Example Project 2

Integrating Human Dimensions Data into HAB Research and Response

Description: This project will inventory decision making organizations and points of articulation in federal, state, local, and tribal decision making communities with resulting data available for use prior to and during HAB events. Based on this inventory, the goal is to identify opportunities to facilitate integration of human dimensions data into HAB decision making processes. A multi-agency program for human dimensions research modeled after the Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) program could facilitate data collection, sharing, and use (see Recommendation 1.2)

The project would be conducted in two phases. Phase 1 would inventory policy, management, research, public, tribal and other partners integral to decision processes for HAB response. Phase 2 would develop and maintain knowledge of the network of organizations and individuals integral to detection, analysis, prediction, and management of HAB outbreaks and their impacts. These data could be used as a baseline to monitor the regulatory process and to identify points of entry for inclusion of critical human dimensions data such as the economic, sociocultural and public health parameters identified in Section 1.1. Additionally, the data may suggest opportunities for, and benefits or challenges of, specialized training for natural scientists in social science approaches or opportunities for interdisciplinary connection for natural and social scientists.

1.3 Assessing Economic Impacts

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

Lead Authors: Porter Hoagland (Email: phoagland@whoi.edu)
Contributor: Guillermo Herrera

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

A first step toward improved understanding and managing HABs is an assessment of their economic, sociocultural, and public health effects. There are well-established methods for estimating the economic damages associated with natural hazards such as HABs. Such methods quantify changes in economic welfare that are reflected in both established markets, where goods and services are traded at a price, and activities and resource uses, such as swimming, that are not directly traded in markets.

Market-based welfare measures quantify the net benefits to parties on both sides of market transactions, i.e., the benefits that consumers enjoy in excess of what they pay for goods and services (called "consumer surplus") in addition to the revenues that producers earn in excess of their production costs (called "producer surplus"). For example, closure of a commercial shellfishery due to a HAB event could reduce the surplus earned by commercial fishermen. However, affected fishermen may compensate for lost revenue by transferring their fishing effort to areas that remain open or switching to non-fishing activities to earn income. An accurate estimation of the economic impacts of the HAB event would account for the income earned through such compensation measures, capturing the net loss (or possibly gain) of revenue to commercial fishermen.

Economists rely upon consumer expenditures as data to help estimate the value of non-market goods and services, such as the cultural value of recreational shellfishing or experience of beach visitation. For example, the "travel cost" method of non-market valuation expresses the economic value of an environmental area (such as a beach popular for swimming) in terms of the amount of money that individuals are willing to spend to visit it (see Lipton et al. 1995).

While economists prefer to focus on net benefits, changes in total sales (i.e., revenues) are simpler to

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calculate and provide an upper bound on the changes in net benefits to producers. A variety of formulas are used to determine changes in total sales from HAB-related shellfish closures. Unfortunately, many of these calculations are not useful for making normative management decisions about how best to respond to HABs.

Beyond measuring effects in the market as a whole, policy makers are also concerned with measures of changes in employment, and in characterizing who benefits (if anyone) and who loses as a result of a HAB event. These effects are known generally as distributional economic impacts. In order to decide between different approaches to responding to HAB events, it is important to fully characterize the implications of each potential management approach. These implications include the economic effects on different sectors of the economy (e.g., commercial shellfish harvesters and processors, the tourist industry, and agricultural producers) and consumers in these sectors, public health impacts, and sociocultural impacts on communities (for example, family stress resulting from changes in income distribution or disruption to social networks). The choice between different management approaches to HAB events will likely involve trade offs among these impacts.

For example, the management of a HAB event involving commercially harvested shellfish involves implicit trade offs between public health risks and forgone profit in the fishery. While policy makers may be loathe to put a dollar value on human morbidity or mortality, the choice of a threshold level of a toxin used in closure decisions involves an implicit willingness to accept some impacts to public health for profits, or vice-versa. This trade off can be expressed as the "value of a statistical life" or morbidity changes can be accounted for by the use of a measure such as "quality-adjusted life years" (QALYs).

The role of anthropogenic factors in the incidence, severity, and duration of HAB events is uncertain. To the extent that anthropogenic factors do contribute to HAB events, however, there are trade offs relevant to this interaction as well. For example, if nutrient runoff from agriculture contributes to the formation of a bloom that leads to beach closures, management should consider not only the trade off between risk of illness and forgone recreational values, but also the impacts of constraining the scale of the agricultural industry or their choice of fertilizers, among other effects of management strategies.

The choice of spatial scale is also important for the analysis of trade offs. Closure of a beach, for example, has local costs (e.g., loss of recreational benefits) and benefits (e.g., reduced health risk), but may also affect neighboring communities (e.g., through changes in visitation).

Research Objectives

1. *Identify the location, type, and spatial and temporal scales of HAB events*. The first need is to characterize the physical natural hazard.

2. *Identify affected markets and nonmarket activities*. The second need is to characterize the relevant affected market(s) and valued activities that occur outside of market institutions.

3. *Characterize the economic impacts of HAB events*. Analytical efforts ought to be devoted to the most serious hazard events. Rough economic impact estimates based upon changes in total sales revenues may be useful as a preliminary criterion in deciding whether or not to proceed with an economic study. For example, a one-time HAB event leading to damages on the order of $2-5 million might not warrant the time and effort of an economic analysis.

4. *Estimate economic welfare changes resulting from HAB events*. The most relevant measure of economic impacts looks at changes in consumer and producer surpluses (described above) as a consequence of the natural hazard. It is appropriate to use surplus changes to help scale appropriate policy responses.

5. *Describe potential policy measures, both qualitatively and quantitatively.* An important need is to

identify the universe of feasible policy responses or management measures. In this group, the option of doing nothing ("living with it") must be included. The cost of implementing policy measures at a range of scales should be calculated.

6. *Identify potentially affected economic sectors and consumer groups*. If decision makers are concerned with the distributional economic impacts on industry sectors or consumer groups, information about these sectors and groups should be compiled. Information on distributional impacts can inform the efforts of other social scientists engaged in HAB-related studies such as social impact assessment (Section 1.2), community vulnerability assessment (Section 1.4), identification of human populations susceptible to exposure (Section 2.4), and risk communication (Section 4).

7. *Qualitatively describe the nature of the economic effects*. If a project aims to describe distributional economic impacts, it is important to characterize the scale of economic effects on each of the affected sectors or groups of interest.

8. *Where both sides of a trade off can be measured in financial terms, make dollar-based comparisons of the implied trade offs*. Implementing management measures to mitigate the economic impacts of HAB events always involves economic trade offs because management measures are costly. The purpose of economic analysis is to make these trade offs explicit and to express them in a common metric.

9. *Where both sides of a trade off cannot be measured in financial terms, estimate the implicit prices of objectives that are not conventionally expressed in dollar terms*. The implicit price of an amenity reflects its effect on the overall price of some good or service. For example, a quality ocean view may carry a high implicit price relative to the overall cost of coastal housing. A view of waters recurrently affected by HABs may reduce this economic value. In many cases, where market data is unavailable or highly uncertain, it may be feasible to estimate an "implicit" price for environmental goods or services. These prices should be used to assess the relevant trade offs.

10. *Where relevant, consider trade offs across space (e.g., between communities or states), over time, among industry sectors or consumer groups, and among social groups such as recreational and tribal communities*. If decision makers are concerned with distributional economic impacts, the trade offs should be characterized across spatial and temporal scales and across industries and consumers. In many cases, this part of the analysis will be of the greatest interest to policy makers.

Example Project

Management of PSP Outbreaks in the Gulf of Maine

Description: Shellfish closures in the coastal waters of the Gulf of Maine during the 2005 outbreak of *Alexandrium fundyense*.

Methods:
- Models of supply and demand in local or regional shellfish markets.
- Accounting for the cost of alternative management measures.
- Nonmarket valuation methods for environmental goods and services.

Outcomes:
- Model to optimize the application of policy responses to HAB events. Model could be used to simulate alternative courses of action in anticipation of or response to HAB events.

Challenges:
- Lack of historical data on shellfish prices and quantities
- Estimating non-market values

Expertise Needed:
- Microeconomic theory
- Econometric analysis
- Policy analysis

Timeline: One to two years.

Estimated Cost: $75,000-$200,000, depending on the scale and scope of the study. Labor costs are predominant.