



1998 ECOLOGY AND OCEANOGRAPHY OF HARMFUL ALGAL BLOOMS

A FEDERAL RESEARCH PARTNERSHIP

Opening Date: November 28, 1997

Closing Date: February 23, 1998



National Oceanic and Atmospheric Administration



Environmental Protection Agency



National Science Foundation



Office of Naval Research



Department of Agriculture



National Aeronautics and Space Administration



NOAA/EPA/NSF/ONR/USDA/NASA Federal Research Partnership

Announcement of Opportunity

Ecology and Oceanography of Harmful Algal Blooms

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- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Coastal Ocean Program
- ENVIRONMENTAL PROTECTION AGENCY
National Center for Environmental Research and Quality Assurance
- NATIONAL SCIENCE FOUNDATION
Directorate for Geosciences, Division of Ocean Sciences
- OFFICE OF NAVAL RESEARCH
- UNITED STATES DEPARTMENT OF AGRICULTURE
Cooperative State Research, Education, and Extension Service
- NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Office of Mission to Planet Earth

INTRODUCTION

Under the National Oceanographic Partnership Program (NOPP), the National Oceanic and Atmospheric Administration's (NOAA) Coastal Ocean Program, the National Science Foundation's (NSF) Division of Ocean Sciences, the Environmental Protection Agency's (EPA) National Center for Environmental Research and Quality Assurance, the Office of Naval Research (ONR), the United States Department of Agriculture (USDA,) and the National Aeronautics and Space Administration (NASA) announce an opportunity to conduct field research, modeling, and laboratory studies on harmful algal blooms (HABs). The Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) Program will support coordinated, well-integrated, interdisciplinary field studies by research teams. Individual studies will also be supported to develop predictive models and address gaps in knowledge related to mechanisms that regulate harmful algal species. The deadline for proposals is February 23, 1998. Final selections will be made by May 22, 1998, for projects to begin in summer 1998.

Harmful algal blooms, including highly toxic species, have increased in frequency, intensity, and severity in U.S. coastal areas over the past several decades. Recent outbreaks, suspected to be due to *Pfiesteria piscicida* and related species, of fish lesions and fish kills in the estuaries of the Mid- and South-Atlantic states, as well as recent red tides and mass fish kills off the Texas coast, represent the most recent and visible examples of this growing threat to U.S. coastal resources, coastal economies, and public health.

RATIONALE

For the purpose of this ECOHAB Announcement, Harmful Algal Blooms include toxic and noxious phytoplankton, benthic algae, and dinoflagellates. As noted above, evidence suggests that over the last few decades, the frequency and duration of HABs have been increasing nationally and worldwide. Formerly, only a few regions of the U.S. were affected by HABs, but now virtually every coastal state has reported major blooms. In many cases, the blooms extend over larger geographic areas and are composed of more than one harmful or toxic species. Furthermore, HABs are not unique to the United States and have attracted international interest from many countries that have commercial and recreational interests in the coastal ocean.

In spite of a growing list of affected resources, our understanding of the biological, physical, and chemical processes that regulate HABs is limited. Toxic blooms can potentially impact virtually all compartments of the marine food-web due to adverse effects on viability, growth, fecundity, and recruitment of marine organisms. Toxins can move through ecosystems and the impacts can thus be far-reaching. Likewise, dramatic ecosystem state shifts can derive from macroalgal overgrowth in benthic systems. In the context of ecological effects, our present knowledge base is inadequate even to define the scale and complexity of many HAB phenomena.

Periodic blooms in some coastal areas have caused virtual collapse of ecosystems with accompanying serious economic impacts. Economic losses in the U.S. from HABs over several decades likely exceed one billion dollars. The costs of HABs are recognized in the need for toxin monitoring programs, closures of shellfish beds, mortality of fish and shellfish, disruptions in tourism, threats to public and coastal resource health, publication of watershed, health and seafood advisories, and medical treatment.

HABs are not only economically costly, but also cause severe human health effects. Human illnesses due to natural algal toxins include: ciguatera fish poisoning (CFP), paralytic shellfish poisoning (PSP), amnesic shellfish

poisoning (ASP), neurotoxic shellfish poisoning (NSP), and diarrhetic shellfish poisoning (DSP). Severe cases of PSP and ASP can result in death, from respiratory arrest and brain dysfunction within 24 hours of consuming the toxic shellfish. Additionally, ASP can have the devastating side effect of permanent memory loss. Human health effects, e.g., neurocognitive impairment, due to *Pfiesteria* have been also noted.

The interagency ECOHAB program addresses the need for long-term, large-scale, interdisciplinary research. The primary objective of this Announcement of Opportunity is to solicit proposals for research on the environmental processes that facilitate and regulate HABs in the coastal ocean. Developing an understanding of how physical and biological processes interact to promote bloom development, maintenance, and decline will contribute to the ultimate goal of preventing, managing, controlling, and mitigating the impacts of HABs, outlined in the nation's comprehensive Federal approaches, "*Marine Biotoxins and Harmful Algae: A National Plan*" (Anderson, D.M., S.B. Galloway, and J.D. Joseph. 1993. WHOI Technical Report 93-02, Woods Hole Oceanographic Institution, Woods Hole, MA. 44 pp.) and "*Harmful Algal Blooms in Coastal Waters: Options for Prevention, Control, and Mitigation*" (Boesch, D.F., D.M. Anderson, R.A. Horner, S.E. Shumway, P.A. Tester, and T.E. Whitledge. 1997. NOAA COP Decision Analysis Series No. 10, NOAA Coastal Ocean Office, Silver Spring, MD. 46 pp. + appendix).

MULTIPLE AGENCY INTERESTS

To address the increased need for research on Harmful Algal Blooms, NOAA, NSF, EPA, ONR, USDA, and NASA combine each agency's unique interests and missions into this coordinated research program. The following outlines specific agency interests in harmful algal bloom research.

NOAA -- HABs and related biotoxin risk must be managed if we are to build viable and valuable sustainable fisheries, protect threatened and endangered species, and effectively manage coastal activities and resources. NOAA's interest is in developing predictive and early warning capabilities to assist in mitigating the impacts of HABs on public health, living marine resources and coastal habitats.

NSF -- Many aspects of species-specific dynamics of plankton and macroalgal populations and species succession that contribute to bloom formation are poorly understood. NSF's interest is in increasing our understanding of the direct and indirect causes of HABs in our coastal regions and their ecological consequences through research on the physiological and ecological basis of bloom forma-

tion, the physical and chemical attributes of coastal oceans that facilitate them, the population attributes of bloom species, and the long term consequences of ecosystem changes.

EPA -- Research programs support an integrated approach to protect the integrity of ecosystems that are affected by blooms through bioindicator development and restoration of degraded ecosystems using a watershed approach. Two specific areas of emphasis for ecosystem protection related to HABs are contaminated sediments and non-point sources of pollution with investigations conducted at the regional or watershed scales. EPA will emphasize *Pfiesteria* research, particularly factors which influence the induction of toxic forms.

ONR -- Plankton blooms resulting from complex coupled physical/biological processes strongly affect the physical, optical, and acoustic properties of the coastal ocean. ONR's interest is in characterizing and forecasting the physical, bioacoustical and optical properties of blooms to improve the capability of the fleet to operate effectively within coastal environments worldwide.

USDA -- Watersheds that flow into waterbodies affected with HABs frequently transect ecosystems with significant agricultural production activities. USDA's interest is to determine the impact of agricultural activities upon watersheds that may promote development of *Pfiesteria*, red tide, or hypoxia zones. Scientists will investigate the non-point sources of contaminants that may promote HAB formation and, as needed, develop research/education programs to control or mitigate the impact of agriculture upon HAB formation.

NASA -- Algal pigments affect optical properties of the water in well characterized ways. In the open ocean, it is possible to quantify pigment concentration using remote sensing techniques because phytoplankton are solely responsible for variation in water color. In nearshore, estuarine, and inland waters, suspended sediments and dissolved organic compounds make the optical properties much more complex. The goal of detecting algal blooms in the presence of other colored materials is the subject of ongoing research. NASA is interested in developing remote sensing techniques that could be applied to the detection or tracking of harmful algal blooms in nearshore coastal environments.

PROGRAM DESCRIPTION

The significant public health, economic, and ecosystem impacts of HAB outbreaks are severe (see "*Marine Biotoxins and Harmful Algae: A National Plan*", Anderson et al. 1993), and the motivations for a coordinated national

research program are made all the more pressing by the recent outbreaks of *Pfiesteria*-related species. In recognition of this need, academic and government scientists and program managers from several agencies worked together to formulate a research strategy entitled *ECOHAB: The Ecology and Oceanography of Harmful Algal Blooms, a National Research Agenda*. The entire document is available at: <http://www.redtide.whoi.edu/hab> as well as agency web sites. The research plan put forth in the ECOHAB report was designed to increase our understanding of the fundamental processes underlying the population dynamics of HABs and the impacts they precipitate. This involves a recognition of the many factors at the organismal level that determine how HAB species respond to and potentially alter their environment. Also of interest are the manners in which HAB species affect or are affected by food web and community interactions, and how the distribution, abundance, and impact of HAB species are regulated by the environment.

In response to the outbreak of *Pfiesteria*-related species the objectives of the 1993 National Plan were adapted to create a national strategy (*National Harmful Algal Bloom Research and Monitoring Strategy: An Initial Focus on Pfiesteria, Fish Lesions, Fish Kills, and Public Health*) for research and monitoring to assess, prevent, and mitigate the impacts of fish lesions, fish kills, and threats to public safety from *Pfiesteria* and *Pfiesteria*-like organisms in the Mid- and South Atlantic and the Gulf of Mexico estuaries. This strategy, also available at the National HAB Office, <http://www.redtide.whoi.edu/hab>, and the web site for NOAA's Coastal Ocean Program, <http://hpsc.noaa.gov/cop/>, assesses the various research needs related to *Pfiesteria* in the context of the growing interest in ensuring public safety and protecting our natural resources from HABs nationwide.

Research needs fundamental to the long-term management of fisheries resources and marine habitats include resolution and integration of various rate processes important to the population dynamics of HAB species (e.g., input and losses due to growth, grazing, encystment, excystment, and physical advection). Our knowledge about each of the many harmful species varies significantly, and even the best-studied remain poorly characterized with respect to the population and community aspects of bloom dynamics.

Nutrient enrichment is a critical factor in all eutrophication, including HAB expression. Thus, land management practices, particularly in intensive agricultural areas, may be contributing to high loading of the nation's watersheds and possibly to blooms of harmful species in coastal waters. While it has not been established that loadings from agricultural and other watershed land use activities are

responsible for outbreaks of HABs, agriculture-based nutrients and other compounds (feed supplements, veterinary compounds, crop and pest control agents, trace elements, etc.) could be important contributing factors. Therefore, there is a critical need for research leading to a better understanding of, and improved strategies for, land use management.

HAB formation and impact in our coastal systems also strongly encourages consideration of control strategies to ameliorate bloom impacts. This aspect of HAB research has been summarized in "*Harmful Algal Blooms in Coastal Waters: Options for Prevention, Control, and Mitigation*" (Boesch, D.F., D.M. Anderson, R.A. Horner, S.E. Shumway, P.A. Tester, and T.E. Whitledge. 1997. NOAA COP Decision Analysis Series No. 10, NOAA Coastal Ocean Office, Silver Spring, MD. 46 pp. + appendix) and provides the background for potential research projects to investigate potential control strategies for HAB species common to our coastal systems.

The specific goals of the research solicited by this Announcement of Opportunity are to:

- Understand the causes of blooms;
- Determine the sources, fates, and consequences of HABs in food webs and fisheries;
- Develop an enhanced predictive and early warning capability for the occurrence and impact of HABs; and
- Explore means for mitigation and control of HABs.

To address these needs, this Program Announcement will support research on the

- Characterization and detection of cells, life stages and toxins, particularly for *Pfiesteria* and its related species;
- Mechanisms underlying the initiation, distribution, and accumulation of individual bloom-forming species, with particular emphasis on *Pfiesteria* and related species;
- Physiological and biochemical bases of the ecological role of toxins in bloom-forming species;
- Physical and biological processes that influence the transport, fate, and effects of marine biotoxins and other HAB impacts;
- Influence of human and natural factors on the biophysical mechanisms that facilitate and regulate HABs, including detection and tracking of conditions suspected of being conducive to bloom formation and potential methods of control;

- The longer-term consequences of ecosystem changes brought about by the increasing frequency of planktonic blooms and community alterations that can come with macroalgal overgrowth in benthic systems and persistent blooms of plankton, and,
- The development of models of the physical, biogeochemical, and ecological processes that can ultimately lead to HAB prediction systems.

A significant challenge to the implementation of this program is that HAB phenomena are diverse with respect to the causative organisms involved, the hydrographic or environmental regimes in which they occur, the factors regulating bloom dynamics, and the nature and extent of their impacts. While laboratory research helps define factors that could be significant in causing blooms, field research and model development are essential to determine and predict the conditions under which blooms form. Comprehensive multidisciplinary studies are needed to fully understand the complex mechanisms underlying the growth and accumulation of harmful species, the formation, transfer, fate of toxins, the impacts of HABs and toxins on ecosystems, and the influence of human activities on these processes. In this regard, a comparative analysis of systems supporting *Pfiesteria* and *Pfiesteria*-related organisms is particularly encouraged.

PROPOSAL SUBMISSION

This Announcement provides an opportunity for investigators to propose research to address the national problem of HABs. To accomplish the Program's objectives, proposals may address integrated, interdisciplinary ***Regional Field Studies*** and ***Comparative Regional Pfiesteria Studies*** on biogeochemical, ecological, and physical processes, or ***Targeted Individual Studies*** on specific biological or physical processes that regulate the occurrence of HAB species, toxin chemistry, and detection methods. Proposals are requested to investigate fundamental physical, biological, and chemical oceanographic and estuarine questions critical to scientifically-based management of fisheries and coastal resources, public health, and ecosystem health in regions threatened by HABs.

Regional Field Studies

Proposals from teams of investigators are encouraged, with clear identification of the individual having responsibility for program integration and synthesis. These regional field studies should be well-integrated, model-based, suitably-scaled, and multidisciplinary studies concentrating on the interaction of the various environmental factors underlying specific HAB problems. Proposed regional studies must present a balanced and well-justified scientific

plan for addressing the issues identified in this announcement, in the ECOHAB National Research Agenda, and in the *Pfiesteria* strategy document. We envision the regional studies to span 3-5 years, encompassing appropriate field studies, data synthesis, and analysis. Proposed efforts should take advantage of existing research efforts and facilities sponsored by other agencies.

Regional field studies should focus on processes influential in the onset, distribution, maintenance, and destruction of HABs, such as the physical structure of coastal waters, competition among phytoplankton or benthic algal species, and adaptive behaviors that result in species dominance.

Timely response to harmful blooms and potential toxicity is hindered by the complexity of mechanisms that contribute to bloom formation and dominance. Therefore, the ability to forecast the onset of blooms and/or predict the subsequent growth, distribution, and dissipation of bloom conditions is of great importance for prevention, mitigation, and management. We particularly encourage proposals that include the development of models to help forecast these conditions, ultimately leading to HAB prediction systems.

Comparative Regional Pfiesteria Studies

It appears that *Pfiesteria* and related species require some common system characteristics for toxicity expression, including eutrophic conditions, shallow depths and relatively long residence times, and fish. However, a combination of these and other factors leads to toxicity in some areas but not others. Because of the strong similarities in environments where *Pfiesteria* and its related species have been observed, studies which compare different regions might provide the means to identify the specific system characters that support toxicity across environments. Proposals are sought to relate basin characteristics and physiological ecology and behavior of the toxic organisms to identify those factors responsible for toxicity expression. Researchers are encouraged to develop multidisciplinary projects comparing systems where *Pfiesteria* and its related species have been reported in order to develop selection criteria for narrowing the number of coastal systems to monitor for future toxic events.

Targeted Individual Studies

We are also requesting proposals for individual studies that address gaps in knowledge related to the nature of HAB phenomena. These studies should, as with regional and comparative studies, address fundamental ecological and oceanographic questions related to HABs. For example, individual studies by one or more investigators could address research issues such as physical transport, and techniques for identifying, detecting, and monitoring biotoxins and HAB species, particularly for *Pfiesteria* and

related species (for highest priorities, see *National Harmful Algal Bloom Research and Monitoring Strategy: An Initial Focus on Pfiesteria, Fish Lesions, Fish Kills, and Public Health*). Studies of nutrient kinetics, physiological bases of growth and toxin production for harmful species, toxin transfer through the food web, and mechanisms for controlling blooms would be of interest. The purpose of the individual studies is to encourage research into key questions on the underlying mechanisms involved with HABs and their control, without necessarily being limited to particular study region(s). These studies should, however, be limited to the goals and objectives of the ECOHAB National Research Agenda and the *Pfiesteria* strategy listed above.

FUNDING

A total of about \$5 million is anticipated for FY 1998, contingent on appropriations. Of this amount about \$4 million is designated for research designed to address the specific research needs associated with the recent *Pfiesteria* outbreak. The projected award range for targeted individual studies is \$100,000 to \$200,000 per year for 1-3 years; regional studies and comparative field studies for *Pfiesteria* and its related species will be supported at up to \$1 million per year for 3-5 years.

PREPARATION AND SUBMISSION OF PROPOSALS

This opportunity is open to all interested, qualified, non-Federal and Federal researchers in the U.S. Proposals submitted in response to this announcement should be prepared and submitted in accordance with the guidelines stated below. Proposals will be subjected to initial screening for relevance to the ECOHAB Program and will be returned without review or advance notification if deficiencies are found. Successful investigators may be asked to make minor revisions in their proposals to fit into an overall program structure.

Prospective investigators are strongly encouraged to include a discussion of how their proposed programs directly address the program goals and how proposed efforts take advantage of existing research efforts and facilities sponsored by other agencies and academic institutions. Prospective investigators should provide a full scientific justification for the research. Proposals should be written to allow adequate review of the details of goals and objectives, conceptual framework, methodological approaches, and integration with other relevant HAB efforts.

Questions that should be addressed in research proposals include:

- **Demonstrated and Potential Harmful Impacts:** What are the present and potential impacts of the HAB problem on human health, the regional economy, fisheries, and ecosystems?
- **Geographic Extent of the Problem:** Is the problem regionally widespread or confined to a relatively small area?
- **Persistence/Predictability:** Is the bloom persistent in time and/or space or recurring to the point that the specified research strategy is appropriate?
- **Existing Data:** Is there an existing body of knowledge about the problem and the area (e.g., oceanographic, biological, meteorological, toxicological) that will allow a field study to be designed effectively?
- **Ongoing, Related Studies:** To what extent could other field programs currently in the region provide additional resources and opportunities to successfully meet the program objectives?
- **Applicability of Results to Other Areas:** Will the information derived from the study have implications for multiple regions or multiple management strategies?
- **Management Implications:** To what extent will the information to be derived from the study have importance (value) to resource management decisions?

Proposals must include plans for the documentation, archiving, and dissemination of ECOHAB Program research data. All funded participants must adhere to data management policies applying to recipients of federal funding in ocean sciences. For examples of data policies, refer to the Coastal Ocean Processes (CoOP) Data Policy available through the CoOP Office or (<http://www.coop.hpel.umd.edu>) or U.S. GLOBEC Data Policy Report No.10 available at <http://www.usglobec.berkeley.edu/usglobec/reports/datapol/datapol.contents.html>. Additionally, data must be submitted to the National Oceanographic Data Center in a timely manner, but certainly by the end of the grant period.

All proposals involving Federal and/or academic scientists must be submitted to the address below. Use the following instructions when preparing your proposal. Full proposals must include the original and 14 unbound copies in the appropriate format and be received by 4 PM EST February 23, 1998. Proposals received after the deadline or proposals that deviate from the prescribed format will be returned to the sender without review. All proposals should be sent directly to:

**ECOHAB Coordinator
NOAA Coastal Ocean Program
SSMC3 Room 9752
1315 East-West Highway
Silver Spring, MD 20910**

If you have any questions or require further information, contact Dr. Kevin Sellner, ECOHAB Coordinator, NOAA Coastal Ocean Program, 301-713-3338, ext. 127; electronic messages can be sent to ksellner@cop.noaa.gov.

PROPOSAL FORMAT

Proposals submitted in response to this Announcement of Opportunity should be prepared and submitted in general accordance with the guidelines provided in the NSF publication, Grant Proposal Guide (GPG) NSF95-27. Specific guidelines outlined in this Announcement supersede those specified in the GPG. Single copies of the GPG are available at no cost from the NSF Forms and Publications Unit, phone 703-306-1130, or via e-mail from pubs@nsf.gov (Internet) or through the Internet at <http://www.nsf.gov/bfa/cpo/gpg/start.htm>. Proposals will be subjected to initial screening for the requirements in the GPG and this Announcement and will be returned without review or advance notification if deficiencies are found. Proposals will NOT be forwarded to other programs if found to be inappropriate for this competition.

A. Sections of the Proposal:

- 1. Signed title page,** cover sheet and certification page. The title page clearly identifies the project's title starting with the acronym ECOHAB, a short title (<50 characters), principal investigator(s) name(s) and affiliation(s), complete address, phone, FAX, and E-mail information, and a budget summary broken out by year. The title page should be signed by the Principal Investigator, and the institutional representative(s) should be identified by full name, title, organization, telephone number, and address. A cover sheet and certification page (NSF Form 1207) should follow.
- 2. One-page abstract/project summary.** An abstract must be included and should contain an introduction of the problem, rationale, scientific objectives and/or hypotheses to be tested, and a brief summary of work to be completed. The abstract should appear on a separate page (NSF Form 1358), headed with the proposal title, institution(s), investigator(s), total proposed cost, and budget period.
- 3. Statement of work/project description.** For Targeted Studies, previous relevant research should be

the first section of the Project Description. For Regional Studies and *Pfiesteria* Comparative Studies, previous relevant research is permitted in an Appendix. The remainder of the Project Description is as follows: The proposed project must be completely described, including identification of the problem, scientific objectives, proposed methodology, relevance to the goals of the HAB Program and its scientific priorities. The project description section should not exceed 15 pages for targeted individual studies (see above) and 25 pages for the collaborative, multiple investigator, multidisciplinary regional field studies and the *Pfiesteria* comparative studies proposals. Both page limits are inclusive of figures and other visual materials, but exclusive of references and milestone chart. Include: (i) the objective for the period of proposed work and its expected significance, (ii) the relation to the present state of knowledge in the field and relation to previous work and work in progress by the proposing principal investigator(s), (iii) a discussion of how the proposed project lends value to the program goals, and detailed descriptions of data management and delivery to NODC. A year-by-year summary of proposed work must be included with intermediate outcomes. Provide a full scientific justification for the research; do not simply reiterate justifications presented in this Announcement of Opportunity. Project management should be clearly identified with a description of the management function within a team.

- 4. Milestone chart.** Time lines of major tasks covering the duration of the proposed project.
- 5. Budget.** Present the budget in grant-year increments with a summary budget for the entire program. Include the following categories: salary and wages, fringe benefits, equipment, travel, materials and supplies (expendables), publication costs, computer services, sub-awards, total cost of this proposal, and cost sharing with other programs.
- 6. Biographical sketch.** For all applicants. Focus on information directly relevant to undertaking the proposed research. Use no more than two pages per investigator.
- 7. Quality Assurance Narrative Statement.** For any project involving data collection or processing, conducting surveys, environmental measurements, and/or modeling, provide a statement on how quality processes or products will be assured. This statement should not exceed two consecutively numbered, 8.5x11 inch pages of single-spaced standard 12-point type with 1-inch margins. This is in addition to the 15 or 25 pages permitted for the Project Description. The

Quality Assurance Narrative Statement should, for each item listed below, either present the required information or provide a justification as to why the item does not apply to the proposed research. For awards that involve environmentally related measurements or data generation, a quality system that complies with the requirements of ANSI/ASQC E4, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," must be in place.

1. The activities to be performed or hypothesis to be tested (reference may be made to the specific page and paragraph number in the application where this information may be found); criteria for determining the acceptability of data quality in terms of precision, accuracy, representativeness, completeness, comparability.
2. The study design including sample type and location requirements and any statistical analyses that were used to estimate the types and numbers of samples required for physical samples or similar information for studies using survey and interview techniques.
3. The procedures for the handling and custody of samples, including sample identification, preservation, transportation, and storage.
4. The methods that will be used to analyze samples or data collected, including a description of the sampling and/or analytical instruments required.
5. The procedures that will be used in the calibration and performance evaluation of the sampling and analytical methods used during the project.
6. The procedures for data reduction and reporting, including a description of statistical analyses to be used and of any computer models to be designed or utilized associated with verification and validation techniques.
7. The intended use of the data as they relate to the study objectives or hypotheses.
8. The quantitative and or qualitative procedures that will be used to evaluate the success of the project.
9. Any plans for peer or other reviews of the study design or analytical methods prior to data collection.

ANSI/ASQC E4, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" is available for purchase from the American Society for Quality Control, phone 1-800-248-1946, item T55. Only in exceptional circumstances should it be necessary to consult this document.

B. Proposal format and assembly

Staple the proposal in the upper lefthand corner, but otherwise leave it unbound. Use 8.5x11-inch paper with 1-inch (2.5 cm) margins at the top, bottom, left and right of each page. Use a clear and easily legible type face in standard 12-point type. All copies must be printed on one side of the page only.

PROPOSAL REVIEW AND SELECTION

Review of proposals and support of the ECOHAB Program will be handled cooperatively by NOAA, NSF, EPA, ONR, USDA, and NASA (hereafter, "the Agencies"). Proposals will be evaluated based on the criteria described in the NSF Grant Proposal Guide and in accordance with established procedures for the Agencies' external merit review. Proposals' responsiveness to the stated goals of this ECOHAB Program Announcement and the ECOHAB Initiative, and complementarity with other research projects will also be considered in the evaluation by panel(s) of expert scientists.

REVIEW AND SELECTION CRITERIA

All grant applications are initially reviewed to determine their legal and administrative acceptability. Acceptable applications are then reviewed by an appropriate technical peer review group. This review is designed to evaluate each proposal according to its scientific merit. In general, each review group is composed of scientists, engineers, social scientists, and/or economists who are experts in their respective disciplines and are proficient in the technical areas they are reviewing. The reviewers will use the following criteria in their reviews:

1. The originality and creativity of the proposed research, the potential contribution the proposed research could make to advance scientific knowledge in the environmental area, the appropriateness and adequacy of the research methods proposed, and the adequacy of the Quality Assurance Narrative Statement.
2. The qualifications of the principal investigator(s) and other staff, including knowledge of pertinent literature, experience, and publication records as well as the probability that the proposed research will be successfully completed.
3. The availability and/or adequacy of the facilities and equipment proposed for the project.
4. The responsiveness of the proposal to the research needs set forth in the solicitation.

5. Although budget information is not used by the reviewers as the basis for their evaluation of scientific merit, the reviewers are asked to provide their view on the appropriateness and/or adequacy of the proposed budget and its implications for the potential success of the proposed research. Input on requested equipment is of particular interest.

GRANT ADMINISTRATION

While the agencies will maintain separate funding mechanisms, a common review process will be used to evaluate and select proposals. Upon conclusion of panel merit review, meritorious proposals may be recommended for funding by any of the agencies at the agencies' option. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency. In addition to the extramural funding, NOAA and other permitted Federal partnering agencies may fund investigators from other Federal laboratories that successfully compete through the ECOHAB Program announcement.

The agencies provide awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. NOAA, NSF, EPA, ONR, USDA, and NASA, therefore, do not assume responsibility for such findings or their interpretation. The agencies welcome proposals on behalf of all qualified scientists and engineers, and strongly encourage women, minorities, and persons with disabilities to compete fully in any of the research and research-related programs described in this document.

In accordance with Federal statutes and regulations, and the agencies' policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from the agencies.

Facilitation Awards for Scientists and Engineers with Disabilities provides funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on an NSF project. Contact the program coordinator in the Directorate for Education and Human Resources. The telephone number is 703-306-1636. The Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the NSF Information Center about NSF programs, employment, or general information. To access NSF TDD, dial 703-306-0090; for FIRS, 1-800-877-8339.

PRIVACY ACT AND PUBLIC BURDEN

The information requested on proposal forms is solicited under the authority of the National Science Foundation Act of 1950, as amended. It will be used in connection with the selection of qualified proposals and may be disclosed to qualified reviewers and staff assistants as part of the review process; to applicant institutions/grantees to provide or obtain data regarding the application review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers as necessary to complete assigned work; and to other government agencies in order to coordinate programs. See Systems of Records, NSF-50, Principal Investigator/Proposal File and Associated Records, 60 Federal Register 4449 (January 23, 1995), and NSF-51, Reviewer/Proposal File and Associated Records, 59 Federal Register 8031 (February 17, 1994). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of your receiving an award.

The public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate or any other aspect of this collection of information including suggestions for reducing this burden, to:

Herman G. Fleming
Reports Clearance Office
Contracts, Policy and Oversight
National Science Foundation
Arlington, VA 22230