9

Shaping the Public Dialogue on Climate Change

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9.1. PUBLIC UNDERSTANDING OF CLIMATE CHANGE

There is widespread agreement in the science community that climate change is adversely affecting marine environments [*Karl et al*., 2009]:

• Effects of rising sea level and increasing storm intensity on natural habitats (beaches, salt marshes, barrier islands, and so on) and human-made infrastructure (e.g., homes, roads, bridges).

• Shifts in distribution, abundance, and productivity of marine species as a result of changes in water temperature, circulation patterns, and food availability.

• Ocean acidification and its impacts on shellfish, corals, and other groups of marine species because of carbon emissions.

The majority of the US population lives within 50 miles of a coast [*National Oceanic and Atmospheric Administration (NOAA)*, 2011], so a focus on coastal and marine impacts represents a promising means by which to help people advance their understanding of climate change through personally relevant impacts.

Among the general public, there is far less awareness of these impacts or of the critical role the ocean plays in the Earth's climate system [*The Ocean Project*, 2009]. Some people associate climate change with rising sea levels [*Lorenzoni et al*., 2006], but most do not associate it with the other aforementioned changes in the oceans. Yet, understanding these issues is at the heart of both climate literacy [*NOAA*, 2009] and ocean literacy [*NOAA*, 2013].

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9.1.1. Cognitive and Social Psychology of Climate Change

Public understanding of climate change lags far behind the consensus of the scientific community and not merely because the public lacks information about climate change [*Brechin*, 2003]. A recent psychological review identified several factors that make this topic particularly challenging [*Gifford*, 2011; *Weber and Stern*, 2011]:

1. **Inherent conceptual complexity**: Risk assessment is challenged by limitations of personal experience (e.g., overweighting recent events), inherent uncertainties in predicting behaviors of complex systems, and common misconceptions in mental models (e.g., seeing climate change as "pollution"). People tend to gravitate toward curtailment of negative behaviors, while overlooking the more powerful impacts of technical innovation and substitution [*Attari et al*., 2010].

2. **Psychological factors**: Mental models can overly simplify climate change and, at worst, be incorrect. These models can lead to confirmation biases, resulting in reinforcement of current beliefs [*Shore*, 1996]. Further, affective and cognitive processes can lead to disengagement, avoidance, or feeling overwhelmed or disempowered.

3. **Social factors**: Climate change is framed as contentious. The news media tend to exacerbate this by aiming for "balance" even when there is an overwhelming scientific consensus [*Tannen*, 1999; *Corbett and Durfee*, 2004]. Public understanding is fragmented across political and ideological boundaries and has become more a question of belief than understanding [*Leiserowitz et al*., 2008].

As a result, the prevalent "cultural models" available for understanding climate change are inadequate, leading to "ineffective personal actions and support for ineffective

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policies, regardless of the level of personal commitment to environmental problems" [*Kempton et al.*, 1997, p. 220]. Fortunately, we now have a better understanding of learning and communication, based on advances in cognitive and social science research. Instead of simply conveying information, we need to facilitate "meaning-making"—helping individuals process information relative to their personal experiences and context.

A "strategic framing" approach to communication [*Bales and Gilliam*, 2004] supports meaning-making by building on careful empirical research to understand what people already value, believe, and understand, and then designing and testing communication strategies that help translate complex science in a way that allows people to examine evidence, make well-informed inferences, and embrace science-based solutions. This is a "nonpersuasive communication" strategy [*Fischhoff*, 2007] that entails explaining causes and consequences rather than advocating particular policies or actions.

This research-based approach can help to address conceptual, psychological, and social barriers described previously by creating new and more effective ways to recruit positive cultural models for understanding climate change. By providing scientifically accurate and well-tested metaphoric language, we can address conceptual complexity, overcome misconceptions, and demystify scientific processes. For example, the "greenhouse effect" is often used to explain global warming, despite the fact that most people do not understand how greenhouses work. An alternative and more effective metaphor is that carbon dioxide in the atmosphere creates a "heat-trapping blanket." As we burn fossil fuels in our daily lives, we release more carbon dioxide and thicken the blanket. And, as we know from our personal experience, a thicker blanket makes us warmer. If we want to reduce the warming, we need to find ways to reduce our consumption of fossil fuels. Research by the FrameWorks Institute has shown that when prompted with this metaphor, laypeople can better explain the links between fossil fuel use, increasing carbon dioxide in the atmosphere, changes in climate and the oceans, and possible solutions [*FrameWorks Institute*, 2010]. By understanding the chain of cause and effect, we can appreciate the nature of the problem, who is responsible, and what kinds of solutions are likely to be effective.

By focusing on specific applications and solutions to real-world problems, we can counteract "crisis" framing and despair. By appealing to strongly held universal values and concepts such as responsibility, stewardship, innovation, and interconnectedness, we can minimize polarization and contention. We must address the social context of climate change as well. A study of European museums presenting the topic of global warming [*Trautmann*, 2007, pp. 68–69] found programs and exhibits have "the best chance of inspiring changes in visitor understanding and behavior if they tell a compelling story that (1) provides hope and a roadmap to a sustainable future, and (2) helps visitors understand how their personal actions can make a difference." We need to go beyond seeing the public simply as individual consumers of knowledge. A civic engagement strategy [*Nisbet*, 2010] views individuals as potential active learners, decision makers, and participants in social and civic issues. To achieve this potential, visitors need inspiration, motivation, and empowerment, as well as knowledge.

9.2. THE POTENTIAL OF INFORMAL SCIENCE EDUCATION

Informal science education institutions (ISEIs) can help bridge the gap between climate scientists and the public, promoting effective public discourse about important environmental issues. In the United States, there are more than 1,500 ISEIs (science centers, museums, aquariums, zoos, nature centers, national parks, and such) visited annually by 61 percent of the population [*Inverness Research Associates*, 1996; *National Science Board*, 2012]. Furthermore, research has demonstrated that ISEIs can have a positive impact on science learning for individuals from groups who are historically underrepresented in science [*Bell et al.*, 2009].

Given that Americans spend only about 5% of their lifetime learning effort in formal, school-centered education, and only a small part of that time is focused on science learning [*Falk and Dierking*, 2010], ISEIs will continue to play a critical role in shaping public understanding of environmental science issues in the years ahead. Recent research indicates that climate change is the environmental issue of most concern to the public and that the public expects and trusts aquariums, zoos, and museums to communicate solutions to environmental and ocean issues and to advance ocean conservation [*Fraser and Sickler*, 2009; *The Ocean Project*, 2009; *Miller*, 2010; *Luebke et al.*, 2012].

Live-animal institutions, such as zoos and aquariums, attract large numbers of people of all ages (more than 175 million in the United States; www.aza.org/visitor-demographics), have strong connections to the natural world [*Belden et al.*, 1999; *The Ocean Project*, 2009], and engage many visitors who may not come with a primary interest in or educational background in science [*National Science Board*, 2012]. These centers have a unique advantage in educating visitors by making strong connections between animals and conservation issues that evoke affective responses [*Luebke et al.*, 2012].

We know from cognitive and social science research that learning is integrated with emotion [*Falk and Sheppard*, 2006] and social development [*Marcus et al.*,

2000; Brader 2006. Experiential learning in ISEIs can activate these affective connections [*Maibach*, 2012] through personal, engaging, and immersive experiences. By tapping into our emotions, these experiences activate the power of our "intuitive" learning processes, creating a more powerful impact than can be achieved by activating "analytical" learning alone [*Kahneman*, 2011]. However, although ISEI interpreters are one of the public's most trusted sources of reliable science information [*Fraser and Sickler*, 2009], research indicates that interpreters resist engaging in these discussions because of lack of confidence in their knowledge and the emotional effort required to interpret distressing topics. Interpreters need specialized training and ongoing support to help them understand climate change, its connections to the ocean, and how to relate it to the living exhibits they interpret.

9.3. DEVELOPING A NATIONAL STRATEGY

Ultimately, we need to take a strategic approach to the way climate change is communicated in ISEIs, with grounding in accurate climate science, a cognitive and social science evidence base, and best practices among informal science education (ISE) practitioners. Since 2007, the New England Aquarium (NEAq) has led a collaboration with an array of environmental science institutions across the United States to create a national effort to increase the capacity of ISEIs to effectively communicate about the impacts of climate change and ocean acidification on marine ecosystems. NEAq is now leading an NSF-funded partnership, the National Network for Ocean and Climate Change Interpretation (NNOCCI). This is a collaborative effort among three key areas of expertise [as recommended by *Pidgeon and Fischhoff*, 2011]:

• *Informal Science Education Practitioners*: NEAq, the Association of Zoos and Aquariums, and a core group of ISE leaders in interpreting climate change—who bring a practitioner perspective and can exponentially facilitate a learning process for additional interpreters—to develop and implement interpretation and training.

• *Climate Scientists*: Woods Hole Oceanographic Institution scientists and advisors with expertise on climate change and the ocean—who can summarize and explain what is known, characterize risks, and describe appropriate mitigation and adaptation strategies—to provide up-to-date research on forecasted global changes to the ocean, with particular attention to effects on coastal animals and habitats.

• *Learning Researchers*: Social scientists in the fields of communication and informal learning, from the FrameWorks Institute, New Knowledge Organization Ltd, Pennsylvania State University, and Ohio State University—who can bring to bear research, theory, and best practices from cognitive, communication, knowledge acquisition, and social learning theory—to conduct and disseminate research on communicating climate change to the public.

NNOCCI's design is based on best practices in informal science learning, climate literacy, cognitive/social psychology, interpretation, community building, and diffusion of innovation:

• *Interpreters as Communication Strategists*. Interpreters can serve not merely as educators disseminating climate change information but as "communication strategists" engaging in conversations with visitors based on audience research, role playing, and reflective feedback on their practice [*Nisbet*, 2010]. They can be leaders in influencing public perceptions, given their high level of commitment, knowledge, public trust, social networks, and visitor contact. On the sociological scale, interpreters can be viewed as a "tiny public" who can advocate for social change in all their interactions in other social circles [*Fine and Harrington*, 2004].

• *Communities of Practice*. The community-building and dissemination strategy for this initiative is built on considerable practical experience with climate change education in informal settings, and on the theoretical perspective of communities of practice [*Lave and Wenger*, 1991; *Wenger*, 1998]. The community of practice approach posits that learning is not an abstract or isolated activity. Instead, it is a social activity that is created through orientation, participation, exploration, reflection, and engagement in a community context. Communities of practice can enable educators to access, share, and create knowledge, and to build professional identity, relationships, and collaboration [*US Department of Educatio*n, 2011]. The Community of Practice model will be applied throughout the "learning life cycle" of the participants, from the regional workshops, to study circles, to ongoing and online support.

• *Social Networks and the Diffusion of Innovation*. In the spread of innovation, the influence of peer networks is of primary importance [*Rogers*, 1995; *Adler and Kwon*, 2002. As a result, it is not necessary to reach everyone to effect change. "Early adopters" of a new technology or ways of thinking and behaving (introduced by innovators) influence others by creating a tipping point for change. The early majority then follow to achieve a critical mass of implementation. Social networks are important because they provide social capital where members influence and support those most closely connected to them and influence others via bridges to other networks. NNOCCI will achieve diffusion and build social capital by (1) providing shorter regional workshops, reducing the "entry cost" and providing an opportunity to try out a new approach while learning firsthand from respected peers; and using study circles to engage a critical mass of

interpreters who can spread the word to others in their immediate environment, professional organizations, and in their personal social networks.

9.4. THE NATIONAL NETWORK FOR OCEAN AND CLIMATE CHANGE INTERPRETATION

Over the next five years, NNOCCI will build on the knowledge, success, and momentum they have generated, ultimately engaging millions of visitors in learning about climate change and the ocean. Figure 9.1 illustrates the relationships between NNOCCI's activities, the audiences they will reach, and the impacts they will achieve. They anticipate the following outcomes:

1. A new "culture of communication" about complex science, environmental and policy topics will form within the ISE community, starting with a durable, evidence-based *core story* and supporting training materials about climate change and its impacts on the oceans. A "core story" is a coherent narrative that combines an interrelated set of values, metaphors, and principles that broaden the public conversation and are consistent with the essential elements of the expert consensus. Visitor research and message testing will inform a robust interpretive strategy embodied in videos, training materials, including a self-guided on-line "e-Workshop" (now available in draft form at frameworksinstitute.org/workshops/climatechange/), and professional development activities.

2. A national network of *interpretive leaders* throughout the ISE field will be skilled and confident in communicating about climate change, and prepared to address other complex issues. Fifteen regional leaders will recruit participants for workshops and co-facilitate Study Circles. Interpretive leaders will train others, including staff, volunteer, and youth interpreters. For the growing network of participants, they will facilitate ongoing dialogue and establish an online community (see www.climateinterpreter.org). Outcomes for interpreters include increased climate literacy; skills in applying strategies, tools, and materials for educating about climate change; understanding of how to participate in a community of practice; and increased engagement in lifelong learning about science.

3. Engagement of a critical mass of *ISE institutions* with a broad national reach. Over five years, they will use study circles (see www.neaq.org/NNOCCI for details) to reach 150 ISEIs in the United States, including every major aquarium, zoos with an ocean exhibit, coastal national marine sanctuaries and national parks, every coastal state and all major urban markets (see Figure 9.2).

4. Increased *public awareness* of climate change as a salient, meaningful, and actionable topic. *Salient* refers to helping people see that an issue is important. For issues of public concern such as climate change, it means getting people to see the interdependence of humans and animals and their shared reliance on habitats. *Meaningful* denotes effectively translating concepts that enable people to make connections they did not make previously, such as appreciating fundamental mechanisms and seeing chains of cause and effect. *Actionable* means conveying who is responsible, suggesting appropriate solutions, and giving people a sense of agency in approaching problems of this magnitude. Visitors exposed to this kind of science interpretation will show increased awareness, knowledge, and engagement; the communications research we conduct ensures that the stories they tell have this effect.

5. Increased capacity of the *next generation of ocean scientists* as effective communicators. We will offer workshops for scientists at professional conferences (such as meetings of The Oceanography Society, American Geophysical Union, and American Society of Limnology and Oceanography) focusing on strategic framing and communication. Impacts for scientists will include increased awareness of the importance of effective science communication and increased skills in translating science for the public.

9.4.1. Target Audience

Aquarium professional and volunteer ("paraprofessional") aquarium interpreters and educators make up the first-stage audience for this initiative. This group represents participating institutions and members of an expanding network of aquariums and ISEIs interested in bringing messages about climate change and the ocean to their visitors. Young scientists are a second key audience serving as partners in communicating complex science topics. A third professional subgroup of the target audience is made up of teen interns and volunteers at participating ISEIs, which intentionally reach out to underserved populations to support science literacy and provide career development opportunities. These youth interpreters represent a high level of ethnic, cultural, and economic diversity. Teens can serve as "communication vectors" through their interactions with visitors as well as via their own social networks. They are at an important stage in their formative development of academic and career interests [*Youniss and Yates*, 2007], and form an important bridge to creating the next generation of well-informed citizens.

The public audience comprises the millions of visitors reached by participating ISEIs each year. These audiences will engage in programs, exhibits, or presentations developed by participants in the study circles and their trainees. A second public audience consists of social contacts encountered by the interpreters during their workday, leisure time, and family commitments—where

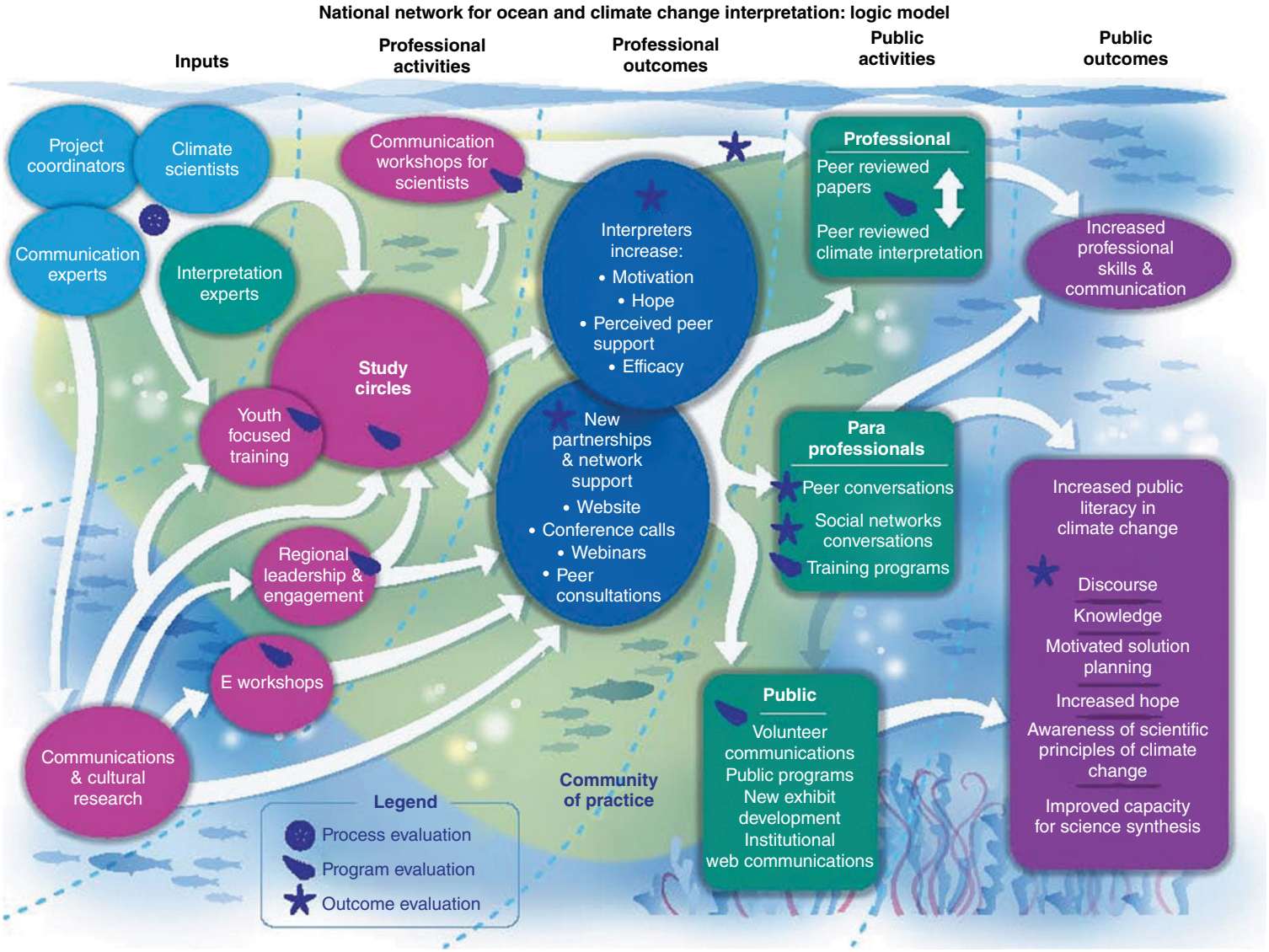

Figure 9.1 NNOCCI logic model, showing the relationships among project inputs, activities and outcomes. For color detail, please see color plate section.

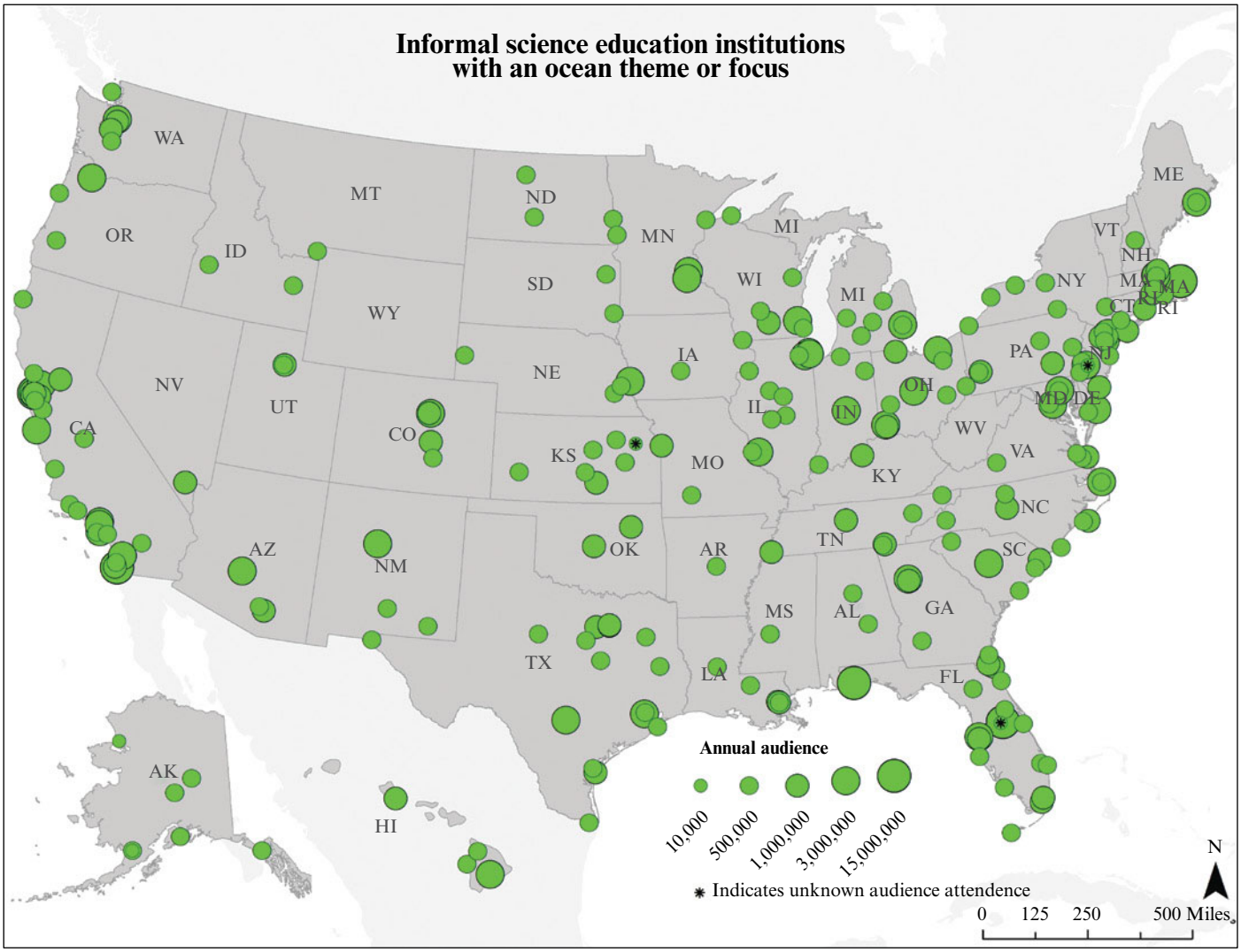

Figure 9.2 NNOCCI has identified 212 ISEIs with an ocean theme or focus as potential participants; the goal is to reach 150 of these. For color detail, please see color plate section.

their influence and knowledge is respected and valued. A pioneering study undertaken by project evaluators [*Fraser et al.*, 2009] demonstrated that volunteerism has impacts on society far beyond the visiting population, and includes role modeling with family and peers, mentoring, behavior in other organizations beyond the volunteer site, and even social activism. This is particularly true for those who find social support within a network that validates the beliefs and values of the participant. *Fraser* [2009] demonstrated that this social validation has direct impacts across the life course and serves as an essential social support that encourages promotion of ideas and values and delivery of information related to environmental issues well beyond the walls of an informal learning institution. NNOCCI evaluators from NKO and Penn State have replicated this finding and validated methods for assessing the impact of study circles on increasing self-efficacy and social engagement in discussions about ocean climate science.

9.5. RESULTS TO DATE

For the initial pilot study circles, FrameWorks developed a curriculum tailored to NNOCCI, incorporating a mix of direct instruction in two key domains: (1) Strategic Frame Analysis, an evidence-based approach to communications drawing on both longstanding and experimental methods from the cognitive and social sciences, and (2) Findings and Recommendations from FrameWorks' research on how the public thinks about oceans and climate change. The curriculum included review of and guidance on materials development and practice and customized technical assistance over time. Based on other study circles, these pilots were designed to help participants incorporate FrameWorks' communications approach to effectively translate climate and ocean science. Materials were based on Frameworks' prior research on climate change and oceans, including 28 focus groups, 2 experimental surveys, 3 media content analyses, 80 cultural model interviews, and metaphor testing with more than 400 Americans.

Study circles have approximately 20 participants representing 10 institutions from across the country, along with a minimum of two climate scientists (graduate student or postdoctoral level) and two communication experts. Participants invest a substantial commitment of time (approximately 100 hours over six months) including: participation in three face-to-face workshops, readings and documentation of their attention to issues in the news, incorporation of new strategies or recommendations into ongoing interpretation and communication practice, and collaboration with fellow participants to review and critique materials and strategies. In addition to face-to-face workshops and webinars, participants receive coaching and technical assistance via Internet and telephone.

The front-end evaluation study of participants before the study circles found that they were ready and eager to learn about climate change communication and interested in building capacity within their institutions. At the same time, they were concerned about how to address the topic without discouraging or antagonizing visitors, uncertain about what level of detail to give, and less likely to engage visitors with the topic because of its complexity and a perceived threat of being challenged by those who do not accept the validity of the science. Overall, participants were seeking a consensus on the most important messages to communicate to visitors and collaboration with others to gain insight and ideas.

Impact assessments have validated the effectiveness of study circles. Most participants cited increased knowledge or understanding of cognitive and communication science or strategic framework analysis strategies and techniques. Participants gained confidence, self-efficacy, and a sense of hope in their ability to effectively communicate to the public about climate change. Most participants said they planned to share strategic framework analysis at their organizations, seeing themselves training others. Most agreed that their participation will help validate, within their institutions, the importance of climate change and the need to allocate more resources. A number of participants were applying what they learned within their "sphere of influence" at their institution, including exhibit and program development. Participants were more likely to engage others in their social network in conversations about climate change, to report increased positive feedback from these discussions, and to self-describe as confident interpreters. Three-quarters of the interpreters and all of their social network members (friends, colleagues, trainees) reported perceiving that social network members were receptive to messages that the interpreters gave, and the majority felt that these conversations left them feeling more optimistic and hopeful.

9.6. LEGACY AND SUSTAINABILITY

NNOCCI seeks to achieve a systemic impact across the ISE community over the next five years, creating a critical mass of participation, engagement, and impact. NNOCCI also will seek to embed its work within multiple ongoing regional and national climate change education networks. NNOCCI's legacy will include the following:

1. An evidence-based core story and supporting training materials will be incorporated in an e-Workshop, which will be widely disseminated via AZA, other professional networks, and climateinterpreter.org.

2. A national network of interpretive leaders will continue to convene and collaborate, starting with regional leaders, as part of NNOCCI's ongoing participation in the national AZA community.

3. The online community at climateinterpreter.org will continue to serve the 150 ISEIs that NNOCCI reaches over the course of the project— a critical mass with a broad national reach— and help to support further dissemination through the ISE community of aquariums, zoos, science centers, and national parks and marine sanctuaries.

4. Ongoing public opinion research will document the lasting impact of this project through increased public awareness of climate change as salient, meaningful, and actionable.

5. Young scientists from Woods Hole Oceanographic Institute and other ocean science graduate programs will bring new perspective and communication skills, enabling them to broaden the impact of their research as the next generation of ocean scientists.

Ultimately, informal science interpreters are envisioned as "vectors" for effective science communication, ocean and climate scientists with enhanced communication skills, and increased public demand for explanation and dialogue about global issues. The NNOCCI project can serve as a model not only for communicating about climate change, but for how ISEIs can address other complex environmental, scientific, and policy topics as well.

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