Maine Policy Review

Volume 32
Issue 2 *Our Shared Ocean*

2023

# Community Science's Contributions to Fostering Relational Values to Overcome Coastal Ecosystems Challenges

Kanae Tokunaga
*Gulf of Maine Research Institute*, ktokunaga@gmri.org

Pauline Angione
*Town of Gouldsboro*, pangione@gmail.com

Bill Zoellick
*Town of Gouldsboro*, bill@zoellick.com

Gayle Bowness
*Gulf of Maine Research Institute*, gayle@gmri.org

Sheba Brown
*Gulf of Maine Research Institute*, sbrown@gmri.org

*See next page for additional authors*

# Community Science's Contributions to Fostering Relational Values to Overcome Coastal Ecosystems Challenges


## Authors

Kanae Tokunaga, Pauline Angione, Bill Zoellick, Gayle Bowness, Sheba Brown, Claire Enterline, Sarah L. Kirn, Abigail Long, Stephanie Sun, and Aaron Whitman

# Community Science's Contributions to Fostering Relational Values to Overcome Coastal Ecosystems Challenges

by Kanae Tokunaga, Pauline Angione, Bill Zoellick, Gayle Bowness, Sheba Brown, Claire Enterline, Sarah Kirn, Abigail Long, Stephanie Sun, and Aaron Whitman

## ABSTRACT

This paper applies the emerging concept of relational values—values people hold toward their relationships with nature and with each other—and brings attention to the role of community science in enhancing relational ecosystem values. We feature Gouldsboro Shore, the Gulf of Maine Research Institute's (GMRI) coastal flood monitoring, and river herring monitoring and restoration efforts as focal examples. In each case, community science contributed to enhancing both people-nature and people-people relationships in the community to overcome coastal ecosystem challenges.

## INTRODUCTION

Community science, which we define as scientific research and monitoring done in partnership with a diverse range of communities with the goal of advancing scientific knowledge and addressing community-defined needs and concerns, activates participants' local knowledge and promotes their sense of belonging to the community. This paper presents community science as an approach to foster people-nature and people-people relationships in coastal and near-shore environments and offers a perspective on how community science can turn individuals' pro-environmental and pro-social values into action for communities to achieve broader societal objectives. We build on the notion of relational value, described as "preferences, principles and virtues about human-nature relationships" (Chan et al. 2018: A1), developed alongside Nature's Contribution to People within the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) framework. Relational value captures the value that cannot be recovered by instrumental or intrinsic values conventionally used in ecosystem service valuation. The notion allows us to elucidate what "people find meaningful about nature" (Chan et al. 2018: A4) and reflect eudaimonic values, meaning those that foster the pursuit of purpose leading to contentment or enhancement of well-being, in environmental decision-making.

Modern environmental decision-making relies heavily on the quantification of ecosystem service values and top-down decisions. The idea of ecosystem services emerged in the 1970s as a framework to communicate values that nature (i.e., ecosystem function) provides to humans (Gomez-Baggethun et al. 2010). Following this utilitarian perspective, monetary evaluation of ecosystem services became a common practice to inform conservation planning and land as well as marine spatial use policies (Egoh et al. 2007). The Millennium Ecosystem Assessment (MEA 2003), commissioned by the United Nations, was the first global-scale concerted scientific effort to evaluate the contributions of ecosystems to human well-being and established the key conceptual and methodological framework for ecosystem service valuation. The idea of viewing and evaluating nature solely through the lens of ecosystem services came under critique by various social scientists (Himes and Muraca 2018; Ishihara 2018). These critiques and practical challenges associated with assessing ecosystem services resulted in the theoretical development of nature values by social scientists, most notably, the development of the "relational value" concept. The concept builds on the notion that ecosystem services, especially cultural values, are something that is a "co-produced and co-created outcome of peoples' interaction with ecosystems" (Fish et al. 2016: 209). A recent methodological assessment conducted by IPBES describes relational value as "the importance of desirable, meaningful, and often reciprocal relationships... between humans and nature, and among humans (including across generations) through nature (e.g., sense of place,

spirituality, responsibility, care, reciprocity, stewardship)".[1] Ecosystem services studied through the lens of people-nature and people-people relationships offer a more holistic way to capture the values nature entails.

Our definition of community science reflects the desire to engage with and create transparency around the practice of bringing community into the scientific process to define a shared goal. It also considers feedback, needs, and concerns often raised by participating communities. The definition encompasses a shared vision for a collaborative problem-solving process including codesign of protocols and bringing expertise and experience of both scientists and the community together. As communities evolve their practice of community science, their aim grows to collaboratively address questions co-created between communities and scientists to develop deep engagement across disciplines and experiences. There is broad recognition among community members of the value in pursuing this work, which may or may not be purely a function of answering scientific questions. The value to the community may also lie in the experience: self-organizing, cooperating, involving youth in consequential work, using the tools and processes of science, and using the results of the research to advocate on their own behalf, advance the goals and needs of the community, and to inform community practice or regulatory decisions.

How community science is done affects what happens as a result of a project. Choices made by organizers regarding everything from the content and structure of volunteer training and engagement, technical and legal solutions to data collection, management, and use, and how the results are shared have a significant influence on a project's ability to achieve its goals. It should also be noted that there are at least two outcomes of community science goals: achieving the scientific purpose as defined by the community and the indirect value of the experience of those who participate in the project. This paper focuses on the latter goal and argues that successful community science programs should foster relational values, thereby enhancing what participants find meaningful about nature and their communities.

Coastal and near-shore areas are hotspots of human-nature interaction. As such, relational value may serve as a useful framework for evaluating and understanding people-nature values. Furthermore, from a community and ecological resilience perspective, enhancement of relational values can contribute to environmental stewardship, community revitalization, and scientific and other types of knowledge that enhance resilience planning. We argue that community science programs designed to promote relational values have a better chance of accomplishing social and ecological objectives than projects focused on scientific goals alone. We present three community science programs that fostered people-nature and people-people relationships. Our focus is to demonstrate how community science can contribute to fostering relational values of coastal ecosystems and overcoming ecological challenges that many coastal communities are facing. We discuss a set of design principles based on the case studies and collective experiences and expertise shared by the author team.

## COMMUNITY SCIENCE PROGRAMS ACTIVATE RELATIONAL VALUES

The following case narratives were developed by those who designed, facilitated, and/or supported the community science programs. Each narrative consists of a description of the objectives and participants, a reflection on the program's challenges and successes, and an examination of the program's contribution to building and activating people-nature and people-people relationships to achieve broader societal objectives.

### *The Gouldsboro Shore Initiative*

In Gouldsboro, community science to restore clam flats created social capital that enables the town to address broader climate and social challenges. We focus here on how community science led to social capital growth. See the Gouldsboro Shore website[2] for information about research objectives, methods, and outcomes for the community science activities.

#### A shellfish resilience lab

As in many coastal communities, green crabs (*Carcinus maenas*) have hit Gouldsboro's clam fishery hard. Since 2014, the town's shellfish committee has restored clam flats by seeding them with one-year-old clams. The committee sought to expand this work by starting with less expensive, newly hatched clams and growing them through their first summer and winter as clam seed for the following spring. With support from the Maine Shellfish Restoration and Resilience Fund, Gouldsboro developed its Shellfish Resilience Lab to learn whether a community-scale clam nursery was operationally and economically viable.

The Shellfish Lab is now in its third year. When it began in 2021, the intent was to grow the newly hatched clams in the harbor behind the lab in the summer, bringing them into the lab's indoor tank in the winter. Volunteers assisted in placing 100,000 small clams into 10 nursery trays, with screening on the top and bottom to enable water circulation. The trays floated in the harbor all summer, requiring only periodic attention. On a bright, cold November day, shellfish committee members and a dozen volunteers separated live clams from algae and broken clam shells, removed green crabs, and took samples to estimate growth and survival rates. They shared pizza, swapped stories, and emerged as the core of a group that would expand and become essential to lab operations.

Clam growth over the summer was adequate,[3] but the trays contained many green crabs, resulting in a clam survival rate of about 33 percent. After consulting with experts, lab leadership decided to grow a portion of the newly hatched clams in an upweller system inside the lab in 2022. The upweller required much more daily attention than the nursery trays. After Gouldsboro's 2022 summer intern returned to school, volunteers were in the lab daily to handle routine cleaning and weekly to collect growth data and drain and clean the tank.

### About clams and beyond

Gouldsboro's Shellfish Lab and the town's broader effort to keep the softshell clam fishery viable have drawn attention from within and outside the community. Drawing on the lab's visibility, the shellfish committee sponsored a Community Clam Dig in October 2022 to explain how to obtain recreational shellfish licenses, find clams, and use a clam rake. After meeting with the shellfish committee to document key access points, volunteers reached out to Maine Coast Heritage Trust and property owners to preserve access. A companion article in this issue of *Maine Policy Review emerged* from that work. For the past two summers, lab volunteers and the town have sponsored well-attended Meet Your Local Clam events where people can sample clam and green-crab recipes while learning about clam harvesting's role in the community. These venues provide opportunities to talk with property owners about shore access. The lab even received a visit from Governor Mills.

Beyond the work with clams, two beneficial outcomes emerged from the community science activities. First, the work with clams opened conversations about how changes in climate and property ownership affect the town. Second, the years of successful collaboration between volunteers, town officials, and town staff have built the capacity to address other community resilience concerns. In 2022, the town and the volunteers acquired state funding to report how sea-level rise, storms, and other climate change effects might affect Gouldsboro's shore infrastructure. Town staff and volunteers organized a Sunday afternoon workshop in early 2023 to share the report with the community and consider other issues critical to the town's future, such as food insecurity and workforce housing. More than 60 people participated over three hours.

*Governor Mills and Gouldsboro shellfish warden Mike Pinkham at the Shellfish Lab*

The volunteers who came together around clams see these projects as a continuation of work that began as community science in the Shellfish Lab. As Gouldsboro moves toward membership in the state's Community Resilience Partnership, volunteers, town staff, and elected officials who worked together on clam flat resilience are central to the work toward community resilience.

### *Gulf of Maine Research Institute's Coastal Flood Monitoring*

With more than 5,000 miles of diverse tidal coastline and only three long-term NOAA tide gauges, Maine lacks the data to support local coastal sea-level rise and storm surge resilience planning. Coastal flooding adaptation efforts rely heavily upon accurate sea-level rise and storm surge flood projections that integrate both near and long-term assessments based on local water levels and flood impacts. Efforts to build coastal flood resilience in Maine face

significant challenges, including limited tide-gauge coverage and observation-based flood thresholds and the absence of a robust network of researchers, civic leaders, engaged community members, and resilience practitioners. The objective of the Coastal Flooding Community Science project is to build a scalable method for establishing the infrastructure to enable communities to collect local water level and flood impact data that can be leveraged for building sea-level rise and storm surge resilience. This project aims to answer the question, "What water level and weather conditions lead to local flooding?"

In partnership with local decision-makers, the National Weather Service (NWS), and the Maine Emergency Management Agency, GMRI selected vulnerable sites for tidal flood monitoring, installed Hohonu tide gauges, and developed a protocol for collecting tidal flood impact observations. The first section of the protocol asks contributors to note the times and locations in which they are collecting data and to describe the water levels they observe, identify evidence of tidal flood events, describe weather conditions, and share photographs of what they see. The latter portion of the protocol asks participants to describe their role within their community, rate their level of concern about tidal flooding, describe how prepared they feel their community is to address flooding, and share the types of adaptation efforts they would like to see prioritized. We also invite participants to share stories of past tidal flooding events they have observed or how their community's coastline has changed over time. Data collected through this project is shared with NWS to pair local tidal flood impact statements with water-level forecasts and will be integrated into open-access user-friendly data viewers that can also be leveraged in municipal planning processes.

Contributors to this project include the National Weather Service, Municipal Leaders, Hohonu, Northeastern Regional Association of Coastal Ocean Observing Systems, NOAA Office of Coastal Management, community-based organizations, educators, coastal residents, and tourists. This project is unique in how it engages middle school educators and their students in the flood-monitoring protocol. Localized observations of tidal flooding provide a range of benefits for participants, partner organizations, and municipalities. Through the Coastal Flooding Community Science project, communities can better understand their tidal flood threshold. Furthermore, the project can leverage engagement through participants' sharing of their levels of concern and preferred adaptation methods to allow participants to contribute to broader municipal decision-making processes.

*Community members making coastal flooding observations at Portland Pier.*

Photo: Gulf of Maine Research Institute

## Participating and contributing to science

Developing close relationships with community partners including municipal offices, libraries, land trusts, and schools has increased engagement and awareness and therefore the amount and quality of data collected. To expand the project, we asked our partners from the National Weather Service and a handful of local communities to test and revise protocols to ensure usability and comprehension by a wide range of participants. This feedback created an informed and accessible protocol to be used for all ages.

The Coastal Flooding Community Science project relies heavily on these trusted relationships to succeed, but also relies on the participation of a wide range of people. Contributing data online is meant to be easy, but we received feedback that it could be easier through the use of an app or simpler link. There was also the question of, "How is my data used?" To combat these questions, we have created signs with QR codes for easy access to the site, along with instructions on how to contribute. We will also be creating a data visualization tool that synthesizes observational data with real-time tidal water level and weather data allowing for a comprehensive view into the impact of coastal flooding and why observations are important.

## Sense of place

The coastal flooding project connects people to place through the coselection of specific flood-monitoring sites. These sites were selected by municipal partners and community members based on what areas were considered most

important and most vulnerable. The selection of these sites along with the collection of data connects people to their local decision-making process, further enhancing people-people relationships, especially when those individuals are participating outside of a job and rather as part of a community.

The data collection itself enhances both people-nature and people-people relationships. The project builds awareness of when predicted high tides occur, which leads people to make close observations of the coastline therefore enhancing people-nature relationships. Data collection builds a greater understanding of when flooding will occur and what the impacts are. To engage folks in data collection, we hosted coastal meetups to make observations, learn about sea level rise, and build community. These coastal meetups allowed community members to witness the impacts of coastal flooding and sea level rise firsthand and left space for stories to be shared and connections to be made. The structure of the project and the use of coastal meetups contributed to dual goals of collecting local data and building community knowledge and resilience, therefore enhancing both people-nature and people-people relationships.

### *Restoring River Herring*

River herring are two species of diadromous fishes, blueback herring and alewife, that live their adult lives in marine waters, but return to their natal freshwater rivers, lakes, and ponds each spring to spawn. In the early 2010s, river herring populations had become depleted in most of their range, from Florida to Maine, due primarily to restricted access to their spawning grounds by dams and undersized crossings that impede or completely block passage. The drop in populations led to the closure of multiple commercial harvests and to consideration of the two species for listing under the Endangered Species Act. Concurrently, however, large-scale dam removals on the Kennebec River resulted in a population rebound from a few thousand fish to a run of over 2 million within the river system. The success of this restoration effort within the state, combined with concern over harvest closures and depleted river herring populations at other sites in Maine, led to interest among many communities to learn more about and to support restoration of their river herring runs. The local interests and concerns coincided with a need by fisheries biologists and managers to gather more data about river herring populations and to complete more habitat and connectivity restoration projects. Community science provides crucial data for river herring monitoring, and community volunteers, local and state government, academic and scientific institutions, and nongovernmental organizations (NGOs) all take part in this effort (Bieluch et al. 2017).

Two local efforts provide examples of how community engagement that supported success in fish population restoration also increased community relationships, sense of place, and long-term people-nature and people-people partnerships. At Patten Stream in Surry, Maine, the town commercial river herring harvest was closed by state and regional decision in 2012 due to the extremely small run size compared to historical numbers and the modeled potential run size. Town officials and community members identified the cause of the problem as a culvert that was limiting the passage of fish and concluded that a fishway was essential for river herring to reach their spawning grounds. Community engagement was essential to develop plans to move forward with restoration, as well as boots-on-the-ground data collection, and passing of fish by hand across the obstructing culvert. A dedicated group of community members formed the town's first Alewife Committee and worked with biologists, a restoration practitioner, and a fish passage engineer to construct and secure funding for a fish passage structure. This group continues to steward the run after 10 years. The codevelopment of the restoration project and community science data collection effort with local individuals led to their success, not only ecologically but also socially through enhanced community relationships. In addition to the nature-people and people-people connections made through planning and performing community science data collection and restoration planning, the work brought community members together through walk-and-talks with biologists, celebrations of fish passage construction, and continued annual events, which increase both ecological and social connections. These increased connections led a local author, Susan Hand Shetterly, to write a children's book about alewife runs and the importance of passage, Swimming Home, and to include a chapter describing these connections in her book, Seaweed Chronicles. It is through the continued leadership and dedication of these community members, led by Barbara and Pat Tedesco, that the volunteer run count continues after 10 years, the fish passage structure is maintained, and additional community science efforts are being added to the work through zooplankton sampling and water-quality monitoring in the alewives' spawning and juvenile rearing pond. This work has increased the community's

*Participants converse with researchers at an Alewife Mitigation Walk to Talk event.*

Photo: Gulf of Maine Research Institute

connection to the alewife run and their connection to each other.Direct interactions with scientific communities

At the outlet of Highland Lake in Westbrook, Maine, a fishway was built by the state's marine fisheries agency in the 1970s at a dam that had previously completely obstructed alewife passage to this historical spawning site. As a state-owned fishway, the Department of Marine Resources was responsible for maintaining the structure and ensuring passage. Performing quantitative run counts, however, was infeasible given available staffing. In the early 2010s, based on the growing concern over low population levels of river herring and interest in restoring the run in the Presumpscot River watershed, state biologists worked with researchers from the University of Southern Maine and restoration practitioners from the Casco Bay Estuary Partnership to develop a volunteer community science run count that would be feasible and accurate. An innovative subsampling method allowed for fewer volunteer-hours than other such river herring projects and has allowed the effort to continue for over 10 years. Over time more community-based organizations have become involved to lead the count, specifically the Presumpscot River Land Trust (PRLT). The PRLT along with GMRI organized an Alewife Migration Walk to Talk with researchers about river herring migration. This event was originally planned to have one session, but multiple sessions were needed to accommodate the community interest. Events like this allow for more community involvement through direct collaboration with researchers studying the ecosystem. Further, the high level of interest in these events and the continued success of the volunteer count demonstrate the enthusiasm of people in an urban community to learn about and engage with their community and the surrounding natural environment.

## DISCUSSION

The three cases presented here tackle a range of environmental issues faced by coastal communities including invasive species control, coastal flooding, and species conservation. Literature on environmental and ecological conservation has discussed the phenomenon termed value-action gap, where individuals do not or are not able to turn their pro-environmental or pro-social values into action (e.g., Babutsidze and Chai 2018; Barr 2006). The three community science programs described here enabled individuals to turn their interests and care for their community and natural environment into action by creating venues to further people-nature and people-people relationships.

In all three cases, coastal environmental and ecosystem challenges directly impacted socioeconomic wellbeing of the communities. Both the Gouldsboro Shore Initiative and river herring restoration efforts aim to sustain the viability of municipal fishery resources. GMRI's coastal flood monitoring aims to provide useful information to protect coastal infrastructure and properties. These programs also attracted volunteers and participation from community members. They included not only those who are impacted directly but also those who cared about these issues.

### *Community Science Design Principles to Foster Relational Values*

The three case studies, as well as the experience and expertise held by the authors, suggest a set of community science design principles, which have the potential to strengthen not only people-nature connections but also people-people relationships within the community.

#### Principle 1: Develop a platform that builds and reinforces a sense of belonging among participants

To ensure inclusive and diverse participation in community science programs, the developed engagement platform (e.g., a workshop, meetups, walk-and-talks, and/or online spaces and tools) needs to provide a safe space for people to show up as their whole selves. Furthermore, organizers should be attentive to creative ways for participants to safely interact with one another, with municipal or other government officials, and with scientists. Projects can offer multiple ways of connecting people (e.g., online vs in person) and provide a structure of engagement and explicit guidelines for

appropriate behavior (and what's not and the consequences) to ensure equitable and satisfying experience for all participants. Organizers can engage participants in developing such guidelines. To encourage interactions among community members, design protocols with the opportunity for data to be collected in pairs or small groups; however, allowing the opportunity for engagement by individuals is also important to encourage participation by those whose schedules preclude meeting with others or those who prefer to engage with nature as a personal experience. Organizers can also encourage social trainings, where participants mentor and coach each other to foster competency and develop collective skills crucial for assuring data quality provided by community science programs.[4]

### Principle 2: Recognize diverse assets and knowledge held by participants and a whole community

The members of any given community bring their lived experience, skills, and knowledge as well as their time to a community science project. These skillsets may be scientific (e.g., a retired scientist from a related field), social (e.g., leaders of formal or informal social groups, teachers or librarians with standing in the community), or governmental (e.g., a retired civil servant or elected official). Finding ways to surface, recognize, and celebrate these assets in a project will not only support project outcomes, but wll also serve to more deeply engage the community. We encourage organizers to develop mechanisms for people to make suggestions about the project's aims, methods, results, and other aspects throughout the process. Programs should embed local knowledge of participants (and whole community) in project design, from framing the question to choosing how and where the data will be used and archived. Organizers can create space for sharing photos or other art artwork (written, sketched, etc.) and storytelling alongside data collection.

### Principle 3: Create adjacent space to discuss and collaborate on broader topics

Successful community science programs can lead to relationships among community members as well as enhance connections to the environment, which can be leveraged to achieve further societal goals. As such, organizers should embrace and provide opportunities for divergent conversations and spin-off projects. Organizers may be able to facilitate access to additional resources and networks through introductions to relevant external organizations or people.

## CONCLUSION

We explored the role of community science programs in building relational values, namely, people-nature and people-people relationships. Relational values can be nurtured by community science programs. Community science programs, by nature, present opportunities to connect people to nature. Such programs provide opportunities for people to turn their sustainability-aligned values and intentions into action to solve ecosystem challenges. The three cases demonstrate the benefits of bringing communities together beyond their participation in collecting data for science. The participants were encouraged to connect with each other and engage in collaborative learning.

Community science programs designed with the three principles presented in this paper, present opportunities to connect people. The three programs presented in this paper have been successful at building social networks within a community—both place-based and practice-based. The Gouldsboro Shore Initiative led to conversation and collaboration on other societal challenges such as climate change and resilience and property ownership changes. The flood-monitoring program used coastal meetups, where community members have the opportunity to connect and share their knowledge with each other. The river herring restoration program's walk-to-talk events facilitated the networking of participants and biologists.

Community science programs' abilities to build such social relationships cannot be overlooked. An explicit focus on building people-people relationships through community science programs creates the potential for communities to achieve broader societal goals through strengthened social networks. The experiences of program participants and social interactions that take place during the program matter as much as achieving scientific purposes in order for community science programs to provide solutions to ecosystem challenges. The three principles developed by this paper can contribute to more community science programs achieving their objectives, fostering relational values, and overcoming barriers to action.

## ACKNOWLEDGMENTS

Author contributions: Tokunaga conceived the idea and conceptual framework, developed manuscript outline, and contributed to drafting introduction, discussion, and conclusion sections. Brown contributed to drafting introduction. Kirn contributed to drafting introduction and developed an outline of the design principles. Angione and Zoellick led and developed the section on the

Gouldsboro Shore Initiative. Bowness, Long, and Sun developed the section on GMRI's coastal flood monitoring program. Enterline and Whitman developed the section on river herring restoration. All authors reviewed and edited the entire manuscript. Part of Tokunaga's work was funded by Toyota Foundation Research Grant titled "Re-framing Ecosystem Service from Local Residents' Perspective: Case-Study of Relational Values in Japan and US."

## NOTES

1 https://www.ipbes.net/node/41790

2 https://gouldsboroshore.me/

3 mean shell length was 12.6 mm

4 Data quality has been noted as one of the challenges associated with using community science data in the river herring monitoring in Bieluch et al. (2017). In this respect, social trainings can contribute to improving community science data quality.

## REFERENCES

Babutsidze, Zakaria, and Andreas Chai. 2018. "Look at Me Saving the Planet! The Imitation of Visible Green Behavior and Its Impact on the Climate Value-Action Gap." *Ecological Economics* 146:290–303. https://doi.org/10.1016/j.ecolecon.2017.10.017.

Barr, Stewart. 2006. "Environmental Action in the Home: Investigating the 'Value-Action' Gap." *Geography* 91(1): 43–54. https://doi.org/10.1080/00167487.2006.12094149.

Bieluch, Karen H., Theodore Willis, Jason Smith, and Karen A. Wilson. 2017. "The Complexities of Counting Fish: Engaging Citizen Scientists in Fish Monitoring." *Maine Policy Review* 26(2): 9–18. https://doi.org/10.53558/MQBZ1678.

Chan, Kai M.A., Patricia Balvanera, Karina Benessaiah, Mollie Chapman, Sandra Díaz, Erik Gómez-Baggethun, Rachelle Gould, et al. 2016. "Opinion: Why Protect Nature? Rethinking Values and the Environment." *Proceedings of the National Academy of Sciences* 113(6): 1462–1465. https://doi.org/10.1073/pnas.1525002113.

Chan, Kai Ma, Rachelle K Gould, and Unai Pascual. 2018. "Editorial Overview: Relational Values: What Are They, and What's the Fuss about?" *Current Opinion in Environmental Sustainability* 35: A1–7. https://doi.org/10.1016/j.cosust.2018.11.003.

Egoh, Benis, Mathieu Rouget, Belinda Reyers, Andrew T. Knight, Richard M. Cowling, Albert S. van Jaarsveld, and Adam Welz. 2007. "Integrating Ecosystem Services into Conservation Assessments: A Review." *Ecological Economics* 63(4): 714–721. https://doi.org/10.1016/j.ecolecon.2007.04.007.

Fish, Robert, Andrew Church, and Michael Winter. 2016. "Conceptualising cultural ecosystem services: A novel framework for research and critical engagement." *Ecosystem Services* 21:208–217. https://doi.org/10.1016/j.ecoser.2016.09.002.

Gomez-Baggethun, Erik, Rudolf de Groot, Pedro L. Lomas, and Carlos Montes. 2010. "The History of Ecosystem Services in Economic Theory and Practice: From Early Notions to Markets and Payment Schemes." *Ecological Economics* 69(6): 1209–1218. https://doi.org/10.1016/j.ecolecon.2009.11.007.

Himes, Austin, and Barbara Muraca. 2018. "Relational Values: The Key to Pluralistic Valuation of Ecosystem Services." *Current Opinion in Environmental Sustainability* 35:1–7. https://doi.org/10.1016/j.cosust.2018.09.005.

Ishihara, Hiroe. 2018. "Relational Values from a Cultural Valuation Perspective: How Can Sociology Contribute to the Evaluation of Ecosystem Services?" *Current Opinion in Environmental Sustainability* 35:61–68. https://doi.org/10.1016/j.cosust.2018.10.016.

MEA (Millenium Ecosystem Assessment). 2003. "Concepts of Ecosystem Value and Valuation Approaches." In *Ecosystems and Human Well-Being: A Framework for Assessment,* 127–147. Washington, DC: Island Press.

**Kanae Tokunaga** leads GMRI's Coastal and Marine Economics lab, conducting marine resource economics, social-ecological systems, and climate resilience research.

**Pauline Angione** volunteers in the Shellfish Lab and in the Shore and Storm Project in Gouldsboro with the shore access database and playing a leading role in program outreach.

**Bill Zoellick** serves as chairman of Gouldsboro's Coastal Resilience Committee and implements data collection systems and experimental work at the town's Shellfish Lab.

**Gayle Bowness** leads GMRI's Municipal Climate Action Program, designing and delivering a variety of sea level rise and coastal adaptation trainings for coastal communities.

**Sheba Brown** leads GMRI's Community Science Program, working to strengthen and develop community science practice throughout the Northeast.

**Claire Enterline** has developed tools to assess Maine's coastal and marine habitat and fisheries health and currently manages a UN Ocean Decade Program FishSCORE at GMRI.

**Sarah Kirn** supports the growth, quality, and visibility of NASA-supported or led scientific research projects that invite public participation. She performs this work from her seat at GMRI.

**Abigail Long** coordinates GMRI's community science projects, engaging communities throughout Northeast to deliver various projects.

**Stephanie Sun** coordinates GMRI's climate engagement efforts, working to provide coastal communities with the knowledge, tools, and confidence they need to build climate resilience.

**Aaron Whitman** works in GMRI's Fisheries Ecology lab, carrying out various on-shore and at-sea sea sampling and surveys to support fishing communities by providing ecological information.