1.1. Identifying Data Needs

Research Need: Characterize the data needed to assess the economic, public health, and sociocultural impacts of HAB events on local and regional scales. Facilitate comprehensive and coordinated data collection and storage across sectors and communities.

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HARRNESS Recommendation: "Compile data and calculate the socioeconomic impacts of HAB events at local and regional scales" (HARRNESS, 55).

HABs are complex phenomena, both in their biophysical attributes (i.e., their causation and development over space and time) and their impacts on human communities. HARRNESS suggests that approaches to the management of HABs have not sufficiently reflected this complexity. The report concludes that improved data collection on an ongoing basis is critical to improved understanding of HABs and their impacts. Biophysical data, emphasized in HARRNESS, are clearly important because they can be used to test hypotheses regarding triggers of HAB events, circumstances which make them especially severe, and ecosystem impacts. These data also inform the development of management approaches.

From a policy and management standpoint, it is also important to have robust empirical information regarding the potential threats and impacts of HABs on economies, sociocultural dimensions, and public health. Data on the biophysical attributes of HAB events alone are insufficient to predict and assess the impacts of blooms, and to determine the most effective allocation of scarce resources to prevent or mitigate these events and their impacts. In addition to understanding the biophysical context of HABs, it is critical to understand their economic, sociocultural, and public health context.

Responses to HAB events typically consist of some subset or combination of various management options, e.g., closures and their enforcement, education and public outreach, *in situ* mitigation, processing to remove toxins in the field, or advance harvesting of a potentially affected resource for placement in protected areas. The optimal portfolio of management measures in anticipation of or response to a bloom will surely depend on its biophysical nature, but also on the impact of the bloom on communities dependent upon affected resources, e.g., fisheries, beaches, and coastal waters. In the case of commercial fisheries, for example, economic and sociocultural considerations important to effective response include lost revenue and social disruption resulting when fishery participants seek temporary or permanent employment in other sectors, the cultural importance of an affected resource or its harvest, and the level of compliance with closures, which mediates public health risk.

HARRNESS builds on a call by the US Commission on Ocean Policy for shared infrastructure and other measures to reduce the impacts of HABs. As stated in the Ocean Commission's report to Congress, *Ocean Blueprint for the 21st Century*, "as more data are collected on HAB occurrences, researchers will be able to more accurately predict future outbreaks by using advanced computer models and taking into account the physical and biological conditions leading to HABs" (US Commission on Ocean Policy 2004). Data needed is not limited to "physical and biological conditions," but extends to the economic, sociocultural, and public health dimensions of HAB impacts and their management.

For example, research in economics is critical to assess the effects of HABs on markets in terms of the aggregate level of profits and their distribution, employment, responses of stakeholders to different regulatory approaches, levels of compliance with closures and other harvest constraints, and public health outcomes and the costs of their mitigation.

Sociocultural research is needed to document nutritional, sociocultural (e.g., recreational activities and cultural practices), and economic dependence on resources and activities affected by HABs; identify social networks (i.e., economic, political, cultural, and other relationships) within and across affected sectors and communities; and determine public perceptions of HABs and management (from regulatory policy to education and outreach) to inform mitigation efforts. These kinds of sociocultural information enable managers to more effectively allocate resources to different HAB problems and policy and management approaches.

> Data characterizing the potential threats and impacts of HABs on economies, sociocultural values, and public health is critical for effective prevention and response.

Types of data needed to assess the health effects from HABs include environmental characteristics as well as medical and epidemiologic data. Specific components of a database useful for public health decision making include:

- HAB-related environmental data, e.g., water quality, HAB taxonomy, HAB toxin levels, GIS mapping, relevant water characteristics (e.g., tides and color), and other HAB-related events (e.g., fish-kills);
- Human patient data, e.g., demographics, clinical descriptions of signs and symptoms, and laboratory test results;
- Illness outbreak-related data, e.g., medical/clinical data for affected people, and epidemiologic data (e.g., person, time, place characteristics of the outbreak, time from exposure to disease onset, and morbidity and mortality rates); and
- Animal patient data, e.g., demographics clinical data, and laboratory and other test results.

In addition to improved and continuously updated data related to the human dimensions of HAB impacts and their mitigation, the collection of "metadata" is important. That is, it is necessary to assess the data needs themselves and prioritize among different, potentially costly, data gathering ventures so as to maximize the benefits of information collected to policy, management, and community decisions. To be effective, a system of data collection must be a two-stage process: The first stage consists of "scoping" to determine comprehensive data needs and availability. The second stage consists of collecting needed data on a cross-sectoral and ongoing basis.

It is easy to argue that more information about economic, sociocultural and public health dimensions is critical to prevent, manage, and effectively respond to the effects of HABs. However, since the resources required to gather such information on an ongoing basis are scarce, it may be necessary to prioritize among different types of information. Furthermore, it is important to organize the data so that it is readily accessible to those who need it (e.g., affected communities, social service providers, policy makers, and public health providers).

Data needs for HAB mitigation and management are likely to be context-specific in some cases. Therefore, it will be important in most cases to study data needs prior to engaging in costly and time-consuming data collection. Some data needs, and effective methods for satisfying them, will apply to a broader range of contexts. For this reason, one of the research objectives listed below is to understand the applicability of a given set of data needs and techniques to a broader temporal or geographical range of HAB events. This understanding will allow managers to assess where it is especially critical to gather context-specific data and where, by contrast, they can achieve economies of scale by applying data gathered in one place or time to other contexts.

The goals and recommendations in this section are inextricably linked to the other topics in the *Socioeconomic Impacts* section. For example, economic impact assessments (discussed in Section 1.3) require data on market activity, recreational visitation, and public health costs. Any quantitative analysis of trade offs involved in different policy approaches clearly requires data to estimate the relative costs and benefits (for economic, sociocultural, and health-related concerns) of different options.

Research Objectives

1. *Improve understanding of the economic, sociocultural, and public health dimensions of HAB events of different types*.

2. *Characterize the variety of stakeholders (i.e., individuals and communities) affected by HAB events*. For example, stakeholders include commercial shellfish harvesters, managers, and wholesalers; recreational harvesters and those involved in other affected recreational activities such as swimming; communities that are economically dependent upon shellfish harvest, tourism, or other affected industries; tribal members who rely on shellfish for subsistence; community water utilities; and coastal residents and others with cultural ties to affected resources or their harvest.

3. *Characterize the spatial and temporal similarities and differences among HAB events to understand when data collected at one place or time informs understanding and mitigation in other contexts*.

4. *Utilize the outcomes of the preceding objectives to prioritize data collection from different locations and to determine the appropriate spatial and temporal resolution of economic, sociocultural, and public health data collection*.

5. *Develop effective methods for gathering and storing data*. This need is discussed in Sections 2.2 (*Improving Surveillance*) and 2.3 (*Developing Epidemiological Methods*).

6. *Improve understanding of ways in which economic, sociocultural, and public health data will be used by publics, scientists, policymakers, tribal members, managers, and other decision makers to assess and mitigate HAB impacts*. This understanding will enable the design of data distribution mechanisms that maximize the benefits of data, e.g., public forums, web-based dissemination, community and other publications, or publicly available databases.

Example Project

Identifying, Prioritizing, and Implementing Sociocultural, Economic and Public Health Data Collection and Management Relevant to *Pseudo-nitzschia* Blooms on the Washington Coast

Description: *Pseudo-nitzschia* produces domoic acid, which is incorporated into the viscera of razor clams and Dungeness crabs, both important commercial and recreational species in coastal Washington. The objective of this project is to identify, provide, and update the sociocultural, economic, and public health data needed to assess and mitigate the impacts of *Pseudo-nitzschia* blooms. This will require data collection in two stages: First, a series of key informant interviews will identify (a) stakeholders, affected markets, and relevant regulations, and (b) the main categories of impacts of blooms and human responses to them. Key informant interviews are in-depth interviews of individuals with valued knowledge about a topic of interest. For example, key informants for this project might include coastal managers, public health professionals, and representatives of affected sectors and communities, including tribes. Second, this project involves the development of a database to store data on public health, sociocultural, and economic impacts and implementation of a data collection process coordinated across sectors.

Methods:

- Archival research to identify historic HAB events; local and regional pathways of exposure to HAB toxins (for example, see Section 2.4, *Identifying Susceptible Populations*); and economic, sociocultural, and public health impacts.
- Ethnographic research to collect case studies informing the development of a database framework. (The term "ethnographic research" refers to a variety of field-based techniques such as interviews and surveys to study a culture).
- A rapid assessment process for collecting data on the economic, sociocultural, and public health impacts of HAB events.
- Evaluation
  - Ongoing communication with and survey of database users (e.g., researchers, public agencies, and policy makers) to determine database utility and modify database design.

- Use of data to test hypotheses such as the extent to which various social groups are susceptible to exposure to HAB toxins.

Outcomes:

- A typology and inventory of stakeholders affected by this type of bloom.
- In the public health dimension, a characterization of the different potential pathways for exposure to domoic acid and their respective health impacts.
- Identification of various data flows, together with an estimate of the cost of gathering data from these sources on an ongoing basis.
- Prioritization of data needs to improve mitigation of the economic, sociocultural, and health impacts of *Pseudo-nitzschia* blooms.

Challenges:

- Providing a database framework that is useful across local and regional scales.
- Prioritizing data needs.
- Quantifying non-market values that are difficult to express in dollar terms such as the emotional trauma caused by HAB illness and recreational pleasure and impacts.

Expertise Needed:

- Economist with expertise in market and non-market valuation techniques, econometrics, and survey design
- Sociologist and Sociocultural Anthropologist
- Database Engineer
- Epidemiologist

Timeline: 6-12 months to establish data needs and design a data collection framework.

Estimated Cost: $200,000

Potential Partners: NOAA, including Sea Grant; universities; local community groups; state health departments; state departments of fish and game; Environmental Protection Agency.

1.2 Assessing Social Impacts

Research Need: Assess the sociocultural impacts of HAB events at local and regional scales.

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HARRNESS Recommendation: "Compile data and calculate the socioeconomic impacts of HAB events at local and regional scales" (HARRNESS, 55).

Harmful algal blooms can wreak havoc in human coastal communities. For example, during the summer of 2005, a HAB event poisoned clams, oysters, and mussels from Maine to Cape Cod. Massachusetts Governor Mitt Romney reported that this event cost the shellfish industry about $3 million per week (Scheicher, PBS News Hour Extra, 2005). By late summer, inshore fishermen returned to work as the effects of the red tide abated. However, offshore fishermen are still waiting in early 2006 for government regulators to re-open their fishing grounds. Monte Rome, owner of Intershell USA, the largest processor of whole scallops in Massachusetts, stated that his operation is one of the businesses most affected by the lingering closures and observed that the scallop fishermen are "really hurting" (Frazer, Cape Cod Times, 2006).

Yet the human toll of HAB events is more complex than landings data or "multipliers" commonly used to assess economic impacts. In addition to economic impacts, coastal communities can suffer profound social and cultural disruption. On the Pacific coasts of Washington and Oregon, a HAB event caused by the toxin domoic acid forced the closure of the widely popular recreational razor clam fishery in the fall of 2002 (Ayres 2003). State agencies closed these fisheries for over twelve months, resulting in the loss of 400,000 potential clam-digging trips. This government action,