

Recommendations

Recommendation 1. The Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health (IWG-4H) should consult with a sufficiently diverse cross-section of human dimensions researchers and utilize this research strategy as a basis for conducting local and regional scientific assessments, identifying innovative research and development needs, and developing programs as required by the Harmful Algal Bloom and Hypoxia Amendments Act of 2004 (HABHRCA).

- 1.1 The Prediction and Response Report developed by the IWG-4H should identify innovative human dimensions research and development needs for effective HAB prediction and response.
- 1.2 As part of the National Scientific Research, Development, Demonstration, and Technology Transfer Plan, in order to provide for human dimensions research and development needs identified in the Prediction and Response report, the IWG-4H should establish a multi-agency partnership to coordinate a competitive, peer-reviewed human dimensions research program modeled after ECO-HAB.
- 1.3 Following NEPA, (a) Scientific Assessments of Freshwater and Coastal HABs and (b) Local and Regional Scientific Assessments of HABs and Hypoxia should integrate the natural and social sciences to evaluate potential methods for preventing and responding to impacts.

JSOST and SIMOR Commitment to Human Dimensions

The Joint Subcommittee on Ocean Science and Technology (JSOST) and Subcommittee on Integrated Management of Ocean Resources (SIMOR), subsidiary bodies of the Cabinet-level Committee on Ocean Policy, identify human dimensions research as a cross-cutting priority to support coastal and ocean resource management. For example, a public workshop sponsored by JSOST in April 2006 to provide the ocean science communities an opportunity to guide development of an Ocean Research Priorities Plan (ORPP) identified human dimensions research as a cross-cutting priority in its natural hazards theme (http://ocean.ceq.gov/about/docs/JSOST_nathaz.pdf). Also, a Federal/State Task Team (FSTT) of SIMOR established in September of 2005 to inform the ORRP stated that “the new focus of ocean research must be on the comprehensive study of marine and coastal ecosystems ... This focus should include a significant investment in enhancing understanding of the ‘human dimension’ as a key component of and influence on these systems” (SIMOR FSST 2006).

HABHRCA Requirements

JSOST established the Interagency Working Group on HABs, Hypoxia and Human Health (IWG-4H) to provide assistance in implementing the Oceans and Human Health Act of 2004 (PL 108-447) and Harmful Algal Bloom and Hypoxia Amendments Act of 2004 (HABHRCA)(PL 108-456). HABHRCA requires a number of reports, assessments, and plans, including: (1) Prediction and Response Report for Harmful Algal Blooms; (2) National Scientific Research, Development, Demonstration, and Technology Transfer Plan on Reducing Impacts from Harmful Algal Blooms (RDDTT); (3) Scientific Assessment of Freshwater Algal Blooms; (4) Scientific Assessment of Harmful Algal Blooms; and (5) Scientific Assessment of Hypoxia. In addition, the Secretary of Commerce is to coordinate with the Interagency HABHRCA Task Force to provide Local and Regional Scientific Assessments of HABs and Hypoxia as requested by states, tribes, and local governments (PL 108-456, sec 104).

- The Prediction and Response Report is to: (1) “review techniques for prediction of the onset,

course, and impacts of HABs ... and provisions for their development;” and (2) “identify innovative research and development methods for the prevention, control, and mitigation of HABs and provisions for their development” (PL 108-456, sec 103).

- The RDDTT Plan is to “establish priorities and guidelines for a competitive, peer-reviewed, merit-based interagency research, development, demonstration, and technology transfer program on methods for the prevention, control, and mitigation of harmful algal blooms” (PL 108-456, sec 104).
- The Scientific Assessment of Freshwater Algal Blooms is to assess current knowledge about HABs in freshwater environments and include a research plan for coordinating Federal efforts to advance scientific understanding of freshwater HABs as part of the Ecology and Oceanography of HABs (ECOHAB) program (PL 108-456, sec 104).
- The Scientific Assessment of Harmful Algal Blooms is to examine the causes, ecological consequences, and economic costs of HABs and describe potential ecological and economic costs and benefits of prevention, control, and mitigation methods (PL 108-456, sec 104).
- The Scientific Assessment of Hypoxia is to examine the causes, ecological consequences, and economic costs of hypoxia in US coastal waters and the Great Lakes and describe the potential costs and benefits of prevention, control, and mitigation actions (PL 108-456, sec 104).

Recommendation 1.1. The Prediction and Response Report developed by the IWG-4H should identify innovative human dimensions research and development needs for effective HAB prediction and response.

The IWG-4H is developing the Prediction and Response report by reviewing the capabilities of federal, state, and local programs (tribal and non-tribal) in HAB prediction and response. Based on this review, the report will identify gaps in capacity, i.e. innovative research and development methods critical to protecting environmental systems, economies, and communities in anticipation of and response to HABs (Quay Dortch, ECOHAB program coordinator, personal communication). The research and development needs described in this human dimensions research

strategy represent significant gaps in national HAB capacity. The IWG-4H should utilize this research strategy to identify innovative human dimensions research and development needs for effective HAB prediction and response. Needs include social scientific approaches for:

- Assessing Social Impacts (Section 1.2)
- Assessing Community Vulnerability (Section 1.4)
- Assessing Economic Benefits of Forecasts (Section 1.5)
- Developing Diagnostic Tools (Section 2.1)
- Improving Surveillance (Section 2.2)
- Developing Epidemiological Methods (Section 2.3)
- Identifying Susceptible Populations (Section 2.4)
- Improving Water Quality Monitoring and Response (Section 3)
- Communicating Risks to Prevent and Respond to Impacts (Section 4)
- Coordinating Approaches to Prevention and Mitigation (Section 5)

In addition to utilizing this strategy, the IWG-4H should consult with a sufficiently diverse cross-section of human dimensions researchers to implement the requirements of HABHRCA. Involvement of human dimensions researchers is critical both to provide information and to develop interdisciplinary collaborative partnerships for HAB research and response. Toward this end, it is not sufficient to consult with Epidemiologists and Economists at the exclusion of researchers with expertise in other critical areas, e.g., Risk Communication, Sociology and Anthropology, and Institutional Analysis.

Recommendation 1.2. As part of the National Scientific Research, Development, Demonstration, and Technology Transfer Plan, in order to provide for human dimensions research and development needs identified in the Prediction and Response report, the IWG-4H should establish a multi-agency partnership to coordinate a competitive, peer-reviewed human dimensions research program modeled after ECOHAB.

Development and implementation of workshops and other efforts informing the RDDTT plan should be substantially informed by this human dimensions research strategy and a sufficiently diverse cross-section of human dimensions researchers as early as

possible. To provide for human dimensions research needs identified in the Prediction and Response report and facilitate interagency approaches to data collection and management, the IWG-4H should establish priorities and programmatic guidelines for substantial interagency investment in human dimensions research integral to the RDDTT plan.

Specifically, following the model of the Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) program, the RDDTT plan should establish programmatic guidelines for a multi-agency partnership to coordinate a competitive, peer-reviewed research program providing for human dimensions needs established in this report and the Prediction and Response report. NOAA's National Centers for Coastal Ocean Science (NCCOS) is an appropriate lead for such a multi-agency HAB-Human Dimensions program (HAB-HD) in view of its experience as an integral partner in ECOHAB, leadership role in developing this report, and interest in multiple human dimensions areas essential to promote coastal environments and communities that are resilient to HABs and other extreme events (<http://www.nccos.noaa.gov/>). NCCOS should coordinate with other interested NOAA offices such as Sea Grant, Office of Education, and Coastal Services Center. Other agency partners may include, but should not be limited to, the Environmental Protection Agency (Drinking Water Impacts), Federal Drug Administration, Centers for Disease Control and Prevention (Public Health Impacts), US Fish and Wildlife Service, and the National Science Foundation Social, Behavioral and Economic Sciences area.

Recommendation 1.3. Following NEPA, (a) Scientific Assessments of Freshwater and Coastal HABs and (b) Local and Regional Scientific Assessments of HABs and Hypoxia should integrate the natural and social sciences to examine potential methods for preventing and responding to impacts.

The National Environmental Policy Act requires Federal agencies to utilize a systematic, interdisciplinary approach to decision making that integrates the natural and social sciences to study and evaluate alternative courses of action such as strategies for preventing and mitigating the sociocultural, health, economic, and environmental impacts of HABs and hypoxia. Following a NEPA-inspired model, (a) Scientific Assessments of Freshwater and Coastal HABs and (b) Local and

Regional Scientific Assessments of HABs and Hypoxia should integrate the natural and social sciences to examine potential methods to prevent and respond to impacts. Toward this end, such assessments should be coordinated across HAB programs focused on natural science (such as ECOHAB) and human dimensions (such as the multi-agency human dimensions program proposed above).

Critical human dimensions information and methods for envisioning and evaluating strategies as part of such assessments include:

- Assessments of Social Impacts (Section 1.2)
- Assessments of Economic Impacts (Section 1.3)
- Assessments of Community Vulnerability (Section 1.4)
- Assessments of the Economic Benefits of Forecasts (Section 1.5)

Potential prevention and mitigation strategies examined by such assessments include:

- Diagnostic, Surveillance and other Decision Support Tools (Sections 2.1 and 2.2)
- Innovative Epidemiological Methods (Section 2.3)
- Identification of Susceptible Populations (Section 2.4)
- Water Quality Monitoring and Response Plans (Section 3)
- Messages and Strategies for Communicating Risks (Section 4)
- Models for Coordinating Prevention and Mitigation Strategies (Section 5)

Recommendation 2. The Interagency Oceans and Human Health (OHH) Research Program should establish goals and priorities for human dimensions research integral to its Interagency Implementation Plan. OHH research programs should draw on the research objectives and example projects in this report to develop requests for competitive research proposals.

The Oceans and Human Health (OHH) Act requires the interagency OHH Research Program to develop an Interagency Implementation Plan for Congress. Among other requirements, the plan is to establish ten-year goals and priorities to advance scientific understanding of the connections between oceans and

human health; describe activities such as funding and training required to achieve them; and use reports and studies conducted by Federal agencies and other expert scientific bodies (PL 108-447).

This human dimensions research strategy is an important resource for the Interagency Implementation Plan. While the strategy focuses on HABs, it provides a framework for human dimensions research related to the connections between human health and a wide array of coastal hazards (including cumulative and episodic human impacts such as pollution and oil spills in addition to chronic and episodic natural events such as HABs and hurricanes). Accordingly, the Interagency Implementation Plan should utilize the research objectives and example projects in this report to establish ten-year goals and priorities, and estimate funding for competitive research. Areas of emphasis may include:

- Assessing community vulnerability (Section 1.4)
- Developing decision support tools (Section 2.1)
- Improving surveillance of human disease (Section 2.2)
- Developing epidemiological methods for identifying and characterizing human diseases (Section 2.3)
- Identifying susceptible populations based on environmental and sociocultural factors (Section 2.4)
- Improving water quality (Sections 3.1-3.3)
- Communicating risks of coastal hazards (Section 4)
- Coordinating mitigative approaches (Section 5)
- Improving education and outreach (Section 6)

In addition, OHH research programs should draw on the research objectives and example projects in these sections to develop requests for competitive research proposals.

Recommendation 3. The National HAB Committee should integrate members in critical human dimensions research areas such as Risk Communication, Anthropology and Sociology, and Institutional Analysis in addition to Economics and Epidemiology.

HARRNESS established a rotating, interdisciplinary National HAB Committee to “represent priority research areas” and “facilitate coordination and communication of activities for the US HAB community at a national level.” This committee should integrate members in critical human dimensions disciplines such as Risk Communication, Anthropology and Sociology, and Institutional Analysis (in addition to Economics and Epidemiology). Representation of priority human dimensions research areas is critical to facilitate comprehensive and effective implementation of HARRNESS; facilitate support by broad stakeholder groups; and “raise the visibility and understanding of HAB issues nationally” (HARRNESS 2005, 59).

Recommendation 4. NOAA’s Monitoring and Event Response for Harmful Algal Blooms (MERHAB) program should utilize this report to identify and implement mission-critical human dimensions research.

Initiated in 1999, NOAA’s Monitoring and Event Response for Harmful Algal Blooms (MERHAB) program aims to incorporate tools, approaches and technologies from HAB research programs into existing HAB monitoring programs and provide managers with timely information needed to enhance and sustain routine HAB monitoring capabilities and mitigate HAB impacts (<http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-merhab.html>). Toward this end, MERHAB is expanding the number of coastal regions benefiting from advancements in algal identification, detection, modeling, and prediction. For example, MERHAB “regional” projects are mitigating HAB impacts and enhancing HAB capabilities for *Karenia brevis* in the Eastern Gulf of Mexico, cyanobacteria in the lower Great Lakes, *Pseudo-nitzschia* along the central and southern California coast, and *Karlodinium micrum* in the Chesapeake Bay. In addition, MERHAB “targeted” projects are producing new technologies for faster, easier, and more economi-

cal methods of detecting a variety of HABs and their toxins. MERHAB is providing critical research and development investments needed by the HAB community to bring these promising methods into routine use to monitor coastal waters, test seafood quality, understand toxic effects on endangered marine species, and prevent human illnesses and deaths due to HAB toxins.

A critical factor in the successful transition to operations of MERHAB projects is the inclusion of state risk management agencies and state scientists in the design and implementation of research projects. Partnering academic and Federal scientists with scientists working in state agencies provides an opportunity to closely align research with the needs of agencies that are on the front lines of mitigating HAB impacts, generating research products that have immediate or near-term application. This approach echoes the emphasis in Section 2.1, *Developing Diagnostic Tools*, on understanding and collaborating with potential users of tools throughout the research, development, prototype testing, and deployment process. The injection of management needs into MERHAB science projects also allows for a better understanding of the regionally-specific political realities that must be addressed in order to obtain long-term funding for routine HAB monitoring and response efforts.

MERHAB researchers have identified a number of critical needs that could be addressed by the social science research community. These include:

- *Region-specific data on the sociocultural and economic impacts of HABs* (Sections 1.1-1.3). Local fishery managers can generally discuss why the public participates in the fisheries they manage and why their fishing activity is important to their quality of life. However, without the help of social scientific approaches, it is difficult for fishery managers to comprehensively document and quantify the sociocultural and economic losses when HAB events preclude normal harvest opportunities and other resource uses. Surveying local communities about the social importance of resources and how they adapt to resource impacts will help managers develop effective response strategies and tailor outreach products. It is important to document impacts so that appropriate prevention and mitigation strate-

gies can be funded, planned, and implemented. This kind of information will also assist members of the HAB community in telling the “whole” story of HAB impacts as they approach federal, state and local lawmakers to request funding for HAB related work. There are many people who are not affected economically by a HAB event, yet who find their social quality of life deeply affected.

- *Improved messages and strategies for communicating to public audiences about risks associated with HABs to reduce vulnerabilities, respond to impacts, and raise public awareness of the importance of routine monitoring and response* (Section 4). Often, the public learns of HABs at the time of a fishery closure. This can lead to frustration, anger, distrust of government actions and, ultimately, health impacts due to failure to comply with governmental warnings. State managers who struggle with HAB-related impacts should consider consulting with risk communication researchers to help them effectively reach populations that are affected by HAB events and/or integral to HAB monitoring and management.

Longer-term needs may include:

- *Utilization of social information to plan and implement short-term rapid response efforts*. Such information could include an understanding of community vulnerabilities to impacts (Section 1.4), identification of susceptible populations (Section 2.4), or models for agency and stakeholder coordination (Section 5).
- *Risk communication research to effectively utilize HAB prediction and forecasting information in communicating risks to various publics* (Section 4).

Recommendation 5. State and local resource managers and other leaders should coordinate regional partnerships integrating the public health community, biophysical and social scientists, affected tribal and non-tribal communities, and other partners to address regional HAB issues.

An example of such a partnership is the widely discussed success story of Washington State's ORHAB (Olympic Region Harmful Algal Bloom) Project (<http://www.orhab.org/>). This collaboration of HAB researchers, fisheries managers and human health managers has successfully met the challenge of bringing scientists and managers to a common set of goals and coordinated approaches to achieving them. The partnership has improved understanding of the state's coastal HAB issues and contributed to the development of solutions. Natural barriers (e.g., collaborating across cultural, disciplinary, and agency boundaries) between these diverse groups were lowered during the process. Managers increasingly understand and use the "language of science" and researchers increasingly appreciate the challenges faced by managers, framing their research questions to inform on-the-ground decisions. State and local leaders should form such regional collaborations in other parts of the nation as a means of producing effective and locally appropriate solutions to local HAB issues.