



USGS Contaminant Biology Program: Program Review Report

February 24-28, 2002

Dulce Skamania Lodge
Stevenson, Washington



U.S. Department of the Interior
U.S. Geological Survey

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USGS Contaminant Biology Program: Summary Report of the Program Review Coordinator

Executive Summary

The U.S. Geological Survey (USGS) Contaminant Biology Program¹ Review was held February 24 through February 28, 2002, at Dolce Skamania Lodge, Stevenson, Washington. The Summary report represents the recommendations of the Program Review Coordinator, and is the result of participation at the meeting, interaction with the Steering Committee and Review Panel, and consideration of their reports, which follow the Summary Report (Tabs B and C).

Overview

The USGS Contaminant Biology Program Review determined that the current Program is technically strong. Scientists in the Program are internationally recognized for their cutting-edge science. The Program benefits from a tremendous diversity in the skills and expertise of the scientific staff. The Review also found that this expertise is being applied to some of the highest priority natural resource management issues facing the Nation. The innovative and entrepreneurial approaches of many scientists in the Program have allowed them to flourish, either in individual-based investigations or as part of collaborative teams with client agencies. Contacts of senior scientists in the Contaminants Program with the client agencies remain strong. In addition to recognizing the significant contributions to contaminant science of the USGS Contaminant Biology Program, the Program Review Coordinator makes the following recommendations, based on input from the two reports and the conduct of the review:

Final Recommendations

The Program Review Coordinator makes the following recommendations. The first two recommendations relate to management, the remainder follows the organizational framework of the capstones.

1. RECRUITMENT, TRAINING FACILITIES, AND EQUIPMENT: Recruitment of new scientists is the highest priority. Centers should continue to invest in capital equipment, skills and facilities to maintain scientific excellence. New hires in the application of genetics and genomics to contamination problems, multiple stressors, and modeling of toxic effects on populations and ecosystems are needed. Create new opportunities for scientists on staff to acquire skills and experience in these disciplines. Centers and Cooperative Research Units should coordinate investment in these areas to maximize investment throughout the Program.
2. ENDORSE STRONG PROGRAM COORDINATION that establishes a programmatic vision and long-term direction to research, facilities, program planning, leadership, project

¹ Since the Review, the name of the Program was changed from the Contaminants Program to the Contaminant Biology Program the name that will be used in the remainder of this report.

development, teamwork, and interdisciplinary coordination; and advocates for a strong Contaminant Biology Program. Establish a research coordination team to establish and implement priorities and communicate with client agencies.

3. ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY – Research on biomarkers should further develop, test and validate these techniques and identify the toxic agents of biomarker response.. Improve understanding of "*emerging*" chemicals through analytical chemistry, toxicity testing and field studies. Explore the potential of *genomic and genetics* to understand toxicological problems in the environment. *Demonstration site*: Relate toxicity testing and toxicological biomarkers to ecological endpoints at the population, community and ecosystem process-levels within a showcase demonstration site or sites in collaboration with other disciplines, including ecological modeling. Organize a workshop to discuss the demonstration project and the range of ecosystem processes that would be suitable as toxicological biomarkers.
4. CONTAMINATED HABITATS- Several types of sites are high priorities for study:
 - *Energy Research* - effects of energy exploration, development, production and use on federal lands, toxicity and decontamination of coal bed methane wastewater, drilling mud and other byproducts, and ecological effects of energy development;
 - *Hazardous waste sites* - including remediation technology, restoration goal development, development of a cross-center restoration ecology team, and workshop on Natural Resource Damage Assessment and Restoration (NRDAR) lessons;
 - *Invasive species* – Expand study of nontarget effects of chemical treatments.
 - *Mercury* – Elucidate the implications of mercury contamination for fish and wildlife populations and systemic effects on the environment.
5. ECOSYSTEM-LEVEL EFFECTS: The Program should improve understanding of sublethal effects and multiple stressors. Rigorous predictive capabilities should be further improved by linking contaminant threats of multiple stressors with population models, and by relating physical processes to fate and effects.
6. SPECIES AND POPULATION DECLINES: Improve toxicity methods and data for under-represented groups, such as reptiles, amphibians, freshwater mussels, and crayfish. Enhance understanding of the role of contamination in national and regional faunal declines, (e.g. amphibians, or sea ducks, respectively) where there is evidence that contaminants are playing a major role. Improve predictive capabilities by developing the physiological basis to understand the sensitivity of untested species.

7. MONITORING AND ASSESSMENT: Increase funding to BEST². Increase Internet availability of monitoring and assessment information to other researchers, our partners, and the public using information technologies. Increase cooperation and collaboration among USGS monitoring programs to link exposure and effects. Capitalize on the long term field experience of Contaminants scientists by linking long term data sets and improving comparability for examining contaminant trends. Improve sample archiving.

Recommended Program Goals

The Review resulted in the following revision to the vision, purpose, mission, goals and objectives for the Contaminant Biology Program:

Toxicology and Chemistry

Determine the causes, fate, exposure and effects of environmental contamination. Develop and standardize biomarkers, molecular biology methods and techniques and other toxicological methods for species underrepresented in toxicological literature, Species of special concern, Emerging chemicals and sublethal effects.

Contaminated Habitats

Develop the scientific basis for assessment, restoration and monitoring of habitats, contaminated by mining, agriculture, urban wastewater, industry, and chemical control agents, with special emphasis on hazardous waste sites, energy and energy development activities and mercury.

Develop the toxicological basis to remediate and prevent contamination by providing information on the safety of chemical concentrations, biological controls, nontarget effects of chemical controls for invasive species, fire, and other hazards.

Integration of Ecological Stressors

Improve the scientific basis for evaluating the effect of multiple stressors at multiple levels of biological organization and multiple temporal and spatial scales. Establish demonstration sites to link ecological models, biomarker responses and toxicological tests in collaboration with other disciplines.

² At the time of the review, BEST was within the Contaminants Program. Since the review included BEST, the recommendations for BEST are described here.

Conduct of the Review

Introduction

The USGS Contaminant Biology Program Review was held February 24 - 28, 2002, at the Dolce Skamania Lodge, Stevenson, Washington. The Review of the Contaminant Biology Program was the fourth in the first cycle of programmatic reviews conducted by the Biology Discipline of the USGS. The purposes of the review were to:

- Assess the accomplishments of the Contaminant Biology Program and evaluate the success of BRD science in meeting the interim goals of the Program.
- Update goals, objectives and priorities of the Program
- Determine the significance and relevance of BRD science
- Enhance communication and collaboration among BRD scientists
- Provide opportunities for budget and program development

Participants

Approximately 90 individuals attended the review. Participants consisted primarily of contaminants research scientists within the Biological Research Discipline (BRD). Scientists from nine Science Centers, the Cooperative Research Program, and BRD Headquarters attended the review. In addition, representatives from the Water and Geology Disciplines also participated, as well as representatives from the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, U.S. Environmental Protection Agency and the National Oceanographic and Atmospheric Administration.

The Review Panel and Steering Committee

As prescribed by the BRD Guidance on Program Review, two committees guided and participated in the review. The Review Panel, comprised of six experts in contaminants and related fields from agencies and organizations from outside the USGS Biology Discipline, reviewed the Program at the Review Meeting and reported its findings. The Steering Committee, which planned the Review, included seven experts in contaminants and related fields within the USGS, the Program Coordinator, and the Program Review Coordinator.

The Review Program. The Review Program was structured to identify new program goals and objectives, describe the program for the Review Panel, and facilitate an effective exchange of information on the Contaminant Biology Program. The structure of the Program Review Agenda (Appendix B) supported these goals.

- The **Plenary** included presentations by the Associate Director and the Chief Scientist for Biology, and the Program Coordinator for the Contaminant Biology Program and panel discussions by representatives of partner agencies, and by other disciplines within USGS. BRD management provided an overview of the role and the status of the Contaminant Biology Program within BRD, and charged the participants to draft sets of goals and objectives for the Contaminant Biology Program.

- A **panel** representing the four USGS Disciplines described relations between other USGS programs and the BRD Contaminant Biology Program. An **interagency panel** addressed relations between the Contaminant Biology Program and other DOI Bureaus and external agencies. Bob Alverts from Bureau of Land Management (BLM), Bill Jackson from National Park Service (NPS), George Noguchi from U.S. Fish and Wildlife Service (FWS), and Wayne Munns from U.S. Environmental Protection Agency (EPA) were on the panel. Their statements are in Appendix C.

- The "**capstone**" talks summarized research efforts of the Contaminant Biology Program. The capstone presentations summarized and evaluated the recent and current research activities underway under each general heading. Presented within an organizational framework, the capstones, in small capital letters, were:
 - ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY
 - CONTAMINATED HABITATS: Urban Wastewater; Mining and metals;
 - Biological and Chemical Controls and Agriculture; Industrial sources
 - Integration of Ecological Stressors
 - SPECIES DECLINE
 - ECOSYSTEM LEVEL EFFECTS
 - MONITORING AND ASSESSMENT

- Associated with each capstone were **case studies** on key and representative research topics. Each of the Capstones was associated with one or more breakout sessions where participants developed recommendations for goals and objectives for each individual capstone and discussed the status and future of the Contaminant Biology Program.

- At **Poster sessions**, participants examined and discussed nearly 80 individual posters in detail. A listing of the Posters may be found in Appendix D .

- At the plenary **Summary Session**, leaders of breakout groups summarized their sessions and the Steering Committee and Review Panel presented their preliminary findings.

- All participants received a two volume **briefing book**, which contained an agenda, general introductory information on the Contaminant Biology Program, a written overview of the program and summaries of the capstone presentation, poster abstracts, recent publication lists by science center, participant lists and contacts, and a full list and individual summaries for each current contaminants research investigation contained in the Science Information System database. Reports and other products of the review will be made available pending approval by the BRD Executive Leadership Team.

Program Goals

The Review process used the interim goals as a starting point. The Interim Goals were established in the 1990's through discussions with senior-level contaminants personnel and designed to guide the program until the completion of the program review. The following goals, and statements of vision, purpose, and mission are recommended for adoption by the program.

Vision

Provide scientific information to protect and restore the Nation's biotic resources from the effects of environmental contaminants.

Purpose

Provide resource managers with the scientific basis to evaluate contaminant threats to natural resources.

Mission

The Contaminant Biology Program conducts research and communicates information on the effects of environmental contaminants on the health and viability of DOI trust species and the ecosystems on which they depend.

Overall Goal

Provide information on fate, effects and ecological risk of environmental contaminants relative to DOI trust species and the ecosystems on which they depend.

Objectives

1. **Environmental Contaminant Methods** - Develop methods to determine exposure and biological and ecological effects.
2. **Multiple stressors** - Determine contaminant effects on ecological degradation of trust resources in relation to other biotic and abiotic stressors.
3. **Scales** - Describe contaminant exposure and effects at multiple levels of biological organization and across spatial and temporal scales.
4. **Synthesis** - Synthesize stressor information as a scientific basis for risk-based decisionmaking.
5. **Communication** - Communicate information to resource managers, regulatory agencies, policy makers and the public.

Program Recommendations and Discussion

The Panel and Committee drafted recommendations for changes to the program. The following discussion summaries are a synthesis of input from the Review Panel, the Steering Committee and Review participants. A table comparing the recommendations of the Review Panel and the Steering Committee may be found in Appendix A.

1. RECRUITMENT, TRAINING, FACILITIES, AND EQUIPMENT:

Recruiting new scientists is the highest priority. Centers should continue to invest in capital equipment, skills and facilities to maintain scientific excellence. New hires in the application of genetics and genomics to contamination problems, multiple stressors, and modeling of toxic effects on populations and ecosystems are needed. Create new opportunities for scientists on staff to acquire skills and experience in these disciplines. Centers and Cooperative Research Units should coordinate investment in these areas to maximize investment throughout the Program.

Discussion - The demographics of our workforce is a **major** challenge. Recruitment of young scientists is sorely needed to maintain our ability to meet the needs for contaminant information from our clients into the future. Coordination across Centers for acquisition of emerging analytical technology will help to make the program more cost effective and stay abreast of new equipment needs.

2. PROGRAM COORDINATION

Establish a research coordination team to advise the Program coordinator in the establishment and implementation of program-wide priorities . Endorse strong Program coordination that establish and implement priorities, communicates with client agencies. establishes a programmatic vision to provide long-term direction to the research, facilities, program planning, project development, leadership teamwork, and interdisciplinary coordination; and advocates for a strong Contaminant Biology Program.

Discussion -The Panel recommended that USGS re-examine organizational structure to reflect the larger goals and objectives of USGS as a National agency. To achieve these agency-wide goals, they recommended that USGS develop performance measures and funding support that are explicitly linked to programmatic research-driven mandates, management and goals performance measures. In addition, they advocated adopting performance measures for actual tasks associated with a project and resource-based question. They also noted the need for an improved science tracking and reporting process, which has the potential to be present in BASIS+, (our forthcoming project tracking system). Enhancing interaction and collaboration among contaminant scientists through workshops and other means is also an important function of the program.

3. **ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY**

Research on biomarkers should further develop, test and validate these techniques. and identify the toxic agents of biomarker response. The Program should improve our understanding of "emerging" chemicals through analytical chemistry, toxicity testing and field studies. The use of *genomic and genetics* to understand ecotoxicological problems should be explored.

***Demonstration site:* The Program should relate toxicity testing and toxicological biomarkers to ecological endpoints at the population, community and ecosystem process-levels within a showcase demonstration site or sites in collaboration with other disciplines, including ecological modeling. A workshop should be organized to discuss the demonstration project and the range of ecosystem processes that would be suitable as toxicological biomarkers.**

Discussion - Biomarkers require continued efforts. USGS should explore how we might best use genetics and genomics to enhance our understanding of contaminant effects. Information on emerging contaminants, including new pesticides, are an increasing need of our multiple DOI Partners. Specific actions include two workshops: one for the demonstration site, and the other to prioritize basic toxicology and analytical methods for emerging contaminants, coordinate analytical method development and identify facilities with research and/or service capabilities.

The lack of understanding of ecological effects of contaminants hampers our ability to make scientifically sound resource management decisions and to place contaminants in context with other stressors. Development of a demonstration site where multiple biomarkers of toxicity, exposure, and ecological effects could be tested and developed would help to move the science forward and move us toward addressing the lack of understanding of the effects of contaminants on ecosystem-level processes. Those organizing this effort should look for opportunities for multiple partners with diverse expertise.

4. **CONTAMINATED HABITATS - Certain sites are high priorities for scientific study:**

***Energy Research* - effects of energy exploration, development, production and use on federal lands, toxicity and decontamination of coal bed methane wastewater, drilling mud and other byproducts, and ecological effects of energy development;**

***Hazardous waste sites* - including remediation technology, restoration goal development, development of a cross-center restoration ecology team, and workshop on NRDAR lessons;**

***Invasive species* - nontarget effects of chemical treatments.**

***Mercury* – Elucidate the implications of mercury contamination for fish and wildlife populations and systemic effects on the environment.**

Discussion - DOI faces many specific types of challenges. DOI lands have a mounting inventory of hazardous waste sites that require remediation and better strategies for restoration, many involving emerging contaminants. Pervasive mercury

contamination of DOI lands and waters requires a concerted effort to understand its implications for fish and wildlife populations and their immune response. Strategies for eliminating invasive species can involve use of pesticides with unforeseen consequences. DOI also has a large part to play in filling the Nation's energy needs. Environmentally friendly development of these resources demands better understanding of ecological and toxicological goals. Specific actions could include a workshop on coal-bed methane.

- 5. ECOSYSTEM-LEVEL EFFECTS: The Program should improve understanding of sublethal effects and multiple stressors. Predictive capabilities should be improved by linking contaminant threats of multiple stressors with population models, and by relating physical processes to fate and effects.**

Discussion - The program should provide opportunities for interactions between ecologists and toxicologists to integrate ecosystem science and ecotoxicology within predictive models. Management should recognize that these studies are difficult. Targeted new hires for multiple stressor science and predictive modeling of toxic effects will be needed.

- 8. SPECIES AND POPULATION DECLINES: Improve toxicity methods and data for under-represented groups, such as reptiles, amphibians, freshwater mussels, and crayfish. Enhance understanding of the role of contamination in national and regional faunal declines, (e.g. amphibians, or sea ducks, respectively) where there is evidence that contaminants are playing a major role. Improve predictive capabilities by developing the physiological basis to understand the sensitivity of untested species.**

Discussion - Historically, most toxicity testing concentrated on a few species and supported regulation. The response of many taxa to contaminants is largely unknown, yet many of these groups are in decline and subject to diverse stressors. Methods to test these species and understand their toxic responses are needed.

- 6. MONITORING AND ASSESSMENT: Increase funding to BEST. BEST should improve linkages between contaminant databases and access to data management tools. Increase internet availability of monitoring and assessment information to other researchers, our partners, and the public using information technologies. Increase cooperation and collaboration among USGS monitoring programs to link exposure and effects. Capitalize on the long term field experience of Contaminants scientists by putting together long term data sets to examine contaminant trends. Improve sample archiving.**

Discussion - Although the USGS Biology discipline has several good contaminant databases, it needs a way to link them. Better linkage of databases would enable USGS to provide assessments, and facilitate the assessments of others. BEST and NAWQA should continue to explore opportunities to link population, effects and exposure measurements to environmental concentrations of chemicals.

Program planning process – Looking to the Future

The Review Panel and the Steering Committee, in their respective reports, made recommendations, for goals, objectives, conduct of the program, areas of study and organization. Over the next few years, the Contaminant Biology Program is scheduled to draft a 5-year plan, like other USGS programs. The Plan is scheduled for completion in the FY 2003-4 timeframe. The Review Process has enabled the Program to jumpstart the process by providing much of the material that will be used in the creation of the Plan, including the goals and a description of the structure for components of the Program. The recommendations listed in this report will serve as an agenda for the activities of the Program Coordinator and the seed from which the five-year plan will grow.

Review Panel

Chair: Steve Schwartzbach, U.S. Fish and Wildlife Service, (now with USGS)
Kathleen M. Johnson, Program Coordinator, Mineral Resources Program, USGS

Alan Steinman, Robert B. Annis Water Resources Institute, Grand Valley State
University

Derek Muir, Research Scientist, Environment Canada, National Water Research
Institute,

William Benson, Director, National Health and Environmental Effects Research
Laboratory, Gulf Breeze Division, U.S. Environmental Protection Agency,

John Stein, Research Scientist, National Oceanic and Atmospheric Administration,
Northwest Fisheries Science Center, EC Division

Steering Committee

Review Coordinator: Tom Muir, Headquarters

Jill Baron, Research Scientist, Fort Collins Ecological Research Center

Herb Buxton, Program Coordinator, Toxic Substances Hydrology Program

Christine Custer, Research Scientist, Upper Midwest Environmental Sciences Center

John French, Research Scientist, Patuxent Wildlife Research Center

Sarah Gerould, Program Coordinator, Contaminant Biology Program

Chuck Henny, Research Scientist, Forest and Rangeland Ecosystem Research Center

Chris Ingersoll, Research Scientist, Columbia Environmental Research Center

Reynaldo Patino, Leader, Texas Fish and Wildlife Research Unit

Acknowledgments

The Review Coordinator and Program Coordinator would like to extend our appreciation to the Review Steering Committee and Review panel for their many contributions to the Contaminants Review Process, principally their hard work, expertise, cooperative spirit and patience. Their extent of their efforts is evidence in the reports that are the backbone of this document. Our thanks also to the representatives from other USGS divisions and other agencies that participated in the Review and the perspectives and insights they provided. We would also like to express our gratitude to the BRD staff who made invaluable contributions to the logistics associated with the Review process, especially Emily Tracy, Cathy Sevila, and Kendra Medlock. We would like to acknowledge the contributions of the researchers and managers who supported and participated in the meeting, many of whom made presentations, prepared posters, lead discussion and prepared reports. Special thanks to Rod DeWeese for his coordination of poster abstracts and the posters sessions. Finally, our thanks to Sue Haseltine and Denny Fenn for their guidance in the preparing of the Contaminants Review and their presentations and participation in the meeting.

