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MAINE EPSCoR
Experimental Program to Stimulate Competitive Research at the University of Maine

Maine EPSCoR's Sustainable Ecological Aquaculture Network (SEANET)

NSF EPSCoR RII Track 1 Strategic Plan for 2014-2019

Maine EPSCoR
NSF EPSCoR RII Track 1

The Nexus of Coastal Social-Environmental Systems and Sustainable Ecological Aquaculture (SEANET)

(EPS-1355457)

Strategic Plan for 2014-2019

Maine EPSCoR RII Management Team:

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EXECUTIVE SUMMARY

Maine EPSCoR Background

The Maine Innovation Economy Advisory Board (MIEAB) serves as the Maine EPSCoR state committee and is responsible for oversight and coordination of the state's EPSCoR portfolio to ensure synergy with the Maine 2010 Science & Technology Action Plan. The Chair of the MIEAB and the Executive Director of the Maine Office of Innovation play key roles in working directly with Maine EPSCoR in project oversight.

Maine EPSCoR at the University of Maine (UMaine) was formally established under a Memorandum of Understanding with the Maine Office of Innovation, and is responsible for the implementation, administration, and evaluation of funded NSF EPSCoR projects. The Maine EPSCoR Director is responsible for day-to-day program oversight and administration, and works in tandem with the SEANET Research Project Director. Both report to the NSF EPSCoR RII Project Director (the UMaine Vice President for Research).

This NSF EPSCoR RII award to Maine EPSCoR at the UMaine also includes the participation of 7 other institutions of higher education in Maine in research, education, and workforce development: University of New England (UNE), University of Maine Machias (UMM), University of Southern Maine (USM), Bowdoin College, Maine Maritime Academy (MMA), and Saint Joseph's College. Colleges in Maine's Community College System also participate in workforce development activities, including Southern Maine Community College (SMCC).

Maine's Sustainable Ecological Aquaculture Network

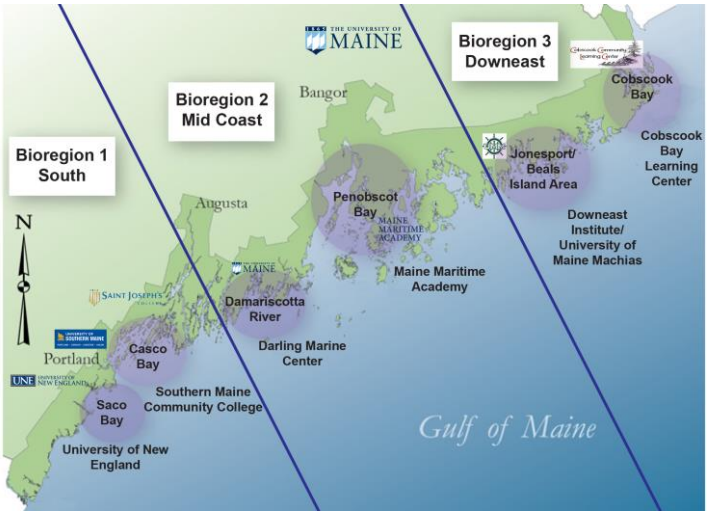
In August 2014, Maine EPSCoR received an NSF EPSCoR Track 1 RII award for its "Sustainable Ecological Aquaculture Network (SEANET)" project (EPS-1355457, FY2014-2019).

Maine's coastal communities and ecosystems face challenges that threaten long-standing economic and cultural traditions: socio-economic shifts, climate change, and declining capture fisheries. Yet, with less than 2% of human food coming from the ocean, and with a projected global population in excess of 9 billion by 2050, coastal communities also have opportunities to address the grand challenges of informing human sustainability and optimizing the use of vital coastal resources. Maine EPSCoR will mobilize the collective capacity of Maine's marine science resources to establish SEANET: a research network in Sustainable Ecological Aquaculture (SEA). SEANET will take a multi-institutional, transdisciplinary research approach to gain a comprehensive understanding of how social-ecological systems (SES) interact with SEA in coastal communities and ecosystems. Researchers will investigate interactions across diverse temporal and spatial scales of Maine's 3,500 mile coastline that comprise a unique, internationally important, living laboratory. SEANET combines research strengths in natural, physical, engineering, and social sciences, and will improve knowledge to action linkages through stakeholder engagement in transdiscipinary research. The multi-institutional, team-based research approach is aligned with priorities outlined in Maine's S&T Action Plan. SEANET advances sustainability science through key approaches: A) building transdisciplinary

collaborative expertise; B) integrating stakeholder participation across all phases of research; and C) conducting research organized around five themes: (1) bio-regional cross-cutting; (2) human dimensions and knowledge systems; (3) coastal SES carrying capacity; (4) changing environment; and (5) SEA innovation for social and ecological gain. SEANET links 20+ disciplines, institutes of higher education (IHE), and stakeholders across Maine, and national and international partners.

By advancing understanding of SES interactions at local and regional scales, SEANET contributes to knowledge about marine ecosystem and social science processes at many biophysical, biogeochemical, socio-economic, and policy levels. SEANET uses a novel bio-regional approach as Maine provides an ideal living laboratory to study place-based interactions that inform local to global decision-making, enabling Maine to serve as a scientific leader and innovator. Sustainability metrics for SEA will be defined and evaluated. SEANET will use novel sensors to expand the understanding of inshore ecosystems, and will couple this knowledge with social science. Important advances in detrital ecology and the modeling of coastal primary and secondary productivity will be made. Innovations in the dissemination of coupled biophysical and social data will be developed in a novel GIS application. The impact of environmental change on the health of native organisms and the resilience of invasive species to change in select Maine coastal zones will be studied. The current state of the art in design and construction of aquaculture infrastructure will be investigated and modes of improvement studied. The local knowledge gained will be utilized in developing innovative products and techniques for the future development of SEA to benefit Maine's aquaculture industry.

SEANET will advance discovery and understanding by promoting teaching, training, and learning through new opportunities for graduate and undergraduate programs, and via the creation of a statewide collaborative SEA network of faculty, postdocs, graduate, and undergraduate students. This project will enhance and diversify human and institutional resources to advance innovation and competitiveness in marine resources in the state, focusing particularly on the participation of underrepresented groups, institutions, and geographies. Maine will become a global SEA R&D center that thrives long after the ESPCoR funding ends. The project will enhance Maine's infrastructure for research and education by creating innovative regional, national, and international partnerships and collaborations among IHEs, non-governmental organizations (NGO), industry, and communities to address the complex issues at the nexus of SEA and other activities. The integrated workforce development plan builds statewide human R&D capacity, and fosters the next generation of STEM innovators. Overall, SEANET will make critically needed research investments to improve linkages between scientific knowledge and the actions of decision-makers to support Maine's culture, economy, and environment, and to improve understanding of human sustainability at local, bio-regional, national, and global scales.



Guidelines for Sustainable Ecological Aquaculture (SEA), used as the scientific vision in this EPSCoR program, were developed by a global team convened by the Food and Agriculture Organization (FAO), which included one of our co-PIs. The transformative potential of this project will be to use these guidelines in a sustainability science implementation framework to determine the social and environmental carrying capacities of SEA systems in Maine's coastal bio-regions. We will determine how environmental and social factors affect carrying capacities by: 1) building a multi-institutional, transdisciplinary, collaborative academic expertise that will balance social and biophysical research; 2) integrating stakeholder participation across all phases of the research; and 3) conducting research that is both idea-based and place-based. SEANET research will contribute to important scientific debates on how to balance the social ecological knowledge gained with local decision-making. Results will advance knowledge and understanding in the marine sustainability sciences especially at the interfaces of marine ecosystems and coastal fishing communities, all in the context of the expansion and the development of a new paradigm for marine aquaculture. This project is consistent with NSF's Grand Challenges, its emphasis on sustainable solutions, and its recent acknowledgement that basic science of aquaculture and social-environmental aspects of allied coastal communities are important.

This strategic plan provides a framework by which this Maine EPSCoR RII project will operate and measure progress and performance.

Maine EPSCoR RII Project Goals

The following are the overarching goals that will be addressed in this project. Detailed outcomes, objectives, strategies, benchmarks, and timeframes can be found in the following sections of this Strategic Plan.

The Overarching Goal & Hypothesis: SEANET proposes to investigate the challenges to coastal SES in the context of Sustainable Ecological Aquaculture (SEA). The scientific vision is to generate more comprehensive, transdisciplinary, coastal marine science that is positioned at the knowledge interface of marine fisheries, ecosystems conservation and restoration, and the new paradigm of SEA. The overarching goal of SEANET is to create a statewide, multi-institutional, academic research network that will advance knowledge and discovery about SEA within Maine's coastal social, economic, and environmental nexus. We pose two, fundamental, cross-cutting research questions:

1. How can a sustainability science approach enable us to understand the complex interactions of coastal SES and knowledge systems within the context of SEA?

2. How can this understanding inform sustainable solutions?

Goal #:	Description:
Goal 1:	Create a statewide, multi-institutional, academic research network that advances knowledge and discovery of sustainable ecological aquaculture systems (SEAS) given Maine's coastal social, economic, and environmental nexus through an improved understanding of coastal social-ecological systems (SESs).

Goal 2:	To use science-based information generated from a buoy water quality monitoring system, empirical field data from cruise transects, and research-intensive aquatic farms to generate new and existing oceanographic measurements in order to develop modeling and GIS tools integrated with socio-ecological models to assist coastal communities to make better decisions related to increasing sustainable aquaculture production across Maine coastal communities to make better decisions related to increasing sustainable aquaculture production across Maine.
Goal 3:	Through observation and collection of field data and by computer (in-silico) simulations, evaluate the effects of environmental change on Maine's coastal marine ecosystems and aquaculture infrastructure and consequences on social, economic, and cultural success of coastal communities.
Goal 4:	To develop research-derived products and SEA technologies that provide social, environmental, and economic benefits to Gulf of Maine coastal communities and promote sustainable ecological aquaculture.
Goal 5:	To advance the scientific basis for decision making through an improved understanding of the social dimensions of sustainable ecological aquaculture (SEA) focused on the current structure, function, and socio-economic context of Maine aquaculture; its response/resilience to change; and potential opportunities and challenges associated with aquaculture-based innovations.
Goal 6:	Prepare Maine's current and future researchers, innovators, and educators with strategies that foster transdisciplinary STEM skills.
Goal 7:	Integrate cyberinfrastructure which enables research and education discovery and innovations in SEA.
Goal 8:	Implement strategies to allow rapid and effective response to new and emerging opportunities in research, innovation, and workforce development.
Goal 9:	Engage the full diversity of Maine's human and institutional resources to ensure the success of the research and education program. Advance partnerships and collaborations to attain project goals, increase research competitiveness, build and strengthen the STEM pipeline in workforce development, commercialize research and education projects, and pave the way for economic development.
Goal 10:	Create and maintain effective outreach & communication networks through strategies that encompass all participants, stakeholders, and the general public, and engages rural communities.
Goal 11:	Create lasting operational support for the proposed infrastructure despite changes in funding sources, research foci, service providers, participating scientists, and stakeholders.
Goal 12:	Conduct effective evaluation to ensure attainment of goals and produce on-going feedback to the Management Team.

SEANET Mission and Vision

Mission

The mission of the Sustainable Ecological Aquaculture Network (SEANET) is to create a statewide, multi-institutional, academic research network that will advance knowledge and discovery regarding SEA within Maine's coastal social, economic, and environmental nexus.

Vision

The new high-quality science and widespread knowledge produced by SEANET will provide the basis for:

- Well-informed public opinion of aquaculture, including its current and potential impacts on our economy, communities, and ecology
- Public and private decisions that properly consider up-to-date knowledge about relationships between climate and production, human activities and environmental quality, and aquaculture and the wild, among others
- Well informed aquaculture workers to support a robust industry
- Improved aquaculture production based on good science and innovative ideas for product and market development, that does not compromise the long term ecosystem health
- Lasting and improved aquaculture-related research and education infrastructure that nurtures multi-institutional and multi-disciplinary collaboration

Risk Mitigation and Succession Plan

For a project of this magnitude and complexity, there are a series of impediments that might diminish success. The most significant potential threats to fully reaching the goals of the SEANET project are outlined below, along with strategies to minimize potential negative impacts.

Component	Condition	Consequence	Impact	Likelihood	Mitigation
Research	Damage to instrumentation	Loss of funds and time	Medium	High	Use secondary data, redeploy if necessary; periodic cruises to collect data; regular cross calibration of sensors; latest bio-fouling mitigation techniques
	Unanticipated maintenance required on laboratory instrumentation	Unbudgeted costs and time	High	High	Perform appropriate preventative maintenance
	Vandalism to buoys and/or sensors	Loss of funds and time	Medium	High	Use GPS tracking to find any stolen equipment; clearly explain deployment plan to local fishermen
	Survey response rates too low	Insufficient data to make reliable inferences	High	Medium	Use best survey practices; provide incentives to increase response rates; perform non-response follow-up

Component	Condition	Consequence	Impact	Likelihood	Mitigation
	Insufficient researcher accountability	Data gaps	Medium	Low	Increase researcher commitment in project vision; provide incentives; establish explicit scope of work
	Insufficient integration and coordination between themes	Data gaps; siloed research activity	Medium	Medium	Increase researcher commitment in project vision; design projects to include recurring material, data, and knowledge transfers between themes
	Coordination and management aspects overwhelm science component	Lack of intellectual merit; science and inspiration suffer	High	High	Clearly delineate leadership roles and involvement; document administrative time and effort; obtain dedicated institutional support and recognition; respect balance of individual and theme/group activities; minimize unimportant meetings and electronic communications
	Research activities and decisions hindered by timeline and budget constraints	Activities and measurements unproductive for capacity building	High	High	Identify weaknesses and devise alternative research activities
	Pure research activities take precedence over research capacity building	Personnel and data gaps jeopardize post-SEANET research	High	Medium	Maintain broad focus; do not overextend commitments to research deliverables; maximize budgetary flexibility; adjust midway to address unexpected personnel and data gaps
	Team member or new hire no longer available	Loss of expertise, skills	High	Medium	Examine alternative sources of skills; adapt research plans to accommodate loss
	Postdoctoral hire fails or is delayed	Delay in placing significant team member	Medium	Medium	Recruit early and use faculty networks to identify strong pools of applicants; plan for back-up researcher and management resources
	Community partners withdraw or decline to participate	Difficulty collecting data	High	Low	Engage stakeholders and maintain ongoing communication
	Industry members do not fully participate/cooperate/provide access to data	Data gaps	Medium	Medium	Maintain ongoing communication to build trust
	Inappropriate hires	Insufficient understanding of interdisciplinarity	Medium	Medium	Maintain active EPSCoR engagement and follow University protocols in the hiring process
Workforce Development	Failure to attract students to available opportunities	Unable to meet goals	Medium	Low	Engage teachers, faculty, and students throughout the pipeline
	Failure to attract enough faculty and post-doctoral mentors	Unable to meet goals	Medium	Low	Recruit early and use faculty networks to identify strong pools of applicants
Cyberinfrastructure	Unable to share relevant data with all interested parties	Unable to meet goals	High	Low	Backup systems in place to provide, ensure, and maintain redundancy and security of data

Component	Condition	Consequence	Impact	Likelihood	Mitigation
Seed Funding	Failure to attract proposals from diverse institutions	Unable to meet goals	High	Medium	Develop a plan to distribute RFP statewide, including community colleges and private institutions
Diversity & Partnerships	Stagnant diversity numbers	Loss of richness in perspectives and participation	Medium	Low	Re-evaluate and revise recruitment methods and programs
Communication & Dissemination	Research findings not appropriately disseminated	Unable to meet goals	High	Medium	Ensure appropriate publication and communication strategies exist; Appointment of a faculty member to serve as SEANET's public ambassador to ensure dissemination in a widely accessible manner
	Intra- and inter-theme communications hampered by geography and schedule conflicts	Siloed activity; duplicated efforts; data gaps	Medium	High	Plan group meetings well in advance to facilitate scheduling; improve user friendliness for remote access to meetings
	Public misconceptions about SEANET project	Lack of support/understanding	Medium	Medium	Pursue an information campaign through mainstream media (i.e. newspaper guest columns); follow communication plan
Sustainability	SEANET does not become self-sustaining	SEANET ceases to be a driving force in aquaculture research	High	Medium	Increase University funding to support the ARI and SEANET; actively pursue external funding opportunities related to SEANET projects and provide technical assistance to faculty for grant writing
Evaluation & Assessment	Poor evaluation	Lack of continuing funding	Medium	Medium	Assure evaluation plan is followed; researchers and students respond to surveys

Succession Plan

Carol Kim (Proxy, AVPR David Neivandt) is responsible for the overall management of the proposed activities, adherence of project personnel to the scope and tasks of the award, budgetary compliance, and reporting. The research project co-directorship provides a strong back-up system. If a Co-PI leaves their institutional position, a replacement (identified via a national and international search) will assume the Co-PI role. Research themes have a leader and two secondary leaders, providing a natural succession plan.

Overall Project Structure

Social-Ecological Systems Analysis

Coastlines are a nexus of human, economic, and ecological dynamics. To advance our understanding of these in the context of SEA, we have adopted a Social-Ecological Systems (SES) framework approach for all research goals (Goals 1-5), and the strategies and benchmarks within these goals have been developed to reflect this approach. An SES framework is not specific to any of the three research themes (1-3) nor to the Human Dimension & Knowledge Systems, or Bio-regional cross-cutting themes. The SES framework is an overarching approach that unifies the themes to address the fundamental research questions of SEANET. Objective 1.4 "Develop, test, and refine a SES framework to advance knowledge and discovery of SEA and

improve the ability to analyze resilience of SES in the context of SEAS" outlines overarching strategies and benchmarks for this unifying approach.

The SES framework incorporates the social/human dimensions from the Human Dimensions & Knowledge Systems cross-cutting theme, the Bio-regional cross cutting theme, and the biophysical dimensions that are in Themes 1-3. The strategies within each research goal allow for social-ecological systems analysis at different scales (or system dimensions) such as spatial, temporal, and jurisdictional scales. This is enhanced via the Bio-regional approach that is also woven into this research framework.

Bio-Regional Cross-Cutting Theme

In order to respond to stakeholder agendas, and to root the global understandings advanced by the SEANET research and education program in diverse social and ecological realities, local and regional dynamics need to be understood. For this reason we have adopted a Bio-regional approach to all research goals (Goals 1-5). SEANET has a unique, coordinated, transdisciplinary approach focused on three Bio-regions, each having two "areas of focus" (two different bays and associated communities in each Bio-region). These six *Areas of Focus* reflect diverse marine ecosystems, riverine inputs, degrees of urbanization, private and common property issues, importance of coastal fisheries, and levels of aquaculture development. The strategies and benchmarks within each goal have been developed to reflect this approach. This also includes engaging with stakeholders within and outside academia. Objective 1.5 "Advance a Bio-regional, place-based SES understanding of SEAS to inform decision-making in Maine and beyond" outlines overarching strategies and benchmarks for this cross-cutting theme.

Human Dimensions & Knowledge Systems Cross-Cutting Theme

The Human Dimensions & Knowledge Systems cross-cutting theme addresses two key but different aspects of SEANET. These are outlined in Goal 5. It includes objectives and strategies to research the human dimensions of SEA: how do the ecological systems and SEA impact people, and how do people impact SEA and the natural systems? In addition, the cross-cutting theme takes a knowledge-to-action (K→A) approach to understand how to link different knowledge systems (such as biophysical and social science), and how best to produce actionable science that can improve decision making.

Overall Research Goal

Goal # 1: **Create a statewide, multi-institutional, academic research network that advances the knowledge and discovery of sustainable ecological aquaculture systems (SEAS) given Maine's coastal social, economic, and environmental nexus through an improved understanding of coastal social-ecological systems (SES).**

Targeted Outcomes:

- A comprehensive sustainability science framework that integrates complex interactions of coastal SES.
- Improved understanding of SES dynamics and resilience in the context of SEAS.
- A robust statewide, multi-institutional academic research network with increased capacity to conduct sustainability science research in SEAS.

Research Approaches:

- Build a comprehensive network of researchers and stakeholders to implement SEANET's sustainability science framework for SEAS.
- Develop, test, and refine SEANET's sustainability science framework to improve the ability to analyze the resilience of SES in the context of SEAS.
- Advance a bio-regional, place-based SES understanding of SEAS to inform decision-making in Maine and beyond.

Goal #1: Overall Research Goals - Summary of Strategies & Benchmarks

(see above for strategies & benchmarks common to this goal and all four research goals)

Goals 1-5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
1.1 Improved understanding and capacity across all objectives	a) Integration and collaboration between all interdisciplinary members of the team	On-going (see communication plan Goal 10)	On-going (see communication plan Goal 10)	On-going (see communication plan Goal 10)	On-going (see communication plan Goal 10)	On-going (see communication plan Goal 10)
	b) Collaboration/ integration with other research teams/institutions	Establish teams and framework	20 project-wide	36 project-wide	36 project-wide	36 project-wide
	c) Development of new research method or adoption of best practice	Establish teams and framework	20 project-wide	24 project-wide	24 project-wide	24 project-wide
	d) External collaborative proposals and/or support submitted	4 proposals/$400K project-wide	15 proposals @ $1.8M project-wide	25 proposals @ $2.1M project-wide	25 proposals @ $3.75M project-wide	30 proposals @ $4.86M project-wide
	e) Peer-reviewed publications submitted/accepted/published	18 project-wide	35 project-wide	55 project-wide	75 project-wide	105 project-wide
	f) Technical publications completed or in process	10 project-wide	15 project-wide	20 project-wide	20 project-wide	20 project-wide
	g) Technical presentations	6 project-wide	12 project-wide	25 project-wide	25 project-wide	25 project-wide
	h) Participation in relevant professional conferences	20 project-wide	30 project-wide	40 project-wide	40 project-wide	40 project-wide
	i) Presentations at SEANET activities.	Present at all-hands team meetings	Present at all-hands team meetings	Present at all-hands team meetings	Present at all-hands team meetings	Present at all-hands team meetings
1.2 Commitment to stakeholder involvement	a) Active collaborations with stakeholder organizations (state-wide and bio-regional)	12 project-wide	12 ongoing and 4 new project-wide	16 ongoing and 4 new project-wide	20 ongoing and 4 new project-wide	24 ongoing and 4 new project-wide
	b) Bio-regional stakeholder/team meetings	Development of stakeholder network	2 per year	2 per year	2 per year	2 per year
	c) Breadth of stakeholder collaboration (private sector, government, NGO sector, other research institutions, K-12)	Development of stakeholder network	Expand as needed	Expand as needed	Expand as needed	Expand as needed
	d) Primary focus on local/state stakeholder scale, secondary regional/ national/international.	Development of stakeholder network				

Goals 1-5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
	e) Research models/processes framed and modified by stakeholder input	Planning & development				
	f) Stakeholder decision-making process or policy informed/changed through research	Development of stakeholder network	Evaluate opportunities for all research projects	Identify likely contributions to decision-making and policy change	Enumerate and explore at least 10 decision-support products for implementation	Implement at least 5 decision-support tools or policy changes project-wide
	g) Serving on related external committee, task force, board, etc.	4 project-wide	4 ongoing and 2 new project-wide	6 ongoing and 2 new project-wide	8 ongoing and 2 new project-wide	10 ongoing and 2 new project-wide
1.3 Build a comprehensive network of researchers and stakeholders to implement SEANET's sustainability science framework for SEAS	a) Implement a series of bio-regional workshops to learn about local needs	Bio-region 1 (Saco and Damariscotta regions) SEAS and SES workshop and proceedings	Bio-region 2 (Casco and Cobscook regions) SEAS and SES workshop and proceedings	Bio-region 3 (Penobscot and Machias regions) SEAS and SES workshop and proceedings	Integrate new data into bio-regional syntheses	Summary report on findings and steps to ensure network sustainability
1.4 Develop, test and refine a SES framework to advance knowledge and discovery of SEA and improve the ability to analyze resilience of SES in the context of SEAS	a) Develop and test an SES conceptual framework for SEA	Comprehensive review of SES frameworks, and development of conceptual framework model	Identify potential SES models for study within each Theme; Test and refine SES conceptual framework integrating model variables from research themes	Test and refine SES conceptual framework; integrate model variables from research themes	Test and refine SES conceptual framework; integrate model variables from research themes	Final report integrating SES frameworks across research themes; integrated framework and decision support
	b) Identify and implement SES framework research methods and protocols for analyzing the resilience of SES in the context of SEAS	Review theoretical model variables; develop research methods and protocols; initiate data collection	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	
	c) Peer reviewed publications submitted and accepted/published	Planning	1-2	1-2	1-2	1-2
	d) Technical publications	Planning	1-2	1-2	1-2	1-2

Goal #1: Overall Research Goals - Summary of Strategies & Benchmarks

Goals 1-5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
1.5 Advance a bio-regional, place-based SES understanding of SEAS to inform decision-making in Maine and beyond	a) Conduct bio-regional symposia to capture local information that will inform SEANET research activities	6 symposia	Track input and update regional agenda	6 symposia	Track input and update regional agenda	6 symposia

Carrying Capacity

Goal # 2: **To use science-based information generated from a buoy water quality monitoring system, empirical field data from cruise transects, and research-intensive aquatic farms to generate new and existing oceanographic measurements in order to develop modeling and GIS tools integrated with socio-ecological models to assist coastal communities to make better decisions related to increasing sustainable aquaculture production across Maine.**

Targeted Outcomes:

- A comprehensive data collection system will be developed using buoy and sensor arrays coupled with other water quality and oceanographic data sources.
- Research will lead to a better understanding of relationships of marine organisms being cultured in the near shore environment and the ecosystem.
- A modeling framework will be developed to analyze these data and to provide predictive tools for assessment of current and future aquaculture sites.

Research Approaches:

- Collect existing, relevant biophysical and social data that are necessary to develop appropriate models and analyses.
- Collect new, relevant biophysical and social data that are necessary to develop appropriate models and analyses.
- Use collected data to develop integrated biophysical and socio-economic models to generate scenarios to inform aquaculture decision-making.
- Define social dimensions context (the baseline), including socio-economics and governance.

Goal #2: Carrying Capacity - Strategies & Benchmarks

Objective	Strategy	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
2.1 Develop model outputs that predict and forecast the dynamics of primary and secondary production in Maine's coastal embayments to facilitate more intelligent siting of aquaculture facilities.	a) A combination of historic and new data from research studies, monitoring programs, buoy-based sensor observations will be collected and collated to populate and test hydrodynamic and biogeochemical models.	Conference calls and all team meeting of modeling (flow, wave, biogeochemical, primary, secondary production, GIS team) and data collection teams	All team meeting 2015 progress, 2016 planning	All team meeting 2016 progress, 2017 planning	All team meeting 2017 progress, 2018 planning	All team meeting 2018 progress, 2019 planning	Brady
	b) Develop hydrodynamic models for 2 Areas of Focus in each Bio-region	Gather existing data and model output for all Areas of Focus	Develop a hydrodynamic model for 2 Areas of Focus, and transfer output to GIS	Develop a hydrodynamic model for 2 new Areas of Focus and transfer output to GIS	Develop a hydrodynamic model for 2 new Areas of Focus and transfer output to GIS	Enter into GIS and disseminate	Xue
	c) Develop a sensor network for aquaculture growing areas	Order and determine sites for six large buoys. Order or develop, and determine sampling sites for ten small sensors in all Areas of Focus in conjunction with regional partners	Deploy large buoy sensor network in 2 Areas of Focus. Initiate water sampling in all bays, develop cyberinfrastructure to deliver data to stakeholders; deploy small buoy network and coordinate with regional partners on maintenance and analysis. Link output to NERACOOS	Rotate large buoy sensor network to 2 new Areas of Focus; continue water sampling; maintain small buoy network system; link output to NERACOOS	Rotate large buoy sensor network to 2 new Areas of Focus; continue water sampling; maintain small buoy network system. Link output to NERACOOS	Continue water sampling; maintain small buoy network system; link output to NERACOOS	Brady
	d) Develop biogeochemical modeling framework for selected Areas of Focus	Collect existing temperature, salinity, nutrient, phytoplankton, and oxygen data from each bay; develop preliminary models	Develop, calibrate, and validate biogeochemical model for Damariscotta River Estuary; serve model output via GIS framework	Continue to develop, calibrate, and validate biogeochemical model for Damariscotta River Estuary and initialize model development for Casco Bay; serve model output via GIS framework	Develop, calibrate, and validate biogeochemical model for Casco Bay; determine choice of third Area of Focus from stakeholder input; initialize model for third Area of Focus; serve model	Finalize development of the Casco Bay model; develop, calibrate and validate biogeochemical model for third Area of Focus	Brady

					output via GIS framework		
	e) Develop organism growth model of secondary production utilizing forcing functions of biophysical data from buoys, sensors, water samples, and transects	Collect existing biophysical data from each bay, and aquaculture farm data from Maine and literature; obtain ShellSim software	Calibrate and validate growth models for shellfish species	Link a growth model for shellfish with coupled hydrodynamic-biogeochemical modeling platform for the Damariscotta River estuary	Link a growth model for shellfish with coupled hydrodynamic-biogeochemical modeling platform for the Casco Bay	Present growth models and economic models in GIS system	Beard, Newall
	f) Test and refine SES framework to incorporate indicators and drivers of primary and secondary production	Review conceptual indicators, drivers and measures of primary and secondary production for inclusion in SES model		Test SES framework integrating indicators and measures for primary and secondary production		Refine SES framework with additional data	Chen, Evans
2.2 Advance our understanding of how detritus quantity and quality varies within and between bay estuaries, and in relation to phytoplankton production, resuspension, and freshwater inputs as a function of SEA intensification	a) Develop a phytodetritus production model	Review literature on production of phytodetritus and existing data in bio-regions	Examine optical water quality, biochemical, and phytoplankton biomass data from 2 Areas of Focus	Examine optical water quality, biochemical, and phytoplankton biomass data from 2 new Areas of Focus	Examine optical water quality, biochemical, and phytoplankton biomass data from 2 new Areas of Focus	Validate phytodetritus model using data from all 6 Bio-regions	Brady
	b) Determine how detritus absorption and utilization varies between species and seasons	Perform laboratory and field experiments comparing mussels, oysters, and clams over ranges of temperature, salinity and food quality	Perform laboratory and field experiments comparing mussels, oysters, and clams over ranges of temperature, salinity and food quality	Perform laboratory and field experiments comparing mussels, oysters, and clams over ranges of temperature, salinity and food quality	Perform laboratory and field experiments comparing mussels, oysters, and clams over ranges of temperature, salinity and food quality	Publish results and integrate into growth model parameters	Byron, Costa-Pierce, Mayer
	c) Investigate detritus formation and production of terrigenous, salt marsh, and kelp detritus.	Review literature; design protocols; identify bio-regional locations; initiate seaweed decomposition experiments	Preliminary fieldwork to test protocols; revise study protocols as required; analyze preliminary results of seaweed decomposition experiments	Execute field studies, and collect data; initiate new decomposition experiments	Add to field studies, and collect data; analyze data	Analyze and write results for publication and information dissemination	Byron, Costa-Pierce, Mayer
	d) Investigate the temporal and spatial patterns of	Identify bio-regional study sites and temporal and	Collect preliminary samples and analyze. Revise	Execute study and gather data	Continue to gather data	Write results for publication and information dissemination	Byron, Costa-Pierce, Mayer

	detritus production.	spatial extents of investigations	protocol as necessary				
	e) Identify, test and implement optical methods for characterization of detritus In relation to biochemical composition and utilization by bivalves.	Review literature on detritus utilization by bivalves; design buoy network and purchase equipment; design cruises and water sampling protocols; design plan for field data gathering as part of cruises and water sampling as articulated above	Correlate field growth with phytoplankton and detritus quality; installation of buoys for initial data gathering; collect buoy data; conduct cruises; gather water samples; correlate field growth with phytoplankton and detritus quality; adjust protocols and designs as needed	Correlate field growth with phytoplankton and detritus quality; use water samples and preliminary buoy data to analyze optical properties; rotate large buoys to new Areas of Focus; collect buoy data in new Areas of Focus continue to analyze results	Correlate field growth with phytoplankton and detritus quality; continue analysis of all data collected from all Areas of Focus to date; rotate large buoys to new Areas of Focus; collect buoy data in new Areas of Focus	Integrate modeling, assay development, biochemical, and optical approach into new assessment of site selection tool for bivalve aquaculture; analyze all data from all Areas of Focus; write results for publication	Byron, Costa-Pierce, Mayer
	f) Investigate the feeding and utilization of detritus by bivalves relative to phytoplankton controls, biochemical composition and digestibility.	Identify appropriate methodologies and experimental designs	Initiate experiments	Continue experiments and revise methodologies as appropriate	Analyze data	Write results for publication and information dissemination	Byron, Costa-Pierce, Mayer
	g) Evaluate the role of excretion products and biodeposits of shellfish species on primary and secondary production, microbial loops, and recycling of organic matter within aquaculture systems.	Design excretion experiment in conjunction with feeding experiment	Execute excretion experiment as feeding experiment progresses	Revise experiment and continue as needed	Analyze data	Write results for publication and information dissemination	Byron, Costa-Pierce, Mayer
	h) Achieve discoveries in biochemical characterization of natural detritus as it relates to food assimilation and growth of wild and cultured bivalves.	Design plan for field data	Review preliminary lab results and adjust experimental designs as needed	Continue experiments	Analyze results	Articulate important discoveries in peer-reviewed literature and to industry	Byron, Costa-Pierce, Mayer

Goal Goal #2: Carrying Capacity - Strategies & Benchmarks

	i) Test and refine SES framework to incorporate indicators and drivers of detritus production	Review conceptual indicators, drivers and measures of detritus production for inclusion in SES model		Test SES framework integrating indicators and measures for detritus production		Refine SES framework with additional data	Chen, Evans, Hanes, Johnson, Lindenfeld, McConnon, Noblet, Teisl
2.3 Advance our understanding of the SES thresholds and resilience factors that influence adoption and acceptance of SEA	a) Identify and implement SES framework research methods and protocols for analyzing the thresholds and resilience of SES across SEA system types (e.g. fed (fish) and non-fed (shellfish, seaweeds)), scale/size, and bio-region	Comprehensive review of SES frameworks, and development of conceptual framework model; identify SEA systems for study (research intensive farms); review theoretical model variables; develop research methods and protocols; initiate data collection	Test and refine SES frameworks integrating model variables from Theme 1 and Human Dimensions cross-cutting theme	Test and refine SES frameworks integrating variables from Theme 2, and from ongoing projects in Theme 1 and Human Dimensions cross-cutting theme	Test and refine SES frameworks integrating variables from Theme 3, and from ongoing projects in Theme 1, 2 and Human Dimensions cross-cutting theme	Integrate SES frameworks and GIS maps	Chen, Evans, Hanes, Johnson, Lindenfeld, McConnon, Noblet, Teisl
	b) Implement and test SEA strategy	Identify 3 Areas of Focus for implementing novel SEA strategies	Engage stakeholders; develop SEA strategy for the 3 identified Areas of Focus; consult with other themes to ensure alignment; identify indicators, measures, scoring scales, and threat indicators for monitoring SES vulnerability	Implement novel SEA strategies in the 3 identified Areas of Focus; collate and incorporate data into SES model	Implement novel SEA strategies in the 3 identified Areas of Focus; collate and incorporate data into SES model	Implement novel SEA strategies in the 3 identified Areas of Focus; collate and incorporate data into SES model	Cross Theme Investigator Participation
	c) Optimize the design of information interfaces for SES models, to be used by a diverse group of stakeholders	Review design options for information interfaces	Identify data types and sources; identify user groups; consult with Human Dimensions theme to ensure alignment	Initiate design of information interface	Test information interface with diverse group of stakeholders	Refine information interface	Johnson, Lindenfeld, McConnon, Noblet, Teisl
Additional Benchmarks for all		Recruit graduate and undergraduate students;	3 presentations; 1 proposal submitted	3 presentations; 1 proposal submitted; 1	3 presentations; 1 proposal submitted; 1	3 presentations; 1 proposal submitted; 2	Brady, Xue, Beard, Byron, Costa-Pierce Mayer, Chen,

objectives in Theme I		organize work plan; 1 presentation		manuscript submitted	manuscript submitted	manuscripts submitted	Evans, Hanes, Johnson, Lindenfeld, McConnon, Noblet, Teisl

Changing Environment

Goal # 3: Through observation and collection of field data and by computer (in-silico) simulations, evaluate the effects of environmental change on Maine's coastal marine ecosystems and aquaculture infrastructure and consequences on social, economic, and cultural success of coastal communities.

Targeted Outcomes:

- A better knowledge base for evaluating effects of future environmental changes on Maine's coastal zones and elsewhere.
- Enhanced understanding of the impacts of ecosystem change on existing and future aquaculture operations.
- Exploration of alternative aquaculture species and methodologies that are conducive to changing ecological factors.
- Enhanced understanding of the interactions and impacts of invasive species on the coastal ecosystem and aquaculture systems.

Research Approaches:

- Apply environmental change models to predict and evaluate changes in species of economic importance, both aquacultured and natural harvest; the effects on the resident flora and fauna, spread of invasive species and diseases, and assess the resilience of coastal infrastructure to changing environmental conditions.
- Develop biophysical data for the existing environmental change models specifically for the Gulf of Maine.
- Identify and measure markers for stress on the ecosystem, the infrastructure, and coastal communities as a result of factors such as: ocean and sediment acidification, temperature, eutrophication, and meteorological events.
- Conduct studies to improve the understanding of the biological and economic feasibility culturing new and emerging aquaculture species and the potential impact of invasive species may have on the ecosystem.
- Conduct studies on the resilience of aquaculture infrastructure to environmental change; investigate parameters effecting design, performance, and maintenance of coastal structures and components, (moorings, foundations) and consequences on the livelihood of coastal socio-economic systems.
- Develop, refine, and apply the social dimensions of the project's conceptual framework to advance the scientific basis for decision-making.

Goal #3: Changing Environment – Strategies & Benchmarks

Goal #3 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
3.1. Advance our understanding of ocean acidification (OA) and climate change impacts on the development, growth, and health of calcifying organisms	a) Assess the effects of climate change on the growth and development of lobsters	Identify graduate student; develop stakeholder network; develop systems for laboratory trials	Assess effects of increasing ocean temperatures on larval lobster growth and development ; refine experiment; consult with other themes to ensure alignment	Assess effects of increasing ocean temperatures on lobster shell development and calcification; analyze data; submit manuscripts; consult with other themes to ensure alignment	Assess effects of increasing ocean temperatures on lobster disease susceptibility and the etiology of shell disease; analyze data; submit manuscripts; consult with other themes to ensure alignment	Model the impacts of temperature on lobster population health and economic viability for culture; submit manuscripts; consult with other themes to ensure alignment	Hamlin
	b) Assess the effects of climate change on the host distribution and over wintering patterns of parasitic Sea Lice	Identify graduate student; develop stakeholder network; develop systems for field trials; refine experiments	Assess effects of increasing ocean temperatures on sea lice larvae survival, distribution and infectious pressure; analyze data; refine experiments; consult with other themes to ensure alignment	Assess effects of increasing ocean temperatures on sea lice larvae's use of peripatetic hosts; analyze data; refine experiments; submit manuscripts; consult with other themes to ensure alignment	Assess effects of increasing ocean temperatures on the infective pressure of sea lice in the gulf of Maine between peripatetic hosts and definitive hosts; analyze data; refine experiments; submit manuscripts; consult with other themes to ensure alignment	Model the impacts of temperature on the infectious pressure of sea lice between fish populations and assess the economic impact on salmon aquaculture in Maine; submit manuscripts; consult with other themes to ensure alignment	Bricknell
	c) Test and refine SES frameworks to incorporate variables and threat indicators of ocean acidification and climate change on development, growth, and health of		Develop theoretical variables and threat indicators, drivers and measures for inclusion in SES model	Test SES framework integrating ocean acidification and climate change indicators		Refine framework integrating additional data and stakeholder input	Lindenfeld, Teisl

Goal #3: Changing Environment – Strategies & Benchmarks

	calcifying organisms						
3.2. Advance our understanding of how environmental change can impact the carrying capacity of coastal SES and the robustness of the ecosystem	a) Construct food web model under 3 different climate change scenarios and use it to calculate ecological carrying capacity under each scenario.	Articulate methodology and identify study site(s); apply for seed funding	Gather input parameter data and construct food web models; identify model modifications to capture each climate chance scenario; refine experiments; consult with other themes to ensure alignment	Balance the model and examine carrying capacity under different climate change scenarios; analyze data; refine experiments	Interpret and write results. Disseminate results to different audiences; analyze data; refine experiments	Write results in peer reviewed literature; continue to disseminate findings to audiences; analyze data; submit manuscripts	Byron
	b) Identify and implement SES framework research methods and protocols for analyzing the resilience of SES to environmental change in the context of SEAS	Review conceptual SES model variables, indicators, measures, threat indicators, and scoring scales for analyzing impact of environmental change on SEAS	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	Final report integrating SES frameworks across research themes; integrated framework and decision support	Lindenfeld, Teisl
	c) Assess the effects of climate change on reproduction and survival of Alaria (a sub-Arctic kelp) as a model species for understanding how marine organisms acclimate and/or adapt to warming	Identify graduate student; develop stakeholder network; begin Alaria strain isolation from the Maine coast (at least two of three bio-regions); refine experiments; consult with	Identify temperature tolerant/intolerant Alaria strains with stress tests to establish acclimation limits; begin search for biomarkers with transcriptomic studies; analyze data; refine experiments;	Assess heritability of temperature tolerance with studies on both life history stages in Alaria and continued transcriptomic characterization of tolerant/intolerant strains; analyze data;	Work with stakeholders to trial grow-outs of temperature tolerant and intolerant strains, comparing growth rates in field; analyze data; refine experiments; submit manuscripts; continue to	Model the impacts of temperature on survival of Alaria and genetic biodiversity across coastal bio-regions in Maine; continue to consult with other themes to ensure alignment and	Brawley

	temperatures in the Gulf of Maine	other themes to ensure alignment	consult with other themes to ensure alignment	refine experiments submit manuscripts; continue to consult with other themes to ensure alignment	consult with other themes to ensure alignment	disseminate results; submit manuscripts	
	d) Assess the effect of environmental change on sediment and water quality with respect to sediment nutrient cycling and flux in aquaculture operations	Identify graduate student; develop stakeholder network; develop systems for field and lab trials; refine experiments; consult with other themes to ensure alignment	Assess the sediment nutrient budget and benthic impact of aquaculture facilities in a changing environment; analyze data; refine experiments; continue to consult with other themes to ensure alignment	Determine whether ocean acidification leads to coastal sediment acidification; analyze data; refine experiments; submit manuscripts; continue to consult with other themes to ensure alignment	Determine the efficacy of introducing polychaetes as an aquaculture sediment remediation/restoration tool with respect to species flux; analyze data, refine experiments; submit manuscripts; continue to consult with other themes to ensure alignment	Incorporate the species metal flux data into customized GIS-based aquaculture models; submit manuscripts	Amirbahman
3.3 Advance our understanding of how environmental change may impact population fitness and species survival	a) Assess the population dynamics of natural bed oysters in selected Areas of Focus	Identify graduate student, develop stakeholder network, develop systems for field trials	Develop understanding of previous genetics in natural bed oyster populations; analyze data, refine experiments	Analyze previous samples for possible overview of genetic status and assess changes in genetic profile; analyze data, refine experiments submit manuscripts	Assess if natural bed populations possess altered fitness compared to commercial strains; analyze data, refine experiments submit manuscripts continue to work with theme IV to disseminate results	Analyze potential use of natural populations in improving the fitness of commercial strains in Maine environments. submit manuscripts continue to work with theme IV to disseminate results	Bowden
	b) Test and refine SES frameworks to incorporate variables and threat indicators of population fitness and		Develop theoretical variables and threat indicators, drivers and measures for inclusion in SES model	Test SES framework integrating population fitness and species survival indicators		Refine framework integrating additional data and stakeholder input	Lindenfeld, Teisl

Goal #3: Changing Environment – Strategies & Benchmarks

	species survival						
3.4 Inventory and assess the infrastructure of aquaculture farms and evaluate vulnerability to stresses that are predicted under conditions related to environmental change.	a) Assess resilience of aquaculture infrastructure to environmental change by investigating parameters affecting design, performance, and maintenance of coastal structures and components	Identify graduate student and postdoc; case studies on degradation of select infrastructure components	Identify first bio-region; build background on design practices adopted, and develop framework for case study	Initiate computational modeling tool development; conduct state of the art survey of design practices and examine case studies	Develop computational algorithms and conduct benchmark studies; select second bio region for developing case study	Identify key parameters affecting design; conduct computational studies on parametric variation on design and assess resilience to environmental change	Thiagarajan
	b) Test and refine SES frameworks to incorporate variables and threat indicators for infrastructure related to SEAS		Develop theoretical variables and threat indicators, drivers, and measures for inclusion in SES model	Test SES framework integrating infrastructure indicators		Refine framework integrating additional data and stakeholder input	Lindenfeld, Teisl
Strategy for all three objectives in Theme II	Attend twice monthly Theme II panning meetings; ensure attendance at Stakeholders meetings	Recruit graduate and undergraduate students	Submit 1-2 manuscript; present at 1 - 2 conferences; submit 1 - 2 grant proposals	Recruit postdoctoral researcher; Submit 2-3 manuscripts; present at 2 - 3 conferences; submit 1 - 2 grant proposals	Submit 2-3 manuscripts; present at 3 - 4 conferences; submit 1 - 2 grant proposals	Submit 3-4 manuscripts; present at 3 - 4 conferences; submit 1 - 2 grant proposals	Bricknell, Byron, Hamlin, Thiagarajan, Bowden, Amirbahman, Brawley, Lindenfeld, Teisl
	Attend twice monthly Theme II planning meetings. Ensure attendance at Stakeholders meetings	Engage with other themes on an ongoing basis to ensure alignment	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Bricknell, Byron, Hamlin, Thiagarajan, Bowden, Amirbahman, Brawley, Lindenfeld, Teisl

Innovation

Goal # 4: To develop research-derived products and SEA technologies that provide social, environmental, and economic benefits to Gulf of Maine coastal communities and promote sustainable ecological aquaculture.

Targeted Outcomes:

- Maine's aquaculture industry will benefit from research and technological developments that add value, improve operations, or expand economic opportunities for current and future products.
- Coastal communities will better understand the opportunity that aquaculture provides to their working waterfronts.

Research Approaches:

- Assess the value of seaweed (macro-algae) for mitigating storm damage and erosion control.
- Develop innovative value added products (focusing on green crabs, abalone, and sea vegetables).
- Reduce energy use in processing infrastructure.
- To create new wealth for coastal residents using cultured shellfish through community-based aquaculture.
- Define social dimensions context (the baseline), including socio-economics and governance.

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
4.1. Assess the potential for sea vegetable aquaculture to ameliorate water quality problems in coastal SEAS	a) Utilize data streams identified and managed under Theme 1 to establish baseline water quality in the vicinity of experimental aquaculture sites and assess change related to bioremediation	Identify 1 with theme 1 an area of Focus for implementing SEA strategy with aim of testing impact on water quality	Engage stakeholders connected to chosen Area of focus; develop SEA strategy for the identified Area; consult with other themes to ensure alignment; identify indicators, measures, scoring scales, and threat indicators for monitoring SES vulnerability	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Lindenfeld, Teisl
	b) Investigate the roles of surface microbial communities on health, growth, and nutrient cycling in kelp with the view that this knowledge can optimize methods for maximal bioremediation.	Integrate bioremediation metrics into the investigation of roles of surface microbial communities in theme 2.	Benchmarks as outlined in the year 2 coordinated plan	Benchmarks as outlined in the year 3 coordinated plan	Benchmarks as outlined in the year 4 coordinated plan	Benchmarks as outlined in the year 5 coordinated plan	Brawley
	c) Investigate the influences of bioremediation practices on the composition and safety of macroalgae and shellfish.	Recruit students. Coordinated plan developed with theme 2 researchers for obtaining samples of aquacultured biomass derived from test plot sites with differing effluent exposure	Collected biomass samples from different test plots. With obj. 3a, b+ c, establish protocols for fractionating, purifying and analyzing biomass compositions at affordable levels of detail and purity (ALDP) in the raw and cooked streams	Continued collection of samples from different test plots; analysis of samples at ALDP; safety assessments based on available composition al data	Continued collection and analysis of samples at ALDP; safety assessments based on available compositional data	Continued collection and analysis of samples at ALDP; safety assessments based on available compositional data	Skonberg, Nayak Myracle
	d) Determine how excess biomass that may be inappropriate for human consumption could be used.	Recruit students; develop list of possible value adding products that could be derived from	Literature search on alternate uses of biomass, evaluation of economic potential for	Together with HD theme and objective 3c, investigate markets for alternate and	Together with objectives 1d, 3c and theme HD, identify alternate and novel uses that match	Identified viable non-food product uses for SEA products	Skonberg, Nayak, van Walsum Myracle

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
		inedible biomass	different options Coordinate with objective 3c for bioactives; apply innovation practices to identify novel uses	novel products	anticipated scales of production		
	e) Investigate the sustainable level of macroalgal aquaculture and develop credible models for determining the available sustainable biomass supplies for non-food uses.	In collaboration with themes 1, 2 and HD, identify required parameters for a credible, comprehensive carrying capacity model; identify theme 1,2 or HD graduate student to work on this objective	Social, economic and harvest data collected with themes 1,2 and HD	Data collected with themes 1, 2 and HD; first versions of models for predicting carrying capacity	Data collected with themes 1,2 and HD; refined models for predicting carrying capacity	Data collected with themes 1,2 and HD; credible models for predicting carrying capacity	van Walsum Lindenfeld, Teisl
4.2. Advance our understanding of the role of SEA technology to protect coastal communities from storm damage	a) Integrated plan with Theme 1 to Implement and test SEA strategy oriented specifically to provide erosion mitigation effects	Develop coordinated plan with Themes 1 and 2 to identify 1 Area of Focus for implementing SEA strategy oriented specifically to provide erosion mitigation effects; determine siting and monitoring of seaweed AQ structure	Together with Theme 1 and 2 researchers, collect and catalogue data on erosion mitigation; engage stakeholders; identify indicators, measures, scoring scales, and threat indicators for monitoring SES vulnerability	Together with theme 1 and 2 researchers, collect and catalogue data on erosion mitigation; make available to objectives 2b,c,d; continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Together with theme 2 researchers, collect and catalogue data on erosion mitigation; make available to objectives 2b,c,d; continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Together with theme 2 researchers, collect and catalogue data on erosion mitigation; make available to objectives 2b,c,d; continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Lindenfeld, Teisl
	b) Identify key parameters influencing siting and orientation of kelp beds	Recruit grad student, attend AQ meetings, develop researcher-industry networks	Assess current state of the art for kelp growing	Identify key parameters for optimal locations	Determine optimal orientation, size, and array configuration	Develop and apply decision support tool to select optimal locations	Zou
	c) Utilize wave basin modeling to look at impact of kelp farm on mitigation of storm damage	Recruit grad student, attend AQ meetings, develop networks	Review latest developments and state of the art for coastline protection	Investigate the kelp farm effect of modification of	Examine the links between hydrodynamics and kelp growth	Combine storm impact and kelp growth information	Zou

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
				hydrodynamics forcing			
	d) Develop computational wave models with and without kelp farm	Recruit grad student, attend AQ meetings, develop networks	Initiate model development	Incorporate kelp farm effects	Refine model to reflect in situ and model data	Apply model to different locations of interest in Maine	Zou
4.3. Advance the available knowledge base to reduce waste and promote sustainable feedback loops within SEA systems	a) Develop separation methods that make use of green extraction methods or enable higher rates of recycling	Recruit grad student, attend AQ and/or green chemistry meetings, develop networks	Literature search on green extraction methods; established protocols for separating protein + shell (crabs), frond and stype (kelp), bioactive constituents in the raw and cooked streams	Standard fractionation methods established, applied to samples derived from obj. 1b and used in obj. 1c, 3b,3c	Standard fractionation methods established, applied with obj. 1b,c and 3b,c	Standard fractionation methods established, applied with obj. 1b,c and 3b,c;.project long data compilation	Skonberg, Nayak, van Walsum Myracle
	b) Isolate constituent components of fractionated biomass	Recruit grad student, attend AQ meetings, develop networks	Literature search on applicable methods; inventory of equipment available; verify known protocols for analysis	In concert with obj. 1b, 3a, compositional analyses at affordable levels of detail and purity (ALDP); purified samples provided to obj. 3c	In concert with obj. 1b, 3a, compositional analyses at ALDP; purified samples provided to obj. 3c	In concert with obj. 1b, 3a, compositional analyses at ALDP; purified samples provided to obj. 3c; project long data compilation	Skonberg, Nayak, van Walsum Myracle
	c) Identify desirable bioactive compounds (polysaccharides, peptides, antioxidants, pigments)	Recruit grad student, attend AQ and/or bioactive meetings, develop networks	Literature search on target compounds; develop methods with objectives 3a,b	Once sufficiently detailed and purified samples are available from obj. 3b, start prospecting for bioactives and valuable extracts; identify as possible key functional properties of proteins	Continued prospecting and evaluation for high value components, stability, assessment of value added components, exploration of modification of functional properties on product quality and stability; all as resources permit	Continued prospecting and evaluation for high value components, stability, assessment of value added components, exploration of modification of functional properties on product quality and stability; all as resources permit; project long data compilation	Skonberg, Nayak, van Walsum Myracle

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
	d) Assess needs and constraints for reducing waste generation from biofouling of aquaculture infrastructure	Recruit student, attend AQ meetings, develop networks	Literature search; communicate with stakeholders, theme 2, HD to help identify relevant issues and constraints	Explore additional AQ needs and challenges associated with biofouling	Explore possible applications to biofouling outside of marine applications (ex. medical devices)	Explore possible applications to biofouling science in broader areas of inquiry	Gramlich, Bousfield
	e) Investigate ecologically benign materials for aquaculture infrastructures that have potential to prevent biofouling	Recruit student, attend AQ meetings; develop networks	Literature search; create list of possible techniques a nd materials for prevention of biofouling	Synthesize and assess candidate formulations for prevention of biofouling, as resources permit	Refine leading candidate formulations, as resources permit	Investigate interactions between coatings or treatments and environment, substrate, as resources permit	Gramlich, Bousfield
	f) Assess the needs and constraints of drying sea vegetables	Recruit student, attend AQ meetings, meet and survey sea vegetable producers, develop networks	Through literature search and stakeholder feedback, and work with theme HD, review and modify needs and constraints as necessary	Through stakeholder feedback, and work with theme HD, review and modify needs and constraints as necessary	Through stakeholder feedback, and work with theme HD, review and modify needs and constraints as necessary	Through stakeholder feedback, and work with theme HD, review and modify needs and constraints as necessary	Nayak,van Walsum
	g) Evaluate approaches to optimize the drying process for reduction of product deterioratioin and energy costs	Preliminary analysis of drying effects associated with different technologies	With literature search and stakeholder feedback, identify most promising dryer design; assemble prototype or laboratory model apparatus as resources permit	Use prototype and/or laboratory model to evaluate drying effects through seasons, weather and initial product quality conditions; evaluate final product quality from different drying conditions	Refine laboratory and/or prototype test procedures and provide data to obj. 3h for inclusion in process models	Together with obj 3g, combine analyses of energy use, cost and product quality retention to determine optimal dryer design parameters	Nayak, van Walsum
	h) Develop and economically evaluate processing technologies that conserve energy, reduce cost and	Develop initial process designs for drying apparatus	Develop simulation model for drying process its energy	Investigate potential synergies in integration of drying and extraction processes	Assess mass and energy balances and processing economics of new drying	Together with obj 3g, combine analyses of energy use, cost and product	Nayak, van Walsum, Chen, Evans, Lindenfeld, Noblet, Teisl

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
	maximize product quality and stability		consumption and cost		and extraction systems	quality retention to determine optimal dryer design parameters	
4.4 Advance our understanding of impact of community based AQ on carrying capacity for SEA, and SES sustainability and resilience	a) Identify at least 1 Area of Focus for implementing SEA strategy orientated to community based AQ; investigate the institutional relationships for governance, ownership, and access control of area(s) to better understand the factors that influence adoption of community-based SEA systems	Engage stakeholders; develop SEA strategy for the identified Area of Focus; consult with other themes to ensure alignment; identify indicators, measures, scoring scales, and threat indicators for monitoring SES vulnerability	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Continue SEA strategy in the identified Area of Focus; collate and incorporate data into SES model	Beal, Evans, Hanes, Johnson, Lindenfeld, Noblet, Teisl
	b) Determine effective and efficient grow-out strategies in each of the three bio-regions that will result in large-scale, economically-viable production of commercially-important, cultured shellfish	Develop plan with regional stakeholders to determine which species are amenable to large-scale grow-out strategies, and which communities wish to participate in a long-term project; recruit students; produce shellfish at DEI for future field trials	Set up field trials with at least one community in each bio-region to test several growout strategies; begin collecting data to refine growout methodologies; produce shellfish at DEI for future field trials	Using preliminary data, continue field trials, adding at least one more community in each bio-region; continue collecting data and refine growout methodologies; produce shellfish at DEI for future field trials	Field trials continue at two or more sites within each bio-region; data collection and creation of a working model to generalize results	Finish field trials and data collection; produce publication(s) for scientific community and general public (growout manual); organize a community forum where results are presented by students and community collaborators	Beal, Chen, Evans
	c) Engage commercial fishermen, K-16 students, and other entrepreneurs in demonstration farming projects designed to provide hands-on training that ultimately will increase the number of jobs and small businesses associated with coastal aquaculture	Develop business plans with individuals; determine which species are amenable to farming projects, and create specific goals for each project; recruit students; produce shellfish at DEI for future field trials	Begin field trials with individuals to test hypotheses developed through the goal-setting activities in Year I; produce shellfish at DEI for future field trials; collect data and refine	Continue field trials. Collect data and refine growout methodologies; produce shellfish for future field trials	Continue field trials. Collect data and refine growout methodologies	Review business plans in light of results; highlight results at scientific and other forums (Fishermen's Forum); modify and refine plans to continue efforts after grant funding expires	Beal, Evans, Johnson, Lindenfeld, McConnon,

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
			grow out methodologies				
	d) Investigate methods to add value to cultured shellfish through changes in existing Maine laws as well as production of new products.	Examine laws that restrict the public from access to shellfish based on species, size, and other determinants (e.g., lobsters smaller than carapace width of 3.25 inches); recruit students	Examine potential markets for undersized cultured shellfish (i.e., lobsters, soft-shell clams, hard clams)	Propose legislation to allow for the sale of what is presently considered "undersized" cultured individuals of various commercially-important shellfish species for human consumption (i.e., soft-shell clams; lobsters; hard clams) or for the aquarium trade (i.e., lobsters); work with one or more entrepreneurs to examine markets and create a business plan	Continue working with entrepreneurs; help them to provide cultured shellfish for identified aquarium and food markets	Continue to develop markets for cultured shellfish and organize a forum on the production of cultured shellfish for these markets	Beal, Evans, Hanes, Johnson, Lindenfeld
Relevant to all of Theme 3	a) Recruit and mentor graduate and undergraduate students.	4 graduate students recruited and on campus by fall 2015; undergraduate students working on research projects prior to and during the summer	PhD students complete some of the courses required for their degree, have completed first year benchmarks in their PhD program; undergraduates present at CUGR	PhD students have passed their comprehensive exam and defended their research proposal; have presented on campus and attended a research conference; undergraduates present at CUGR	PhD students have prepared a first paper manuscript for publication and presented at a conference; undergraduate presents at CUGR	PhD students defend dissertation, prepare two manuscripts for publication, have presented at a National level conference; undergraduates present at CUGR	Van Walsum, Skonberg, Brawley, Zou, Nayak, Gramlich, Bousfield, Beal, Evans, Hanes, Johnson, Lindenfeld, Noblet, Teisl, Chen, McConnon
	b) Further develop AQ network of researchers and stakeholders.	PIs attend a AQ meeting, are collaborating on research with at least one other SEANET researcher, seek to	PIs present at AQ meetings, collaborate with other SEANET researchers, ideally leverage	PIs present at AQ meetings, collaborate with other SEANET researchers, ideally	PIs present at AQ meetings, collaborate with other SEANET researchers, ideally leverage	PIs present at AQ meetings, collaborate with other SEANET researchers, ideally leverage	Van Walsum, Skonberg, Brawley, Zou, Nayak, Gramlich, Bousfield, Beal, Evans, Hanes,

Goal #4: Innovation – Strategies & Benchmarks

Goal #4 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
		leverage SEANET resources with additional funding and research opportunities	SEANET resources to attract additional funding and research opportunities	leverage SEANET resources to attract additional funding and research opportunities	SEANET resources to attract additional funding and research opportunities	SEANET resources to attract additional funding and research opportunities	Johnson, Lindenfeld, Noblet, Teisl, Chen, McConnon

Human Dimensions

Goal # 5: **To advance the scientific basis for decision making through an improved understanding of the social dimensions of sustainable ecological aquaculture (SEA) focused on the current structure, function, and socio-economic context of Maine aquaculture; its response/resilience to change; and potential opportunities and challenges associated with aquaculture-based innovations.**

Targeted Outcomes:

- Improved understanding of how society can advance the scientific basis for decision making in Maine and beyond in the context of sustainable ecological aquaculture (SEA).
- Improved understanding of the social and economic dimensions of sustainable ecological aquaculture (SEA) in Maine; social responses and resilience to change; and opportunities and challenges associated with aquaculture-based innovations.
- Increased capacity to produce actionable science and inform decision making.

Research Approaches:

- Develop, refine, and apply the social dimensions of the project's conceptual framework and knowledge system framework to advance the scientific basis for decision making.
- Define social dimensions context (the baseline), including socio-economics, cultural dimensions, and governance; model social responses to change (advance research to predict social response to SES drivers); and identify and model potential social dimensions of aquaculture-based innovations.
- Utilize social dimensions knowledge to advance linkages between knowledge and action.

Goal #5: Human Dimensions

Goal #5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
5.1 Advance our understanding of how place-based complexities influence adoption of SEA and can support sustainability trajectories within bio-regions	a) Conduct mixed methods research (interviews and surveys) in bio-regions across diverse stakeholder groups to understand vulnerabilities, assets, levels of conflict, economic strengths, networks and perceptions.	Design interview protocol and go through IRB consult with other themes to ensure alignment	Conduct, code and analyze interviews; design survey, go through IRB	Implement survey; submit manuscripts	Analyze survey	Submit manuscripts	Chen, Johnson, Noblet, Teisl
	b) Analyze existing and generate new data sources to create socio-economic snapshot of industry with a community context	Identify existing data, conduct economic impact analysis of industry; consult with other themes to ensure alignment	Develop an updated, more detailed economic profile of industry and community context	Conduct industry analysis	Analyze data, submit manuscripts	Update economic Impact analysis of industry; measure impact of SEANET	Chen, Evans, Gabe, McConnon, Teisl
	c) Develop and measure socio-economic indicators for sustainability of aquaculture within the context of other coastal activities	Identify and define key factors in collaboration with Theme I; consult with other themes to ensure alignment	Conduct interviews or focus groups to solicit stakeholder input on indicators; work with industry to examine key production relationships	Develop various versions of indicators to be tested as part of a communicati on strategy under Objective 3			Chen, Evans, Hanes, Johnson, McConnon, Noblet, Teisl
	d) Test and refine the SES framework to incorporate place-based complexities	Develop theoretical place-based indicators, drivers and measures for inclusion in SES model	Test SES framework integrating place-based indicators		Refine framework integrating stakeholder input on indicators		Chen, Evans, Hanes, Johnson, Lindenfeld, Noblet, Teisl
5.2. Advance our understanding of how place-based and coastwide knowledge can inform scientific decision-making at multiple spatial & temporal levels	a) Use valuation approaches (via survey) to measure knowledge, practices, and preferences of stakeholders and coastal/ocean user groups (e.g., beach goers)	Identify coastal user groups; design interview protocol and go through IRB; consult with other themes to	Conduct, code and analyze interviews; utilize data to inform survey design; go through IRB	Administer survey; analyze data	Analyze data, submit manuscripts	Submit manuscripts	Evans, Noblet, Teisl

Goal #5: Human Dimensions

Goal #5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
and at different functional levels		ensure alignment					
	b) Develop models to estimate production risks in a changing environment	Coordinate with Theme 2 to identify anticipated biophysical/ecological changes in the Gulf of Maine	Work with industry to examine key production relationships	Analyze data to identify potential production risks and opportunities	Analyze and develop possible risk mitigation strategies; submit manuscripts	Submit manuscripts	Chen, Evans, Teisl
	c) Conduct mixed methods research (interviews, survey, and archival document analysis) to generate new understandings of governance and decision making	Design interview protocol and go through IRB; assess availability and quality of documents, eg. archival transcripts of regulatory hearings; consult with other themes to ensure alignment	Conduct, code and analyze interviews; design survey, go through IRB; analyze archival material	Implement survey; submit manuscripts	Analyze survey; conduct, code and analyze interviews	Submit manuscripts	Hanes, Johnson, Lindenfeld
	d) Test and refine SES framework to incorporate knowledge practices and preferences of stakeholders, and interactions with other coastal coupled systems	Develop theoretical place-based indicators, drivers and measures for inclusion in SES model	Test SES framework integrating indicators and measures for stakeholder knowledge practices and attitude, and interactions with other coastal systems		Refine SES framework		Chen, Evans, Hanes, Johnson, Lindenfeld, Noblet, Teisl
5.3. Advance our understanding of how science communication influences adoption of SEA as a means of creating a more generalizable understanding of how collaboration and engagement can be more effective	a) Conduct mixed methods research (interviews and survey) of stakeholders to investigate processes by which knowledge is linked to action	Design interview protocol and go through IRB	Conduct, code and analyze interviews; design survey, go through IRB	Implement survey	Analyze survey; conduct, code and analyze interviews	Submit manuscripts	Evans, Johnson, Lindenfeld, Noblet, Teisl
	b) Engage key stakeholders in designing and implementing research to advance knowledge	Build researcher-stakeholder networks; work with Themes 2 and 3 to identify	Ongoing communication with stakeholders, eg. meetings, technical	Ongoing communication with stakeholders, eg. meetings, technical	Ongoing communication with stakeholders, eg. meetings, technical	Ongoing communication with stakeholders, eg. meetings, technical	Evans, Johnson, Lindenfeld, McConnon

Goal #5: Human Dimensions

Goal #5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
	co-production and K-A linkages	areas where new environmental changes, or new innovations, will need communicatio n strategies developed	reports, white papers, briefs, hearings, community meetings	reports, white papers, briefs, hearings, community meetings	reports, white papers, briefs, hearings, community meetings	reports, white papers, briefs, hearings, community meetings	
	c) Survey SEANET researchers to identify barriers and opportunities for improving transdisciplinary collaborative capacity	Participate in development of team-wide network	Develop survey of researchers, go through IRB, implement survey	Analyze survey results to identify barriers and opportunities , present results and possible improvement strategies to team	Implement survey design to measure change in researcher behavior and perceptions	analyze survey, submit manuscript	Lindenfeld, Teisl
	d) Document mass media trends to understand perceptions of aquaculture and science	Develop strategy for creating mass media database based on research and stakeholder input and need; consult with other themes to ensure alignment	Build database, enter data, analyze trends; Deliver tech reports to team and stakeholders	Build database, enter data, analyze trends	Build database, enter data, analyze trends; Deliver tech reports to team and stakeholder s	Build database, enter data, analyze trends	Lindenfeld
5.4. Identify and implement SES framework research methods and protocols for analyzing the resilience of SES in the context of SEAS	a) Identify and implement SES framework research methods and protocols for analyzing the resilience of SES in the context of SEAS	Workshop with theme team to review theoretical model variables, indicators, measures, and scoring scales; initiate data collection	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	Test and refine protocols and advance methods; collate and incorporate data into SES model	Final report integrating SES frameworks across research themes; integrated framework and decision support	Chen, Evans, Johnson, Lindenfeld, Noblet, Teisl
For the purposes of Theme four, stakeholders are defined as: citizens, consumers, industry, business, government, non-profits, NGOs, and	Strategy for all three objectives in Theme IV	a) Recruit 5 graduate and 10 undergraduate students	Submit 1-2 manuscripts; present at 1 - 2 conferences; submit 1 - 2 grant proposals; support 10	Recruit postdoctoral researcher; Submit 2-3 manuscripts; present at 2 - 3 conferences; submit 1 - 2	Submit 2-3 manuscripts ; present at 3 - 4 conference s; submit 1 - 2 grant proposals; support 10	Submit 3-4 manuscripts ; present at 3 - 4 conferences ; submit 1 - 2 grant proposals; support 10	Chen, Evans, Gabe, Hanes, Johnson, Lindenfeld, McConnon, Noblet, Teisl

Goal #5: Human Dimensions

Goal #5 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5	Investigator
any other communities with a vested interest in aquaculture.			undergraduate students	grant proposals; support 10 undergraduate students	undergraduate students	undergraduate students	
		b) Engage with other themes on an ongoing basis to ensure alignment	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Regular participation in all-team meetings; meetings and ongoing communication with themes as needed	Chen, Evans, Gabe, Hanes, Johnson, Lindenfeld, McConnon, Noblet, Teisl

Workforce Development

Goal # 6: Prepare Maine's current and future researchers, innovators, and educators with strategies that foster transdisciplinary STEM skills.

Targeted Outcomes:

- A strong, coherent, and integrated statewide STEM education system that promotes collaborations, partnerships and innovative programs to achieve goals.
- Improved workforce preparedness in STEM through P-20 teacher and student opportunities.
- Increase in Maine's capacity to conduct sustainable research on a statewide level.

Programmatic Objectives:

6.1 Opportunities for students embedded within the research program will foster the next generation of STEM professionals.

6.2 Faculty and postdoctoral associate mentoring will be used to foster recruitment, retention, career development, and the development of transdisciplinary skills in this area.

6.3 Enhance the development of educator STEM and leadership skills that will foster improvement in K-20 workforce preparedness in the research area.

6.4 Implement ME EPSCoR "SEAWaRD" programs to increase STEM awareness, aspirations, skills, and hands-on learning in K-12 students and teachers.

6.5 Statewide collaborations to build, coordinate, and implement best practices in STEM.

6.6 Coordinate programs with other NSF-supported workforce activities.

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
6.1 Opportunities for students embedded within the research program will foster the next generation of STEM professionals.	a) Undergraduate Student Research Internships	Begin recruitment; support 20-25 students	80 students supported	80 students supported	80 students supported	80 students supported
	b) Grad Student Research Internships	Begin recruitment; support 10 students	20 supported	20 supported	20 supported	20 supported
	c) Innovation for Undergrads & Grads	Recruit students; hold 1 workshop for 25 students; employ 10 students as Interns with stakeholders	Recruit students; hold 1 workshop for 25 students; employ 10 students as Interns with stakeholders	Recruit students; hold 1 workshop for 25 students; employ 10 students as Interns with stakeholders	Recruit students; hold 1 workshop for 25 students; employ 10 students as Interns with stakeholders	Recruit students; hold 1 workshop for 25 students; employ 10 students as Interns with stakeholders
	d) Curriculum Development	Form Curriculum Development Committee	Implement 1 interdisciplinary course and create distance learning opportunities	Continue course offering and expand course to reflect new research findings	Continue course offering and expand course to reflect new research findings	Continue course offering and expand course to reflect new research findings
	e) Community Colleges	Work with SMCC to develop experiential course content	Work with SMCC to pilot an experiential learning experiences as part of SMCC Marine Science Curriculum that includes monitoring and maintain a buoy and sensors in Casco Bay	Continue to implement pilot an experiential learning experiences; recruit students to become undergrad interns	Continue to implement pilot an experiential learning experiences; recruit students to become undergrad interns	Continue to implement pilot an experiential learning experiences; recruit students to become undergrad interns

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
	f) Mentoring and Retention	Develop Mentoring Oversight Committee and near-peer mentoring workshops	Train senior students to be near-peer mentors for junior students	Continue to train new senior students to be near-peer mentors for junior students	Continue to train new senior students to be near-peer mentors for junior students	Continue to train new senior students to be near-peer mentors for junior students
	g) Graduate program		Form committee to scope the development of Grad Cert. and statewide SEA Grad Program	Research Feasibility of potential Certification program and Grad School	Disseminate research outcomes and make recommendations to partner institutions	Plan and Implement research findings and recommendations
6.2 Faculty and postdoctoral associate mentoring will be used to foster recruitment, retention, career development, and the development of transdisciplinary skills in this area.	a) Postdoctoral researcher new hires	Begin search process and hire 2 new post doc.	Support 2 hires	Begin Search Process for new hires	Hire and support 3 post docs	Hire and support 3 post docs
	b) New faculty hires	Begin search process and hire 3 new UM faculty hires and 1 new UNE faculty hire	Support 4 new faculty hires	Support, mentor, retain	Support, mentor, retain	Support, mentor, retain
	c) Faculty development and mentoring		Plan for faculty mentor program and implement for four mentor pairs	Continue mentor program	Continue mentor program	Continue mentor program; plan for mentor sustainability
	d) Workshops	Host one workshop for faculty in areas of technical assistance activities (e.g.	Host one workshop for faculty in areas of technical assistance activities (e.g.	Host one workshop for faculty in areas of technical assistance activities (e.g.	Host one workshop for faculty in areas of technical assistance activities (e.g. cyber, patents, and innovation)	Host one workshop for faculty in areas of technical assistance activities (e.g. cyber, patents, and innovation)

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
		cyber, patents, and innovation)	cyber, patents, and innovation)	cyber, patents, and innovation)		
6.3 Enhance the development of educator STEM and leadership skills that will foster improvement in K-20 workforce preparedness in the research area.	a) Statewide teacher professional development workshops	Plan professional development opportunities	Host 3-5 workshops for teachers	Host 3-5 workshops for teachers	Host 3-5 workshops for teachers	Host 3-5 workshops for teachers
	b) Teacher stakeholder internships	Research Internship possibilities and feasibility	Implement teacher internships for 10 participants	Implement teacher internships for 10 participants	Implement teacher internships for 10 participants	Implement teacher internships for 10 participants
6.4 Implement ME EPSCoR "SEAWaRD" programs to increase STEM awareness, aspirations, skills, and hands-on learning in K-12 students and teachers.	a) High school research internships	30 participants	30 participants	30 participants	30 participants	30 participants
	b) Cobscook Community Learning Center (CCLC)	Work with CCLC to develop experiential course content	CCLC is developing STEM career pathways curriculum related to SEANET research to engage students	Work with CCLC to pilot an experiential learning experience for high school and native students to monitor and maintain buoys and sensors; explore additional collaborations	Work with CCLC to pilot an experiential learning experience for high school and native students to monitor and maintain buoys and sensors; explore additional collaborations	Work with CCLC to pilot an experiential learning experience for high school and native students to monitor and maintain buoys and sensors; explore additional collaborations
	c) Cooperative Extension 4H	Research and explore potential curriculum toolkit; begin development of introduction curriculum kit;	Pilot curriculum with 500 students and 60 professional; complete and duplicate one toolkit; research and complete	Pilot curriculum with 500 students and 60 professional; complete and duplicate one toolkit; research and explore next	Pilot curriculum with 500 students and 60 professional; complete and duplicate one toolkit; research and explore next	Pilot curriculum with 500 students and 60 professional; complete and duplicate one toolkit; research and explore next potential curriculum

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
		recruit 1 grad student	next curriculum toolkit; support 1 grad student	potential curriculum toolkit; support 1 grad student	potential curriculum toolkit; support 1 grad student	toolkit; support 1 grad student
	d) Native STEM Scholarship Development Program (Diversity Goal 9)	Recruit 2 Grad students; support 5-10 high school interns; STEM Summer Camp for 25 students; bi-monthly after-school program for 50 middle school students per year and 10 undergraduate and graduate AISES students	Support 2 grad students; support 5-10 high school interns; STEM Summer Camp for 25 students; leverage WaYS to conduct after-school program for 50 middle school students per year; Reestablish AiSES program at UMaine and conduct programing in Washington County for middle school students at the Passamaquoddy Boys and Girls club to expand outreach	Support 2 grad students; support 5-10 high school interns; STEM Summer Camp for 25 students; bi-monthly after-school program for 50 middle school students per year and 10 undergraduate and graduate AISES students	Support 2 grad students; support 5-10 high school interns; STEM Summer Camp for 25 students; bi-monthly after-school program for 50 middle school students per year and 10 undergraduate and graduate AISES students	Support 2 grad students; support 5-10 high school interns; STEM Summer Camp for 25 students; bi-monthly after-school program for 50 middle school students per year and 10 undergraduate and graduate AISES students
	e) UMaine Women's Resource Center (Diversity Goal 9)	Support Expanding Your Horizons (EYH) conference for 500 girls; provide STEM Workforce	Support EYH conference for 500 girls; provide STEM Workforce min-grants for 3 projects per year	Support EYH conference for 500 girls; provide STEM Workforce min-grants for 3	Support EYH conference for 500 girls; provide STEM Workforce min-grants for 3 projects	Support EYH conference for 500 girls; provide STEM Workforce min-grants for 3 projects

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
		min-grants for 3 projects per year to support up to 60 students	to support up to 60 students	projects per year to support up to 60 students	per year to support up to 60 students	per year to support up to 60 students
	f) Camp CaPella (Diversity Goal 9)	Support 100 students with disabilities; program to be determined	Support 100 students with disabilities; program to be determined	Support 100 students with disabilities; program to be determined	Support 100 students with disabilities; program to be determined	Support 100 students with disabilities; program to be determined
	g) UMaine Center for Community Inclusion and Disability Studies (Diversity Goal 9)	Support 10-15 students with disabilities; program to be determined	Support 10-15 students with disabilities; program to be determined	Support 10-15 students with disabilities; program to be determined	Support 10-15 students with disabilities; program to be determined	Support 10-15 students with disabilities; program to be determined
	g) Upward Bound (Diversity Goal 9)	Support 25-30 Upward Bound students	Support 25-30 Upward Bound students	Support 25-30 Upward Bound students	Support 25-30 Upward Bound students	Support 25-30 Upward Bound students
	h) Seed funding	Support 3 seed grant for STEM education and workforce development	Support 3 seed grant for STEM education and workforce development	Support 3 seed grant for STEM education and workforce development	Support 3 seed grant for STEM education and workforce development	Support 3 seed grant for STEM education and workforce development
6.5 Statewide collaborations to build, coordinate, and implement best practices in STEM.	a) Tribal communities (Diversity Goal 9)	Conduct assessment of Maine's tribal communities' K-20 needs	Continue and disseminate findings of assessment of Maine's tribal communities' K-20 needs			

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
	b) Statewide STEM groups	ME EPSCoR Staff will collaborate with statewide STEM education groups	ME EPSCoR Staff will collaborate with statewide STEM education groups; participate in Bi-annual STEM Summit for up to 350 participants	ME EPSCoR Staff will collaborate with statewide STEM education groups	ME EPSCoR Staff will collaborate with statewide STEM education groups; participate in Bi-annual STEM Summit for up to 350 participants	ME EPSCoR Staff will collaborate with statewide STEM education groups
6.6 Coordinate programs with other NSF-supported workforce activities.	a) NSF EPSCoR RII Track 2	Leverage SEANET workforce activities with one other Track 2 workforce activity	Leverage SEANET workforce activities with one other Track 2 workforce activity			
	b) UMaine NSF grant awardees	Explore potential collaborative opportunities	Explore potential collaborative opportunities	Explore potential collaborative opportunities	Explore potential collaborative opportunities	Explore potential collaborative opportunities
	c) UMaine RiSE Center	Explore potential collaborative opportunities for teacher education and preparedness				
	d) Other partners	Explore and leverage new workforce activities with other statewide NSF STEM awards	Explore and leverage new workforce activities with other statewide	Explore and leverage new workforce activities with other statewide	Explore and leverage new workforce activities with other statewide NSF STEM awards	Explore and leverage new workforce activities with other statewide NSF STEM awards

Goal #6: Workforce Development Strategies & Benchmarks

Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
			NSF STEM awards	NSF STEM awards		

Cyberinfrastructure

Goal # 7: Integrate cyberinfrastructure which enables research and education discovery and innovations in SEA

Targeted Outcomes:

- Cyberinfrastructure tools that are critical to advancing R&D in the state help overcome the challenges of Maine's remote, rural locations and large geographic size.
- Expanded communication tools allow for greater research, education, and innovation opportunities between partners.
- Upgraded hardware facilitates collaborative efforts for project participants.
- Visualization tools allow for greater resolution and understanding in research and education.

Programmatic Objectives:

7.1 Increased processing/storage capacity enables the RII research and education effort.

7.2 Cloud computing technology allows for optimal management of the research enterprise, data handling, shared resources, and increased collaboration opportunities.

7.3 Upgraded communication tools to foster an effective virtual organization.

Goals #7: Cyberinfrastructure - Strategies & Benchmarks

Goal #7 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
7.1 Increased processing/storage capacity enables the RII research and education effort	a) Data Centers	Purchase new storage system				
	b) Graphics Processing Unit	Purchase GPU to expand capacity for high speed graphical data and computations				
	c) Storage	200 TB of high Performance storage at AGC and 600 TB for USM				
	d) High Performance Computing	Replace ACG HPC with 512 cores and new firewall				
	e) Archiving	Add 500 TB of high performance live storage and 1500 TB of backup				
7.2 Cloud computing technology allows for optimal management of the research enterprise, data handling, shared resources, and increased collaboration opportunities	40 virtual machines deployed and supported	80 virtual machines deployed and supported	80 virtual machines deployed and supported	80 virtual machines deployed and supported		

Goals #7: Cyberinfrastructure - Strategies & Benchmarks

7.3 Upgraded communication tools	a) Visualization Walls		2 Wall system deployed at Partner Institution			
	b) Video conferencing	2 high definition videoconferencing systems to be deployed at UMaine ARI and UNE MSC	2 high definition videoconferencing systems to be deployed TBD	2 high definition videoconferencing systems to be deployed at TBD		
	c) Training Workshops	3-5 training workshops per year on CI related technologies	3-5 training workshops per year on CI related technologies	3-5 training workshops per year on CI related technologies	3-5 training workshops per year on CI related technologies	3-5 training workshops per year on CI related technologies

Seed Funding

Goal #8: Implement strategies to allow rapid and effective response to new and emerging opportunities in research, innovation, and workforce development.

Targeted Outcomes:

- Increase statewide research and STEM opportunities, collaborations and partnerships.

Programmatic Objectives:

8.1 SEANET research seed grant program.
8.2 ME EPSCoR workforce development seed grant program.
8.3 Transdisciplinary innovation working groups.
8.4 Fostering innovation technical assistance workshops.

Goals #8: SEED FUNDING - Strategies & Benchmarks

Goal #8 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
8.1 SEANET research seed grant program	a) Competitive Research Seed Grant awards	Planning Year	2 per year	2 per year	2 per year	2 per year
8.2 ME EPSCoR workforce development seed grant program	a) Competitive Workforce Grant awards	1-6 per year	1-6 per year	1-6 per year	1-6 per year	1-6 per year
8.3 Transdisciplinary innovation working groups	a) Support Transdisciplinary innovation working groups	Plan networking opportunities	Host 2-4 networking events for stakeholders, students, and faculty	Host 2-4 networking events for stakeholders, students, and faculty	Host 2-4 networking events for stakeholders, students, and faculty	Host 5 networking events for stakeholders, students, and faculty
8.4 Fostering innovation technical assistance workshops	a) Host innovation workshops	Plan workshops	Host two workshops for stakeholders, students, and faculty in areas of innovation and technical assistance	Host two workshops for stakeholders, students, and faculty in areas of innovation and technical assistance	Host two workshops for stakeholders, students, and faculty in areas of innovation and technical assistance	Host two workshops for stakeholders, students, and faculty in areas of innovation and technical assistance

Diversity & Partnerships

Goal #9: Engage the full diversity of Maine's human and institutional resources to ensure the success of the research and education program. Advance partnerships and collaborations to attain project goals, increase research competitiveness, build and strengthen the STEM pipeline in workforce development, commercialize research, and education projects, and pave the way for economic development.

Targeted Outcomes:

- Broaden participation in state STEM education programs and activities.
- Increased Native American community involvement in STEM research and education.
- Expanded opportunities in STEM research and education for women and girls.
- Greater inclusion of persons with disabilities in STEM research and education.

Programmatic Objectives:

9.1 Broaden overall participation and success through individual diversity.
9.2 Partnerships to commercialize research and education projects.
9.3 Partnerships to pave the way for economic development.
9.4 Collaborations to expand and train a STEM workforce.

Goals #9: Diversity - Strategies & Benchmarks

Goal #9 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
9.1 Broaden overall participation and success through individual diversity	a) Actions increase diversity in directly supported personnel	Women: 39% Diversity: 4% (% of total)	Women: 41% Diversity: 5% (% of total)	Women: 43% Diversity: 6% (% of total)	Women: 45% Diversity: 7% (% of total)	Women: 47% Diversity: 8% (% of total)
	b) Women and girls	560 diverse participants	560 diverse participants	560 diverse participants	560 diverse participants	560 diverse participants
	c) Expand Native American program involvement	70 participants	75 participants	80 participants	85 participants	90 participants
	d) Implement disability programs	115 participants	115 participants	115 participants	115 participants	115 participants
	e) Implement At-Risk	30 participants, including Upward Bound and other programs to be determined	30 participants, including Upward Bound and other programs to be determined	30 participants, including Upward Bound and other programs to be determined	30 participants, including Upward Bound and other programs to be determined	30 participants, including Upward Bound and other programs to be determined
	f) STEM Career Pathways	Begin Planning	Finalize pilot	Engage workforce and diversity programs	Engage workforce and diversity programs	Engage workforce and diversity programs
9.2 Partnerships to commercialize research and education projects	Expand #PUI & Community College	6 institutions	One additional, 7 institutions total	One additional, 8 institutions total	One additional, 9 institutions total	One additional, 10 institutions total
9.3 Partnerships to pave the way for economic development	a) Host innovation workshops and other research related needs	Host one workshop	Host one workshop	Host one workshop	Host one workshop	Host one workshop
	b) Coordinate with local NGOs and Stakeholders	Begin planning	Utilize research-intensive SEA	Utilize research-intensive	Utilize research-intensive SEA Farms	Utilize research-intensive SEA Farms for

Goals #9: Diversity - Strategies & Benchmarks

	to increase opportunities		Farms for outreach	SEA Farms for outreach	for outreach and begin GIS model	outreach and complete GIS model
9.4 Collaborations to expand and train a STEM workforce	a) Support education of undergrads through innovation workshops and SENCER	Host two workshops per year	Host two workshops per year	Host two workshops per year	Host two workshops per year	Host two workshops per year
	b) Support STEM Education for Prek-12 through partnerships and teacher professional development	Begin Planning	500 participants	550 participants	600 participants	650 participants
	c) Tribal communities	Conduct assessment of Maine's tribal communities' K-20 needs	Continue and disseminate findings of assessment of Maine's tribal communities' K-20 needs			

Communication and Dissemination

Goal # 10: Create and maintain effective outreach & communication network through strategies that encompass all participants, stakeholders, and the general public.

Targeted Outcomes:

- Effective communication networks enable successful collaboration, interdisciplinary team building, and sharing of ideas and data.
- Outreach programs and partnerships expand institutional participation, knowledge, and engagement.
- Maine's citizenry achieve a greater understanding of sustainability science issues.

Programmatic Objectives:

10.1 Implement communication strategies for efficient data sharing among program partners and to foster coordination across disciplines, teams, and institutions.

10.2 Stakeholder engagement to ensure two-way sharing throughout the research process.

10.3 Disseminating research results to the scientific community to further knowledge and increase collaboration opportunities.

10.4 Dissemination of results and impacts to build an informed citizenry with enhanced awareness of the societal benefits of research, and to build research and education capacity.

10.5 Communications with NSF and other EPSCoR jurisdictions to enhance collaborations.

Goal #10: Communication and Dissemination – Strategies & Benchmarks

Goal #10 Objectives:	Strategies:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
10.1: Data sharing communication strategies.	a) Monthly team meetings	Conduct one meeting a month using technology to encourage attendance	Conduct one meeting a month using technology to encourage attendance	Conduct one meeting a month using technology to encourage attendance	Conduct one meeting a month using technology to encourage attendance	Conduct one meeting a month using technology to encourage attendance
	b) Seminar series, innovation workshops and theme-based workshops	Conduct 2-3 innovation workshops and 3-5 seminar series	Conduct 2-3 innovation workshops and 3-5 seminar series	Conduct 2-3 innovation workshops and 3-5 seminar series	Conduct 2-3 innovation workshops and 3-5 seminar series	Conduct 2-3 innovation workshops and 3-5 seminar series, conduct 3 theme-based workshops
	c) Science communication training	Conduct 2 per year for faculty and students	Conduct 2 per year for faculty and students	Conduct 2 per year for faculty and students	Conduct 2 per year for faculty and students	Conduct 2 per year for faculty and students
	d) Internal program website	Updated regularly – at least monthly and alert users of changes	Updated regularly – at least monthly and alert users of changes	Updated regularly – at least monthly and alert users of changes	Updated regularly – at least monthly and alert users of changes	Updated regularly – at least monthly and alert users of changes
	e) Newsletters	Publish 2 per year	Publish 2 per year	Publish 2 per year	Publish 2 per year	Publish 2 per year
	f) CI improvements	Improve video conferencing technology; find ways to collaborate virtually; complete set up in year one	Continue use of video conferencing technology; improve or expand virtual collaboration opportunities	Continue use of video conferencing technology; improve or expand virtual collaboration opportunities	Continue use of video conferencing technology; improve or expand virtual collaboration opportunities	Continue use of video conferencing technology; improve or expand virtual collaboration opportunities
10.2: Stakeholder engagement.	a) Stakeholder advisory board	Convene group once in year 1	Convene group once in year two	Convene group once in year three	Convene group once in year four	Convene group once in year five
	b) Bio-regional symposia	Conduct 3 bio-regional symposium	Conduct 1 bio-regional symposium	Conduct 1 bio-regional symposium	Conduct 1 bio-regional symposium	Conduct 3 bio-regional symposium
	c) Aquaculture Bootcamps	Conduct 2 bootcamps	Conduct 1 bootcamp			
10.3: Communicate with scientific community.	Publications, presentations, conferences, Web sites	1 major publication; 10 technical presentations; sponsor ME EPSCoR State Conference	3 major publications; 40 technical presentations; present at NSF EPSCoR National Conference	5 major publications; 50 technical presentations; sponsor ME EPSCoR State Conference	7 major publications; 60 technical presentations; sponsor ME EPSCoR State Conference: present at NSF EPSCoR National Conference	9 major publications; 70 technical presentations; sponsor ME EPSCoR State Conference

Goal #10: Communication and Dissemination – Strategies & Benchmarks

Goal #10 Objectives:	Strategies:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
10.4 Disseminate results to build an informed citizenry.	a) Networking with media partners	Conduct editorial visit or networking visit with at least one media outlet; coordinate with UMaine Marketing and Communication Department	Conduct editorial visit or networking visit with at least one media outlet; coordinate with UMaine Marketing and Communication Department	Conduct editorial visit or networking visit with at least one media outlet; coordinate with UMaine Marketing and Communication Department	Conduct editorial visit or networking visit with at least one media outlet; coordinate with UMaine Marketing and Communication Department	Conduct editorial visit or networking visit with at least one media outlet; coordinate with UMaine Marketing and Communication Department
	b) Web-based SEANET knowledge portal		Complete initial phase of design of portal in year two.	Make improvements and update	Make improvements and update	Make improvements and update
	c) ME EPSCoR website redesign	Examine ways to redesign Maine EPSCoR website to include SEANET and incorporate	Update on a monthly basis	Update on a monthly basis	Update on a monthly basis	Update on a monthly basis
	d) Guest/invited presentations/lectures	Provide 4-7 per year	Provide 4-7 per year	Provide 4-7 per year	Provide 4-7 per year	Provide 4-7 per year
	e) Professional videos	Produce 3-5 per year related to research and workforce development	Produce 3-5 per year related to research and workforce development	Produce 3-5 per year related to research and workforce development	Produce 3-5 per year related to research and workforce development	Produce 3-5 per year related to research and workforce development
	f) Social media	Update social media sites weekly	Update social media sites weekly	Update social media sites weekly	Update social media sites weekly	Update social media sites weekly
	g) K-12 communities linking workforce development activities to communications resources	Create one link with workforce development per year to expander broader understanding of the research projects	Create one link with workforce development per year to expander broader understanding of the research projects	Create one link with workforce development per year to expander broader understanding of the research projects	Create one link with workforce development per year to expander broader understanding of the research projects	Create one link with workforce development per year to expander broader understanding of the research projects
	h) Research and workforce presentations		Present at STEM Summit		Present at STEM Summit	
	i) Develop smartphone aps related to research and workforce needs	Plan	Plan and begin development	Continue development	Roll out prototypes and test	Produce 1-3 apps by year five
	j) posters/exhibits	Create SEANET display for	Update display as needed	Update display as needed	Update display as needed	Update display as needed

Goal #10: Communication and Dissemination – Strategies & Benchmarks

Goal #10 Objectives:	Strategies:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
		EPSCoR exhibit board				
	k) Interactive exhibits	Work with the Discovery Museum on planning for an interactive exhibit	Create interactive exhibit for Maine Discovery Museum	Evaluate and improve exhibit for Maine Discovery Museum	Evaluate and improve exhibit for Maine Discovery Museum	Evaluate and improve exhibit for Maine Discovery Museum
	l) Other communication mechanisms	Conduct Maine EPSCoR State Conference; create project print media (brochures, flyers, posters, etc.)	Co-sponsor National EPSCoR Conference with NH; create project print media (brochures, flyers, posters, etc.)	Conduct Maine EPSCoR State Conference; create project print media (brochures, flyers, posters, etc.)	Conduct Maine EPSCoR State Conference; create project print media (brochures, flyers, posters, etc.)	Conduct Maine EPSCoR State Conference; create project print media (brochures, flyers, posters, etc.)
	l) Track and evaluate communications	Track and evaluate communications activities on a monthly basis	Track and evaluate communications activities on a monthly basis	Track and evaluate communications activities on a monthly basis	Track and evaluate communications activities on a monthly basis	Track and evaluate communications activities on a monthly basis
10.5 Outreach and communications with the NSF EPSCoR community.	NSF EPSCoR Office program officer & staff communications; other jurisdictions	Provide one check-in on a monthly basis; connect with other jurisdictions at least once a year; participate in NSF Communicating Science activities as requested	Provide one check-in on a monthly basis; connect with other jurisdictions at least once a year; participate in NSF Communicating Science activities as requested	Provide one check-in on a monthly basis; connect with other jurisdictions at least once a year; participate in NSF Communicating Science activities as requested	Provide one check-in on a monthly basis; connect with other jurisdictions at least once a year; participate in NSF Communicating Science activities as requested	Provide one check-in on a monthly basis; connect with other jurisdictions at least once a year; participate in NSF Communicating Science activities as requested

Sustainability

Goal # 11: Create lasting operational support for the proposed infrastructure despite changes in funding sources, research foci, service providers, participating scientists, and stakeholders.

Targeted Outcomes:

- SEANET has a diverse but targeted portfolio of research, with evidence of success that lays the foundation for post-RII continuation.
- SEANET has a post-RII diverse portfolio of external funding, including grants and contracts from federal and state agencies, private sector contracts, private foundation grants, and philanthropic gifts from individual donors – that allows it to retain a critical mass of expertise for sustainable ecological aquaculture research.

Programmatic Objectives:

11.1 Fostering partnerships and collaborations for a secure future.

11.2 Provide post-RII sustainability for SEANET through external grants, contracts, and other support mechanisms.

Goal #11: Sustainability – Strategies & Benchmarks						
Goal #11 Objectives:	**Strategies:**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
11.1 Foster partnerships and collaborations for a secure future	a) Maximize inter-institutional collaboration	Establish SEANET partners program for other institutions	Implement SEANET partner integration efforts	Expand integration efforts across institutions	Expand collaboration via virtual organizational capabilities	Prepare for post-RII continuation of partnerships
	b) Build a network of university-stakeholder partnerships	Require all SEANET projects to have stakeholder participation	Develop stakeholder database	Refine collection process for stakeholder collaboration information	Explore ways to further the stakeholder network	Plan for post-RII continuation of stakeholder networks
	c) Conduct annual all-team retreat	Conduct annual all-team retreat	Conduct annual all-team retreat	Conduct annual all-team retreat	Conduct annual all-team retreat	Conduct annual all-team retreat
11.2 Provide post-RII sustainability for SEANET through external grants, contracts and other support mechanisms	a) Provide grant development support for SEANET teams	1 grant writing workshop; NSF Program Officer outreach	Management Team support for collaborative grantwriting; NSF Program Officer outreach	Host workshop to strengthen capacity to procure external grant proposals; NSF Program Officer outreach	Management Team support for collaborative grantwriting; NSF Program Officer outreach	Management Team support for collaborative grantwriting; NSF Program Officer outreach
	b) Expand state and federal agency relationships	Funding opportunities database	Expand database and inventory of contracts; plan scoping meetings	Make 2 new agency contacts	Make 2 new agency contacts	Make 2 new agency contacts
	c) Develop base of foundation and private support; build SEANET endowment	Identify foundations with aligned goals	Expand foundation list; cultivate relationships with 2 foundations	Add 2 more foundation relationships; look at potential endowment donors	Add 2 more foundation relationships; look at potential endowment donors	Add 2 more foundation relationships; look at potential endowment donors

Evaluation & Assessment

Goal # 12: Conduct effective evaluation to ensure attainment of goals and produce on-going feedback to the Management Team.

Targeted Outcomes:

- SEANET participants achieve greater capacity and competitiveness in this field.
- Findings are used to enhance efficacy, identify obstacles, and assist in developing corrective action plans.
- The appropriateness of the investment relative to accomplishment is firmly established.
- New knowledge gained allows for more effective planning, strategic actions, and management

Programmatic Objectives:

12.1 Independent external evaluation to provide ongoing assessment and feedback to the Management Team.
12.2 AAAS to provide evaluation, review and guidance for all project components.
12.3 A Technical Advisory Board provides scientific guidance to the project.
12.4 NSF EPSCoR review activities to assist in ongoig refinement of the project.
12.5 Internal management processes to ensure that program achieves goals, objectives, and milestones.

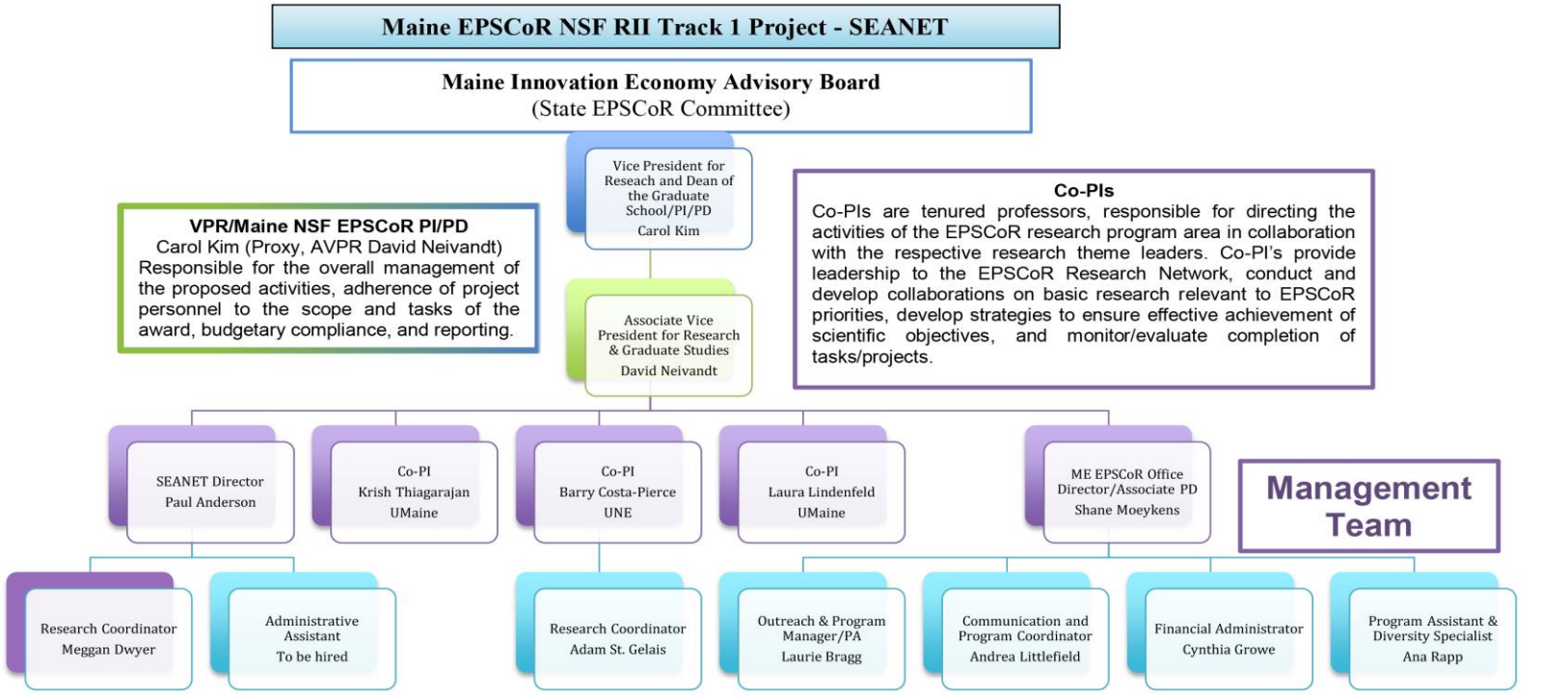
Goal #12: Evaluation & Assessment - Strategies & Benchmarks

Goal #12 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
12.1 External evaluation by independent reviewer	a) Annually assess overall project performance	Initial planning and evaluation development; baseline survey; report	Year-round review; case analysis; surveys; 1-2 site visits; annual report	Year-round review; case analysis; surveys; 1-2 site visits; annual report	Year-round review; case analysis; surveys; 1-2 site visits; annual report	Year-round review; case analysis; surveys; 1-2 site visits; annual report
	b) Utilize qualitative investigations	Develop analysis matrix for qualitative investigations	Report on qualitative investigations (June 2016)	Report on qualitative investigations (June 2017)	Report on qualitative investigations (June 2018)	Report on qualitative investigations (June 2019)
	c) Utilize quantitative analysis	Develop analysis matrix for attitudinal, network, productivity, and other behavioral data	Report on analysis of attitudinal, network, productivity, and other behavioral data (June 2016)	Report on analysis of attitudinal, network, productivity, and other behavioral data (June 2017)	Report on analysis of attitudinal, network, productivity, and other behavioral data (June 2018)	Report on analysis of attitudinal, network, productivity, and other behavioral data (June 2019)
	d) Feedback loop	Disseminate report to SEANET teams; Management review & recommendations (July 2015)	Disseminate report to SEANET teams; Management review & recommendations (August 2016)	Disseminate report to SEANET teams; Management review & recommendations (August 2017)	Disseminate report to SEANET teams; Management review & recommendations (August 2018)	Disseminate report to SEANET teams; Management review & recommendations (July 2019)
12.2 AAAS assessment	a) AAAS on-site assessment	Plan	Two-day site visit of national panel (4-5 members) perform review	Plan	Two-day site visit of national panel (4-5 members) perform review	N/A
	b) AAAS report & feedback loop	NA	AAAS panel produces assessment report	Disseminate report to SEANET teams; Management review & recommendations	AAAS panel produces assessment report	Disseminate report to SEANET teams; Management review & recommendations
12.3 Technical Advisory Board	a) On-going evaluation & assessment	Establish board with 10 members - first site visit	1-3 phone or videoconference meetings; site visit	1-3 phone or videoconference meetings	1-3 phone or videoconference meetings; site visit	1-3 phone or videoconference meetings; site visit

Goal #12: Evaluation & Assessment - Strategies & Benchmarks

Goal #12 Objectives:	Strategies:	Year 1	Year 2	Year 3	Year 4	Year 5
	b) Identify opportunities and resources.		SEANET Advisory Board review and provide feedback on external funding requests from SEANET, as needed. Recommendations to ME EPSCoR Mgt Team for final funding decision. (May 2016)	SEANET Advisory Board review and provide feedback on external funding requests from SEANET, as needed. Recommendations to ME EPSCoR Mgt Team for final funding decision. (May 2017)	SEANET Advisory Board review and provide feedback on external funding requests from SEANET, as needed. Recommendations to ME EPSCoR Mgt Team for final funding decision. (May 2018)	SEANET Advisory Board review and provide feedback on external funding requests from SEANET, as needed. Recommendations to ME EPSCoR Mgt Team for final funding decision. (May 2019)
12.4 NSF evaluation & assessment	a) NSF EPSCoR Reverse Site visit	NA	RSV; management review & recommendations	NA	RSV; management review & recommendations	NA
	b) NSF program officer visit	ME EPSCoR State Conference	ME EPSCoR State Conference	ME EPSCoR State Conference	ME EPSCoR State Conference	ME EPSCoR State Conference
	C) Attend NSF EPSCoR national conferences & workshops	NSF EPSCoR National Conference, PD/PA meetings, any special EPSCoR training workshops (on-going)	NSF EPSCoR National Conference, PD/PA meetings, any special EPSCoR training workshops (on-going)	NSF EPSCoR National Conference, PD/PA meetings, any special EPSCoR training workshops (on-going)	NSF EPSCoR National Conference, PD/PA meetings, any special EPSCoR training workshops (on-going)	NSF EPSCoR National Conference, PD/PA meetings, any special EPSCoR training workshops (on-going)
	d) NSF EPSCoR reporting	Annual report filed on time	Annual report filed on time	Annual report filed on time	Annual report filed on time	Final report filed on time
12.5 Maine EPSCoR management and SEANET	a) ME EPSCoR & SEANET management	Mgt Team weekly; Stewardship Council monthly	Mgt Team weekly; Stewardship Council monthly	Mgt Team weekly; Stewardship Council monthly	Mgt Team weekly; Stewardship Council monthly	Mgt Team weekly; Stewardship Council monthly
	b) MIEAB reporting (state committee)	September 2015	September 2016	September 2017	September 2018	September 2019

Maine EPSCoR SEANET Organizational Chart



SEANET Director

Oversees SEANET research network operations; translates research findings into practice; develops collaborations with regional, national and international organizations to develop Maine coastal economy.

SEANET Office

SEANET Office staff provide day-to-day operational support to the Management Team and Stewardship Council in the management of all research components of the NSF RII EPSCoR Track I award to ensure that all activities conform to the research goals and benchmarks. SEANET Office staff will also provide support to project faculty, students, and partners.

Maine EPSCoR State Director/Associate PD

Provides professional leadership, vision, and overall program management for the Maine EPSCoR office and portfolio of funded EPSCoR awards.

ME EPSCoR Office

EPSCoR Office staff bolsters the effectiveness of project coordination and management by providing staff and expertise for administrative and financial management, communications, and outreach. Responsibilities include coordination and implementation of: workforce development activities; broadening participation, joint conferences and workshops; AAAS evaluations; data collection and reporting; and general oversight of project compliance and progress.

Stewardship Council (SC)

SEANET includes three research themes and two cross-cutting themes. UMaine and UNE faculty serve as co-leaders of research and cross-cutting themes to ensure communication across the research themes and across disciplines. This approach creates a core faculty group to plan and implement the activities with an interdisciplinary and collaborative perspective. Theme leaders communicate with their respective theme teams to ensure ongoing collaboration. Management Team (MT) and SC members also serve as theme co-leaders, ensuring functional redundancy. The SC meets at least monthly and implements proposals from the MT with regard to the management of the research program, and the workforce development program embedded in the research program. Theme leaders and co-leaders are members of the SC.

Project Participants

THE UNIVERSITY OF MAINE

UNIVERSITY OF NEW ENGLAND

Collaborating Partners

Bowdoin

SAINT JOSEPH'S COLLEGE

Cobscook Community Learning Center

THE UNIVERSITY OF MAINE AT MACHIAS Naturally!

MAINE MARITIME ACADEMY

UNIVERSITY OF SOUTHERN MAINE
PORTLAND • GORHAM • LEWISTON • ONLINE

DOWNEAST INSTITUTE FOR APPLIED MARINE RESEARCH AND EDUCATION