3. Recreational and Drinking Water Impacts

This section combines discussion of the following research topics and needs established in the "Recreational and Drinking Water" section of HARRNESS (Fig. 11).

3.1 Improve Monitoring and Documentation
Research Need: Expand and improve systematic monitoring and documentation of the occurrence of algal toxins in drinking and recreational waters.

3.2 Develop Short-Term Response Plans
Research Need: Develop short-term response plans for algal-contaminated water to protect public health.

3.3 Develop Water Quality Standards
Research Need: Incorporate algal toxins into water quality standards for drinking and recreational waters.

Figure 9. Recreational and Drinking Water Impacts - Research Topics and Needs

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HARRNESS Recommendations: Same (HARRNESS, 58).

HARRNESS notes that "the abundant growth of cyanobacteria in reservoirs contributes to significant practical problems for water supplies. Moreover, many of the known cyanotoxins (e.g., microcystins and saxitoxins) have been associated with deleterious health effects. The full impact of the presence of these toxins on contaminated water bodies remains unknown." Although "surveys conducted in the US have identified algal toxins in drinking water and recreational waters … there is no ongoing systematic monitoring program in place to identify high-risk areas." Moreover, "water utility managers and those responsible for recreational water quality do not have water quality standards on which to base decisions for safe levels and practices. Therefore, water users are not necessarily protected from exposures and subsequent related health effects" (HARRNESS 2005, 58).

> Social science is critical to improve monitoring, documentation, and response strategies to reduce the impacts of algal toxins in drinking and recreational waters. For example, surveys of water management agencies are needed to determine perceived needs for response plans and develop models for effective interagency coordination.

The need for clean drinking and recreational waters is especially critical for health issues, but quality of life issues are also important. In addition to causing health problems ranging from mild discomfort to life-threatening, HABs create significant problems of a socioeconomic nature. The costs of water quality monitoring will ultimately be born by the general public, adding another economic consideration. Availability of clean water is typically considered to be a right of the general public, but municipal water systems are increasingly

managed through contracts to private firms. In effect, responsibilities for water management and impacts of contamination cut across private and public domains. Recreation in coastal waters may also be seen as a public right, but infrastructure is largely provided by privately-owned businesses. The private and public domains are cross-cut there also, creating complexity in monitoring and response.

Social and biological science are both necessary to improve monitoring, documentation, and response to algal toxins in drinking and recreational waters. As described below, social science research objectives are especially needed.

Research Objectives

An introductory note about social science research methods may be useful. Since social science research focuses on characteristics of social groups, including knowledge, perceptions, and values shared by their members, careful attention has to be given to identification and measurement of variables that are culturally relevant (Weller and Romney 1988, Sobo and de Munck 1998, Ryan and Bernard 2000, Bernard 2006). The concern is that representation of shared information (i.e., culture) must have internal validity. That is, social research methods such as surveys and interviews must reflect the categories and content specific to a social group's culture (Romney, Weller, and Batchelder 1986; Strauss and Quinn 1997; Blount 2002; Quinn 2005). Assumptions by researchers that culture is known prior to designing and implementing a study will likely lead to imposition and utilization of incorrect or erroneous categories, thereby producing biased results. Preliminary research to elicit and identify cultural content is an absolute necessity if internal validity is to be attained. Research instruments, especially formal surveys, must be derived from social science inquiry that grounds them relative to the relevant social group's knowledge and experience (Blount and Gezon 2003).

The procedures used in preliminary research will essentially be the same for each research objective below, although the details may vary from objective to objective. In each case, information about knowledge, perceptions, and other characteristics is sought from individuals within the social group in order to identify information shared across members. The procedures involve ethnography (informal and formal interviews) and focus group discussions, followed by draft descriptions of analyzed patterns of shared information presented to other interviewees or discussion groups for their feedback (e.g., corrections and amplifications) (Johnson 1999, Bernard 2006, Garcia-Quijano 2006). The results can then serve as background information to the construction of more formal research methods – typically, surveys to elicit information from larger samples within the population (Blount 2004). These may be more or less standard socioeconomic surveys, but modified by the results of the preliminary research. Sampling should be done according to characteristics of each social group, but in most cases, sampling will be systematic.

Since these preliminary/exploratory steps in social science research are fundamental to each objective below, they can be assumed to be present and thus do not need to be repeated.

1. *Survey water resource managers and others responsible for the quality of drinking and recreational waters in order to identify current and projected monitoring, documentation, and response practices*. The research to meet this objective would include questions about current monitoring, documentation, and response systems, but the thrust would be to ascertain perceived needs for improved methods. The research would document the extent to which HABs are viewed by water resource managers and other key organizations as current health problems and the problems perceived to result from increased occurrence. The survey could be regional and inclusive of all management agencies and organizations, providing a comprehensive account of the perception and understanding of HABs and the needs for monitoring, documentation and response. Systematic sampling of agencies and organizations could be applied to larger coastal areas, e.g., deriving samples from cities in the Gulf Coast states and then generalizing to the entire US Gulf Coast.

2. *Identify and describe public perceptions of algal toxins and their harmful effects in drinking and recreational waters*. This should be a large scale project comparing sample populations (e.g., townships and communities) in areas previously

affected by HABs to populations in unaffected areas. The comparative samples will (a) document public perceptions of HABs and their impacts, and other related variables, prior to any experience with HABs (called "perception baselines") and (b) describe changes in perception baselines as a result of experience with HABs. In both instances, results would describe public understanding, gaps in public knowledge, level of trust in water utility and coastal resource management agencies, and other important variables. In the case of (b), the molding of perceptions by experience with HAB events might reveal dimensions of public perception that inform systematic monitoring, documentation, and response strategies. Case studies in affected communities could begin to yield profiles of the types and extent of socioeconomic impacts preliminary to developing guides of likely consequences when HABs occur in new areas.

For example, four townships or communities could be selected for comparison: one as a control in which there has been no history of impacts from HABs on drinking water or recreational water, one in which HAB events have impacted drinking water, one in which HAB events have impacted recreational water, and one in which HAB events have impacted both drinking and recreational water. The comparisons would reveal changes in public understanding and perception as a result of experience with HAB events, thereby informing strategies for stakeholder involvement and outreach integral to monitoring, documentation, and response. To illustrate, if results show that communities recurrently affected by HABs tend to have relatively little trust in warnings issued by coastal resource management agencies, then research on building trust (see Section 4, *Risk Communication*) may be a critical component of response planning.

3. *Identify and describe the nature and extent of public support for increased monitoring of public water supplies and water management strategies to protect against HABs*. The same sample areas and town/community samples could be used to describe and elicit public support for increased monitoring. Recent surveys on water quality reflect a diminishing confidence in the quality of public water supplies, reinforced by massive advertising to convince the public that commercial, bottled water is safer and by the increasing number of reports of problems with the safety of public water systems. This diminution of support and the willingness of populations to support increased monitoring and documentation, both in terms of regulations and financial costs, would be measured. Opposition to water additives has always been present among some members of the general public, and surveys would need to measure support for any new additives to control quality, should those be necessary. A particularly useful approach would be a study of a community recently affected by HABs to ascertain whether, and the extent to which, experience of impacts increased public awareness of and sensitivity to the need for increased protection. The responses could be used to inform the construction of surveys for communities with no history of exposure.

4. *Identify and describe the public's perception and understanding of the need to monitor and regulate activities that are known to produce or exacerbate HABs*. National and global expansion of HABs is considered to be partly a result of human activities such as changes in agricultural and aquaculture practices that increase nutrient loading, overfishing, and ballast water discharge (HARRNESS 2005, 9). If regulatory strategies for preventing and controlling HABs are to successfully restrict such activities and thereby control HABs, then it is important to document the public's understanding of the need for such restrictions and willingness to comply with alternative regulatory and enforcement mechanisms. Research is necessary to document related beliefs and perceptions in communities (a) recurrently affected, (b) briefly and infrequently exposed, and (c) never exposed to HABs. One outcome would be improved understanding of the role and value of public experience in developing and enforcing regulatory strategies to prevent and manage impacts of HABs.

5. *Survey water resource managers and organizations in areas recurrently or potentially affected by HABs to (a) describe existing monitoring and response plans and perceived needs for improve-*

ment and (b) identify areas where no plans have been developed and assess perceived needs for development. The research would seek information as to whether monitoring and response plans were developed and implemented after HAB events, both to assess perceptions of their success and to elicit needs for more effective planning. The research would attempt to identify conditions under which agencies would see the need to develop short-term response plans. It would also assess the feasibility of and identify models for interagency coordination on local and regional scales. A major goal of research on this objective would be documentation and assessment of actual experiences, providing historical models.

6. *Survey water resource managers and organizations to identify whether they would be willing to incorporate algal toxin information into drinking and recreational water quality documentation*. This research would assess whether water resource agencies see a need to incorporate algal toxin information into descriptions and reports about water quality, how the information should be expressed if a perceived need exists, and what the consequences would be in terms of public perceptions and responses. A trade off might exist between the public perception of health protection and an increase in governmental warnings and regulations, affecting the ways in which agencies might wish to proceed. An especially important research project would be the identification of health, economic, and sociocultural consequences of HABs and prediction of what information would have been the most educational to help plan for and alleviate them. Selection of information could be based on instances in which harmful effects were actually present and required amelioration.

7. *Identify models that address regulatory, institutional, and citizenry involvement and assess the advantages and disadvantages of each type, for (a) public water supply and (b) recreational water availability and use*. The survey in this instance would be of examples of managerial systems in areas prone to HABs. The units would be public or private organizations responsible for water management, and the research would focus initially on the ways in which the units address regulations, institutional activities, and citizenry involvement and input. Once types of management-sponsored involvement are identified, surveys would need to be developed that address perceptions of the relative strengths and value of each type, including problem areas or topics. Input would be solicited to assess major considerations to each type of involvement and desirable outcomes expected. The example project below provides an instance of how research on this objective might be designed.

Example Project

Perceptions of HABs in Corpus Christi Bay Recreational Waters: Informing Management and Education

The Texas Gulf Coast is lined with a number of large inland bays. From the upper coast southwestward to Mexico, these are Galveston Bay, Lavaca/Matagorda Bays, San Antonio Bay, Copano/Aransas/Redfish Bays, Corpus Christi Bay, Nueces Bay, and Baffin Bay. Although these bays share common characteristics, each bay has different environmental and social features, depending on a number of factors such as amount of surrounding wetlands, rainfall and vegetation patterns, and surrounding human population. Galveston Bay is surrounded by large population centers that number collectively in the millions, whereas the other bays have much smaller but rapidly growing populations. Galveston Bay is also surrounded by the giant southeastern Texas petrochemical industries, and it includes Buffalo Bayou and the Houston ship channel and port. Research on water issues in the industrial, urban areas of Galveston Bay would be more complex and on different scales than the lower part of the Bay and the other bays to the southwest. The particular bay chosen for the example project, Corpus Christi Bay, is the most urban of the bays other than Galveston, but on a much smaller scale. Research issues would be similar to those of the other bays, even the lower Galveston Bay.

Description: The project aim is to describe perceptions held by three categories of recreational users of Corpus Christi Bay of threats from HABs to the water quality of the Bay and its associated impact on recreation. The three categories are: (1) tourists who use the

bay for recreation, specifically fishing and boating; (2) residents of the two urban areas, Corpus Christi and Ingleside, who use the Bay or are engaged in activities that relate directly to the Bay (fish houses, commercial fishers, seafood restaurants); and (3) officials of recreational organizations. The latter include the Packery Channel Park, the Redhead Pond Wildlife Management Area, the Corpus Christi Botanical Gardens, the Hans A. Suter Wildlife Park, the Texas A&M University-Corpus Christi Nature Trail, and the Indian Point Park/Sunset Lake Hike and Bike Trail.

Methods: Officials representing each of the organizations will be interviewed about pollution problems in the Bay, sources of point and non-point source pollution (especially estuarine problems from agricultural runoff into the Nueces River), the increasing impact on the Bay from urban population growth, and the possible negative impacts from pollution and other extreme natural events, including HABs. They will also be asked what they believe (1) tourists and residents know about pollution and about HABs and (2) tourists and residents should know, i.e., what should be more widely known. The perspectives shared by officials will serve to construct questions for preliminary research with tourists and residents. The pilot study will be ethnographic (i.e., informal interviews and focus groups), leading to construction of preliminary questionnaires. The questionnaires will also be tested prior to development of a formal questionnaire as the research instrument, which will be administered directly by interviewers.

Outcomes: The questionnaires will serve as databases for statistical analyses to produce profiles of perception type, their frequencies, and levels of significance. The results will be expected to show where gaps in knowledge and misunderstandings are the more striking and in need of education.

Challenges: The major challenge is expected to derive from the paucity of knowledge about pollution effects and HABs on the part of the recreational sector. Administration of questionnaires directly by individuals is intended to counter what would be very low response to mail or telephone interviews.

Expertise Needed:

- Anthropologist
- Sociologist,
- Environmental/Marine Scientist
- Statistician

Timeline: The project would require two years, 18 months for data collection and six months for data analysis and final report.

Estimated Cost: $250,000. The major expense would be salary for personnel, including the project coordinator/principal investigator and graduate student assistants to help with the data collection and analysis. The second major expense would be for research costs at field sites, i.e., for per diem and travel.