, getting higher platform reliability and lifetimes that most other global programs, and thus making the US effort one of the most cost-effective. In addition, via CINAR, the NOAA Argo programs has access to our testing facilities, which includes a tall 10m tank in Clark South (for surface attitude and firmware functionality tests) and 2 high-pressure vessels for ballasting and high -pressure buoyancy system/sensor testing. In addition, our close collaborative relationships with our platform and sensor suppliers are critical, supporting an ecosystem of small ocean-tech companies, enabling the ongoing development, assessment and verification of technical advances that we can slowly introduce into the global array.

Managing Argo data requires in-depth expertise on both sensor/platform technologies but also the oceanography of the regions being monitored. The CINAR Argo effort is expert on the Atlantic Ocean, which presents particular challenges due to its strong and deep ocean variability. This expertise comes through CINAR's long history and focus on the Atlantic region.

Argo data underpins many of NOAA's operational forecasts including seasonal to sub-seasonal climate forecasts, and ocean state predictions. For instance, Argo data are prevalent inputs into the present forecasting assessments of the likely El Nino developing. In addition, Argo data dominate those used to track global ocean warming and its role in the Earth's energy budget and the global sea level budget, such as is published in assessments such as those of the Intergovernmental Panel on Climate Change or the NOAA supported 'State of the Climate' volume of the Bulletin of the American Meteorological Society. As NOAA works towards developing coupled numerical weather forecasting capabilities, Argo data will be a key enabler of that advance.

Argo data is also enabling and supporting a large amount of NOAA's ocean research, with over \$240M of project funding using Argo data in 5 years. Over one research paper a day is published utilizing Argo data directly, with more using Argo-dominated gridded products. This research is enabled by the easy availability of the Argo data set, its known high quality and high level of documentation, and tools provided for new users.

Ocean reference stations and sustained observations

The sustained deployment of surface moorings at trade wind sites provide Ocean Reference Stations (ORS) that are unique in NOAA's global ocean observing portfolio. First, the surface moorings carry redundant, reliable instrumentation (for surface meteorology, air-sea fluxes, and ocean temperature, salinity, velocity) that is world class in its accuracy and data return rate. Second, the ORS do not send real time observations to modelling centers and other users for ingestion and assimilation but instead withhold observations so that they serve as unique reference time series for assessing the realism of models and ocean surface products from satellites.

The ocean and atmosphere both are driven by the thermal gradients between the equator and the poles; the oceans, with their ability to store, transport, and release heat and moisture to the atmosphere, play an important role in weather and climate. Air that is heated rises at the equator and descends in the subtropics, resulting in broad regions of winds flowing from the east to the equator. Around the globe these easterly trade wind regions cover roughly 50% of the ocean surface. These regions are where there is net ocean heating and large evaporation providing energy and moisture to drive the atmosphere over a range of scales, from the general Hadley circulation down to intense hurricanes. They are also where the ocean provides CO₂ to the atmosphere in contrast to the higher latitudes where the ocean gains CO₂ from the atmosphere. Integrated across the expanse of the trade wind regions, errors and uncertainties in how models simulate the air-sea exchange of heat, freshwater, momentum, and compounds such as CO₂, challenge our ability to understand the way in which the atmosphere and ocean interact and compromise the realism of that interaction in models used to predict weather and climate.

NOAA relies on models to address societal needs and fulfill its missions. The high-quality, withheld ORS observations are unique, independent means to assess the realism of how NOAA models simulate the coupling of the ocean and atmosphere and motivate and guide improvement to the models. Recent analyses using the ORS time series have shown that NOAA's NCEP2 reanalysis significantly underestimates the heat going into the ocean in the trade wind regions and that the current coupled climate models have the same shortcoming. At times, NCEP2 had the sign of the air-sea heat flux incorrect, indicating the ocean heated the atmosphere. These analyses also showed unrealistic, low-passed temporal variability in NCEP2 net air-sea heat flux. Another CINAR project, the OA (Ocean Atmosphere) Flux project uses the ORS data to anchor and validate a gridded surface flux project with much greater fidelity than current models.

The ORS project works to facilitate interactions centered on improving models. It produces merged, long time series of ORS observations as requested by modelers and provides a delayed mode archive of telemetered surface meteorology for exchange with modeling centers in return for our access to operational model information at grid points near the ORS. ORS expertise is also shared with NOAA investigators at PMEL (Seattle) and PSL (Boulder).

Fisheries in a changing climate

The Northeast U.S. Shelf Large Marine Ecosystem (NEUS LME) is a biologically diverse and highly productive region that supports rich fisheries that for centuries have shaped the culture and economies of the region. However, the LME is currently undergoing environmental changes to a degree not experienced by most other US coastal regions. Of the diverse impacts to the LME, none have the potential to shape the composition and productivity of the ecosystem more than climate change.

In this regard, CINAR undertakes many interdisciplinary approaches to stock assessment and management, integrating across climate, ecosystem, and human dimensions to support science-based decision making. Many activities are not possible for NOAA because of a lack of expertise or infrastructure, or the need for independent opinions and assessments from scientists not involved in regulatory activities.

For example, multiple projects support NOAA's research track stock assessment process. CINAR scientists provide assessment and population dynamics expertise and a transdisciplinary approach that integrates across climate, ecosystem, and fisheries science. Collaborations with NEFSC scientists are leading to the development of flexible stock assessment models that can integrate climate information and acknowledge the impact of non-stationarity in the system on fishery resources. CINAR scientists provide alternative perspectives and complementary skills that contribute to inclusive approaches to identifying the best scientific information on which to base assessments.

CINAR projects support the application of management strategy evaluation to explore the performance of alternative management strategies (e.g. harvest control rules) that are resilient to projected climate change. CINAR scientists provide specialized skill sets in complex simulation modeling that complement those of NEFSC scientists.

CINAR has the capacity, skill sets, and infrastructure to mentor and train students and junior career professionals in fisheries and climate science in a way that NOAA cannot. This enables regional capacity building and provides hands-on professional development, with CINAR students and post-docs making significant contributions to NOAA stock assessment processes, with many being subsequently hired by NOAA.

Through open conversations in a welcoming environment outside of the regulatory process, CINAR's Marine Resource Education Program (MREP) provides guidance by fishermen for fishermen, in close collaboration with the respective regional fishery management councils and NOAA scientists and managers. MREP brings relationships and connections to coastal communities that NOAA does not have (and cannot have because of its role as a regulator).

Together with partners at NOAA, CINAR is developing capacities to support climate-informed EBFM that includes human dimensions. Complementary expertise from CINAR and NOAA scientists is producing downscaled projections for temperature, circulation, and biogeochemistry. Other projects are using NEFSC's trawl survey database to project future changes in the distribution of fish and invertebrates and identify the implications for coastal communities.

CINAR scientists are also collaborating with the NEFSC to strengthen the agency's capacity to engage in socioeconomic research that furthers our understanding of the impacts that regulators have on marine resource users.

APPENDIX D. RESPONSES TO THE DETAILED CHARGE QUESTIONS

Science Planning Charge Questions

1. Are the research programs and projects selected in a manner that is effective?

Yes. CINAR projects originate as a collaboration between a NOAA program manager and a CINAR investigator. This means that the projects are directly relevant to national priorities.

2. To what extent do CINAR programs and projects support the NOAA Strategic Plan?

Yes. CINAR projects are highly relevant to NOAA's Strategic Plan. With its focus on ocean climate and fisheries, CINAR is making fundamental contributions toward the goal of creating a "Climate Ready Nation" and promoting an economic and environmental stewardship while advancing a "New Blue Economy." In fact, CINAR is uniquely positioned to draw linkages between these goals through projects like the Northeast Climate Integrated Modeling initiative.

3. Does the research adhere to CINAR research themes?

Yes. The CINAR office organizes projects into the five theme areas, ensuring that projects adhere to the broad goals articulated in the original proposal.

4. Are social science questions or topics being appropriately considered?

Partially. CINAR has strong social science capacity that has been tapped for several projects. However, NOAA did not prioritize social science in the RFP, and there is considerable untapped potential. There are many social science questions across CINAR's five themes. Developing projects in these spaces would strengthen societal decision making.

5. Is there adequate flexibility within the research process to adapt to new or unexpected findings?

Yes. CINAR is highly nimble and able to respond quickly to sudden events and opportunities. However, the limitations of Task 1 or other discretionary funding make it hard for the CINAR community to organize around emerging areas such as offshore wind.

6. Are there ways that NOAA could improve interactions and communications with CINAR investigators during science planning and research?

Yes. CINAR requires a close collaboration between investigators and NOAA program managers. Both NOAA and CINAR would benefit from more deliberate efforts to broker connections between these groups. Both would also benefit from drawing on CINAR expertise during regional research planning at NOAA.

Science Review Charge Questions

1. What is the quality of the research conducted by the CI under each of the five research themes?

The quality of research being conducted by the CINAR partners is excellent.

2. How innovative is the research being conducted?

The research being conducted by the CINAR partners is both innovative and is also relevant to NOAA's mission.

3. Are there ways that NOAA could assist the CI with start-ups, new ideas, innovation?

Yes. The recommendations for this are captured across the other topic areas so will not be repeated here.

4. Does NOAA work with the CI to provide clear criteria for measuring progress in accomplishing their goals?

There seemed to be a lack of metric tracking beyond high level tabulation of the number of projects and money administered. It is also not clear whose goals are being referenced by this question (NOAAs or CINARs). It would be helpful for more focus to be put on this so that this type of information could be conveyed to future reviewers to help with their assessment of progress towards goals, but as things stand for this review committee, this question is difficult to answer with specificity.

Outreach Charge Questions

1. Is the CI producing research products that are being adopted by NOAA and its partners for its operations?

Yes, CINAR research products are generally well-integrated into NOAA's operations.

2. Does NOAA work with the CI and its investigators to ensure/encourage adoption of the products produced by CI investigators?

The CI PIs work closely with their NOAA sponsors to ensure their research aligns with NOAA's needs and can be easily used/operationalized by NOAA end-users. These working relationships typically exist directly between the PI and the NOAA sponsor, without involvement of the CI director, administrator, and support staff.

3. Are the CI products and supporting data visible, accessible and independently understandable to users?

Some of the CI products and supporting data are visible, accessible, and independently understandable – good examples of this include Robots4Whales, WHOI HABhub, and the Argo Float Program. However, this is not standard across all CI projects and there is room for improvement in data visibility, access and interpretation by users.

Education and Workforce Development Charge Questions

1. Are the educational activities/opportunities (K-12, undergraduate and graduate students) offered by the CI appropriate and effective?

Yes, there are multiple CINAR programs that engage students at a range of career stages.

2. Does the CI effectively integrate with minority serving institutions (whether CI partners or not) and NOAA Cooperative Service Centers?

Not as much as it could. In particular, the review panel noted opportunities to expand collaboration with UMES and their Living Marine Resources Cooperative Science Center.

3. Is the demographic structure of the CI appropriate to enhancing diversity in the workforce?

The review panel could not properly evaluate this as CINAR does not keep track of diversity. However, the extreme concentration of CINAR funding among a small number of PIs and institutions suggests that there are significant opportunities for enhancing diversity.

4. Are there ways that NOAA and the CI could better work together in strengthening educational programs and NOAA workforce development?

Definitely. In particular, development of a cooperative program focused on DEI in graduate education in the marine sciences seems like an important gap that would benefit CINAR institutions and NOAA's recruiting efforts.