

December 22, 1997

EPA-SAB-EPEC-LTR-98-001

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

Subject: Review of the EPA's Draft Ecological Research Strategy

Dear Ms. Browner:

The Ecological Processes and Effects Committee (EPEC) of the Science Advisory Board met on July 21-22, 1997 to review the Agency's draft Ecological Research Strategy. Scientists within the Office of Research and Development (ORD) developed the Ecological Research Strategy to focus on the single, broad goal to "provide the scientific understanding required to measure, model, maintain and/or restore, at multiple scales, the integrity and sustainability of ecosystems now, and in the future." The strategy was developed to guide planning and implementation of research over the next three to five years. ORD plans to revise the strategy during the summer and fall and to publish the final strategy in the winter.

The Charge consisted of two parts. The Charge questions are included as Attachment A. The first part of the Charge for the review of the ORD Ecological Research Strategy asked for the Committee's general impression of the overall strategy, paying particular attention to the direction and established goals and objectives and, in particular, asked for comments on six broad areas which are outlined in the next section of this report. In the second part of the Charge, EPEC was asked to provide their views on specific issues related to the Ecological Research Strategy report.

1. Part I of the Charge: General Comments

In responding to Part 1 of the Charge, EPEC focused its comments on the following six broad areas:

- a) *The consistency of the concepts and terminology with EPA's ecological risk paradigm,*
- b) *The consistency of the research strategy and the elements with the goals and objectives as stated in each section of the Ecological Research Strategy,*
- c) *The appropriateness of the direction of the ORD portion of the research considering the unique capabilities of the organization,*
- d) *The appropriateness of the research areas and what others might be considered in lieu of, or in addition to, those identified,*
- e) *The clarity of ORD's focus and the rationale behind the program direction and out-year emphasis, and*
- f) *The utility of maintaining a core research focus as a planning and research implementation foundation.*

EPEC strongly compliments ORD for undertaking the comprehensive, long-term planning exercise that led to the production of the "Ecological Research Strategy." Strategic planning is essential for proactive operation, priority setting and resource allocation for ORD, and for coordinating efforts across the Agency. Developing an ecological research strategy is especially important for the Agency, given its historical emphasis on human health issues, since it is now clear that the historical assumption was incorrect that protecting human health is sufficient to protect ecological systems.

Strategic planning efforts for the Ecological Research Strategy should be consistently and regularly conducted. A five-year cycle may be reasonable for ORD, but major deviations from the strategic plan should trigger "updates." It may be appropriate to subject major plan changes to external review.

The Committee further compliments ORD for its effort to expand its planning horizons beyond specific pollutant and narrow pollutant-specific regulatory mandates. The broad view goal of ecological resource protection was the correct starting point for this document. Broadly based strategic planning will ensure that Agency research efforts are progressive and forward-looking rather than reactive and backward-looking.

The Committee, however, is concerned with how the ORD Ecological Research Program intends to use the two definitions of ecological integrity presented during the overview of the research plan. The definition of ecological integrity used in the Executive Summary of the Ecological Research Strategy document was: "maintenance of ecosystem structure and function characteristic of a reference condition deemed appropriate for its use by society." (Definition 1). A second definition was presented in the overview: "the degree to which an ecosystem represents a balanced, resilient community of organisms with biological diversity, species composition, structural redundancy, and functional processes comparable to that of the natural habitats of a region." (Definition 2). The Committee feels that this second definition incorporated some valuable components that should be integrated with the first definition, such that it is clearly stated that both scientific criteria and societal values contribute to establishing the best attainable condition of an ecosystem.

As discussed in the Lakes Biocriteria Report (SAB, 1997), scientific criteria should be used to establish a reference condition that reflects the highest ecological integrity for an ecosystem. Subsequently, a continuum of ecosystem health, from the reference condition to one significantly impaired by human activities, should be defined, along with benchmarks that can be used to assess ecosystem health during the process of ecosystem management. Both the scientific process of characterizing ecological integrity and the process of setting societal goals should be used in the determination of the desired endpoint for a particular ecosystem.

The SAB Committee strongly endorses the continued and expanded use of the Ecorisk Framework as the organizing paradigm for the four core areas. While we recognize that the Framework has served as a key research outline template for the development of the Ecological Research Strategy, there remains considerable opportunities to forge even a stronger linkage between the two. The Framework elements of Problem Formulation, Analysis, Risk Characterization and Risk Management should serve as key sections and each element of the Ecological Research Strategy should be carefully designed to fit into a specific section of the framework. Agency investigators should continually ask themselves "Where does my program fit in the framework and how are my results going to feed into the next steps of the Framework?"

Discussion with Agency staff during the review clearly identified numerous examples where these questions had not been asked. The result was that program linkages apparently were unclear and not well developed. For example it was not clear how information developed in the Upper Darby field assessment would be communicated to the Risk Management team in such a way that it would facilitate decision-making. The Ecorisk Framework forces all parties to think more carefully about the design of their program and most importantly, to think about how the data that they develop may actually be used to facilitate environmental decision making.

Further attention to the Framework will also underscore the importance of the need for an early dialog by researchers with stakeholders in the Problem Formulation phase, as well as throughout the entire process. Currently the Ecological Research Strategy as summarized in Table E-1 does not show stakeholder involvement until the very last column. If future ecological research is to have relevance vis-a-vis ecosystems to improve human uses, services, and ecological values, then stakeholders must participate in the discussions during the planning and problem formulation stages, as well as during the end of the process. However, the scientific analysis portion of the ecorisk framework should remain transparently science-driven. The SAB Committee recommends that future flow charts of the Ecological Research Strategy be redrawn to clearly show the important role of early and multiple places for stakeholder involvement.

2. Part II of the Charge: Specific Areas

The second part of the Charge for the research strategy asked for the Committee's views on issues related to specific areas of research and how they might be improved. The Committee also provided its views on issues related to specific areas of research and how they might be improved.

2.1 Multi-Stressor, Multiple Levels of Biological Organization and Multi-scale Research

The Committee was asked to provide comments and the associated rationale on:

The strategy gives special attention to multi-stressor, multiple levels of biological organization and multi-scale research within a multimedia context. EPA is interested in SAB concerns, advice, recommendations, and cautions associated with this approach.

The Committee notes that multi-stressor, multi-scale, and multi-endpoint issues were not discussed extensively in the strategic plan or by EPA staff during the review. The Committee assumes that such regional scale work is primarily being conducted within the Mid-Atlantic Integrated Assessment (MAIA) project, which the Committee has reviewed previously as a part of the Environmental Monitoring and Assessment Program (EMAP). EPEC supports the MAIA activity and other similar regional-scale studies involving different stressors and ecological endpoints. However, prudence is needed to make sure that the research strategy does not get too far ahead of itself without a sound technical foundation.

EPEC strongly recommends that ORD expand regional-scale work. The Committee believes that ORD should refine these concepts and methodologies by developing the scientific foundations, both in terms of methodological advances and

real-world applications, necessary for regional-scale, community-based ecosystem management. The following approaches should be included as research in support of this goal: methodologies to identify relative risks across multiple stressors, methodologies to assess cumulative effects of multiple stressors on critical ecological endpoints, methodologies to identify endpoints at higher levels of organization (ecosystem and landscape), methodologies for risk management incorporating the decision-making and stakeholder interfaces that are essential for regional environmental protection and management, and methodologies to identify benchmarks of ecological condition and associated performance evaluation measures that can be used to characterize the efficacy of management of regional environments. The Committee recommends using real-world case studies, not abstract exercises, as the focal point for testing and refining these concepts and methodologies. Such case studies should also be used as opportunities to verify or validate models to define better their utility and limitations.

2.2 The Four Fundamental Areas of Core Research

The Committee was asked to provide comments and the associated rationale on:

The strategy identifies four fundamental areas of core research to be applied to specific environmental issues. These are in the areas of monitoring, modeling and process research, risk assessment, and risk management. Comments are solicited on the appropriateness of the goals and objectives of these four research areas, the research areas proposed to address those goals and objectives, and the milestones proposed in response to the objectives. Further, considering the limitations in personnel expertise and financial resources, recommendations on alternatives in lieu of, or supplemental to, the research foci proposed are encouraged.

While the Committee feels that the four core research areas are generally appropriate, we recommend that ORD define these four areas using the following scientific questions (that currently appear in Section 2.2 of the draft Ecological Research Strategy), rather than the bulleted descriptions currently used:

- a) What is the current condition of the environment, and what stressors most significantly affect the condition? (monitoring research);
- b) What are the biological, chemical, and physical processes affecting the exposure and response of ecosystems to stressors? (process and modeling research);
- c) What is the relative risk posed to ecosystems by these stressors, alone and in combination, now and in the future? (risk assessment research); and,

- d) What options are available to manage the risk to or restore degraded ecosystems? (risk management and restoration research).

This recommended change is not simply editorial, but would shift the focus of the core research to include areas that the Committee strongly endorses and that are currently under-represented or missing from the research plan.

For example, the first question places an appropriate emphasis on both defining a healthy condition of the environment of concern (independent of particular stressors) and addressing the potential effects of the particular stressors on the environment of concern. The clear focus on understanding and providing the tools to measure ecological system condition, as a prerequisite for assessing the effects of stressors, is at times lost in the more detailed components of the draft Ecological Research Strategy. Maintaining this focus is important to support the type of community-based and watershed-based decision making in which EPA is increasingly engaging. Moreover, using questions to define the core research area provides a more accurate description of the current research plan, particularly with respect to indicators, than does the shorthand monitoring research bullets in the current draft.

Similarly, the Committee recommends a revision of the second question to read, “What are the biological, chemical, and physical processes affecting the condition of ecological systems and their exposure and response to stressors?” This revised question more accurately conveys the Committee’s recommended focus regarding process and modeling research than does either the current description or the current program.

Specifically, we endorse an increased emphasis on ecological process research for landscapes and a variety of ecosystem types (such as described in portions of Section 3.3.4. of the Ecological Research Strategy), as opposed to the current emphasis on developing a unified modeling framework for all systems and the dominant investment in atmospheric modeling.

The third question, on relative risks, refers to research to improve the understanding of which stressor, and which combinations of stressors, are more important to ecological systems. While the Science Advisory Board, through its Reducing Risk (SAB, 1990) and Integrated Risk projects, has discussed the concept of relative risks extensively, there remains an important research need to develop improved tools for assessing relative risks across stressors, as well as for assessing cumulative risks and risks from combinations of multiple stressors affecting ecological systems.

In addition to shifting the relative emphasis of various projects within the four core areas, the Committee recommends that ORD allocate money and resources in a more balanced way among the four areas. While we recognize that many specific research projects can be assigned to more than one core area, the overall allocation still appears substantially to under-invest in the methodological aspects of relative risk assessment. Additionally, we encourage increased allocation of resources in the area of developing risk management guidance and risk management guidelines that would expand the risk management component of the Research Strategy beyond developing physical treatment techniques.

The Committee's recommendations regarding changes to the description and substance of the four core areas and the resulting changes in research emphasis should also be incorporated into the program objectives. Specifically, the program objectives could be rewritten to clarify their direct relationship to the corresponding goal, as well as to the driving influence that the objectives have on the development of the four core areas. For example, the objectives could emphasize the development of the scientific understanding and tools to assess the condition (i.e., integrity and sustainability) of ecological systems, the development of scientific understanding and tools to assess the response of these systems to stressors, and the development of the scientific understanding and tools to manage and restore these systems.

2.3 Priority Environmental Threats

The Committee was asked to provide comments and the associated rationale on:

The strategy identifies priority environmental threats for ORD to apply its core research. Comments are solicited on the appropriateness and focus of the research proposed, any suggested additions or alternatives, and the clarity of the rationale for the selections. Comments on the consistency of the goals, proposed research and milestones are also solicited.

The SAB Subcommittee observes that the list of priority threats reads more like a client-generated list that one would expect from reviewing Program Office priorities rather than the result of a systematic application of the criteria in the ORD Strategic Plan. The Subcommittee recommends that Agency researchers revisit "Reducing Risk" (SAB, 1990) and incorporate the recommendations from the Science Advisory Board's upcoming Integrated Risk Project (IRP) report to help better define realistic ecological threats and to bring focus more clearly to priority issues.

2.4 Other Federal or Non-Federal Research Programs

The Committee was asked to provide comments and the associated rationale on:

It is clear that EPA cannot address all of the areas of research required to meet the overarching goal. EPA is interested in SAB recommendations on where the Agency should be depending on other Federal or non-Federal research programs rather than undertaking or expanding the research in-house or through the extramural grants program.

The committee applauds ORD's increased interaction with other Federal agencies designed to leverage research efforts and dollars and reduce duplication of effort. Such multi-Agency activities are often difficult, but ORD's EMAP Program provides a good example of the positive scientific benefits that can derive from multi-Agency environmental initiatives with EPA taking an active coordinating role. We know of few research areas where other Federal or non-Federal research programs are carrying out ecological research that overlaps with EPA's. Possibilities that warrant further investigation are NIH-funded research relative to endocrine disruptors, and Department of Defense research on contaminant remediation. On the other hand, there may be gaps in ecological research that are not being covered by any Federal agency, and it would be worthwhile for ORD to canvas other Federal agencies to identify those possible research gaps.

2.5 Improving Coordination of Research Across Laboratories and Centers and the Proposed Approach to a Corporate Data Management Approach

The Committee was asked to provide comments and the associated rationale on:

The strategy is founded on an integrated approach to ecological research focused on sustainability and restoration. Comments are sought on the planning concept to achieve that goal including recommendations for improving coordination of research across Laboratories and Centers and the proposed approach to a corporate data management approach.

ORD has wisely adopted a mix of intramural and extramural research to carry out its ecological research goals. EPEC endorses this approach. The Committee believes, however, that better integration of intramural and extramural research will further maximize benefits to ORD. We recommend that the Ecological Research Strategy explicitly address this integration, especially given the importance of extramural research to ORD's total research budget. Optimally, the Ecological Research Strategy and the Agency should identify the full suite of research deemed necessary to carry out ORD's ecological research goals, and then identify those portions of the research that would be best carried out in-house vs. extramurally based upon EPA's expertise and facilities. Extramural research should be used to fill these gaps that occur when the proposed research is within EPA's purview but where ORD does not have the relevant expertise. This scoping process could then form the basis for writing Requests for Applications (RFA's) that specifically address the unmet

research needs. These RFA's should be open to all investigators so that the best talent can address an issue. Regardless of the way in which research topics are apportioned among intramural and extramural sources, the Ecological Research Strategy should clarify the rationale behind that apportionment.

The Committee heard brief examples of ongoing efforts to integrate intramural and extramural research, but there was insufficient time to discuss them fully. The "adopt-a-grant" program that circulates information about extramurally funded research projects to potentially interested labs and regional offices seems to be a worthwhile but minimal approach to integration. The Committee recommends exploring a diversity of ways to strengthen the collaboration between ORD scientists and extramural scientists. The Committee strongly urges ORD to develop the maximal collaboration among scientists within and outside the Agency in advancing its Ecological Research Strategy, as the nature of the science itself demands cross-disciplinary collaboration.

The results of research funded by the extramural program should feed back into the next strategic planning cycle, so that new research needs identified during the course of the research can be followed up.

In conclusion, the Subcommittee found the Ecological Research Strategy to be well done. EPEC emphasizes the importance of the pro-active approach taken by the Agency in the Ecological Research Strategy. The plan is an important tool for priority setting, resource allocation and for coordinating efforts across the EPA. We look forward to the response of the Assistant Administrator for ORD.

Sincerely,

/signed/
Executive Committee

/signed/
Ecological Processes and Effect Committee

REFERENCES

- EPA, 1997. *Ecological Research Strategy, Strategic Directions and Priority Research Objectives*, Draft, USEPA, Office of Research and Development, Washington, DC, June 20, 1997.
- SAB, 1997. *Review of the Draft Guidance for Lake and Reservoir Bioassessment and Biocriteria*, USEPA, Science Advisory Board, Washington, DC, EPA-SAB-EPEC-LTR-97-007. May 1997.
- SAB, 1990. *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, USEPA, Science Advisory Board, Washington, DC, EPA-SAB-EC-90-021. September 1990.

ATTACHMENT A: CHARGE TO THE COMMITTEE

In virtually every major environmental act, Congress has required that the U.S. Environmental Protection Agency (EPA) not only ensure that the air is safe to breathe, the water safe to drink, and the food supply free of contamination, but also that it protect the environment. As a result, the EPA's Office of Research and Development (ORD) has established ecological protection as one of the seven highest priority research areas for investments over the next five years. Within this context, during the last year, the scientists within ORD have developed an Ecological Research Strategy to guide planning and implementation of research over the next three to five years.

The Ecological Research Strategy focuses on the single, broad goal to: "Provide the scientific understanding required to measure, model, maintain and/or restore, at multiple scales, the integrity and sustainability of ecosystems now, and in the future." The research is organized around four fundamental areas of research needed by the Agency and in which ORD has made significant contributions traditionally. These are, 1) ecosystem monitoring research, 2) ecological processes and modeling research, 3) ecological risk assessment research, and 4) ecological risk management and restoration research. Within this comprehensive framework, research objectives and priorities are presented in terms of both basic science to maintain focused, core research competencies and for how these capabilities to address high priority environmental threats.

The accompanying draft Strategy was developed after an assessment of current capability and capacity of the scientific resources in ORD coupled with the needs of the client offices now, and in the future. It also considers the activities of other agency efforts and the proposed research attempts to complement and not duplicate those programs. The ORD Ecological Research Strategy further articulates the current and future direction of the Program within the context of the Agency's Government Performance and Results Act commitments, and establishes the long-term program goals and objectives, and documents the rationale for the chosen program direction. While the Strategy delineates the research areas comprising the overall Ecological Research Program, specifics for these research areas, including the scientific approach at the individual project level, and the anticipated project products, performance measures, and specific schedules, will be included in subsequent research plans for specific areas of research and Laboratory/Center Implementation Plans and are not a part of this Strategy.

The purpose of this peer review is to obtain an external assessment of the draft Strategy. The charge to the reviewers has two parts. First, EPA is asking for your general impression of the overall strategy, paying particular attention to the direction and established goals and objectives. In the second part, the Agency is seeking views

on issues related to specific areas of research.

Part I. General Comments

EPA invites comments on all aspects of the research strategy. Of particular interest is to receive comments on:

- a) The consistency of the concepts and terminology with EPA's ecological risk paradigm,
- b) The consistency of the research strategy and the elements with the goals and objectives as stated in each section of the Ecological Research Strategy,
- c) The appropriateness of the direction of the ORD portion of the research considering the unique capabilities of the organization,
- d) The appropriateness of the research areas and what others might be considered in lieu of, or in addition to, those identified,
- e) The clarity of ORD's focus and the rationale behind the program direction and out-year emphasis, and
- f) The utility of maintaining a core research focus as a planning and research implementation foundation.

Part II. Specific Areas

We invite comment on any and all technical aspects of the research approaches and activities within the Research Strategy and how it might be improved. We are particularly interested in comments (and associated rationale) on the following issues:

- a) The strategy gives special attention to multi-stressor, multiple levels of biological organization, and multi-scale research within a multimedia context. EPA is interested in SAB concerns, advice, recommendations, and cautions associated with this approach.
- b) The strategy identifies four fundamental areas of core research to be applied to specific environmental issues. These are in the areas of monitoring, modeling and process research, risk assessment, and risk management. Comments are solicited on the appropriateness of the goals and objectives of these four research areas, the research areas proposed to address those goals and objectives, and the milestones

proposed in response to the objectives. Further, considering the limitations in personnel expertise and financial resources,

recommendations on alternatives in lieu of, or supplemental to the research foci proposed are encouraged.

- c) The strategy identifies priority environmental threats for ORD to apply its core research. Comments on the appropriateness and focus of the research proposed, any suggested additions or alternatives, and the clarity of the rationale for the selections. Comments on the consistency of the goals, proposed research and milestones are also solicited.
- d) It is clear that EPA cannot address all the areas of research required to meet the overarching goal. EPA is interested in SAB recommendations on where the Agency should be depending on other Federal or non-Federal research programs rather than undertaking or expanding the research in-house or through the extramural grants program.
- e) The strategy is founded on an integrated approach to ecological research focused on sustainability and restoration. Comments are sought on the planning concept to achieve that goal including recommendations for improved coordination of research across Laboratories and Centers and the proposed approach to a corporate data management approach.

NOTICE

This report has been written as part of the activities of the Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use.

**U.S. ENVIRONMENTAL PROTECTION AGENCY
SCIENCE ADVISORY BOARD
ECOLOGICAL PROCESSES AND EFFECTS COMMITTEE**

July 21-22, 1997

CHAIR

Dr. Mark A. Harwell, Rosenstiel School of Marine and Atmospheric Science,
University of Miami, Miami, FL

VICE CHAIR

Dr. Alan W. Maki, Exxon Company, USA, Houston, TX

MEMBERS

Dr. William Adams, Kennecott Utah Copper Corp, Magna, UT

Dr. Virginia Dale, Environmental Sciences Division, Oak Ridge National
Laboratory, Oak Ridge, TN

Dr. Carol Johnston, Natural Resources Research Institute, Duluth, MN

Dr. Frederick K. Pfaender, Director, Carolina Federation for Environmental
Programs, University of North Carolina, Chapel Hill, NC

Dr. William H. Smith, Professor of Forest Biology, School of Forestry and
Environmental Studies, Yale University, New Haven, CT

Dr. Terry F. Young, Environmental Defense Fund, Oakland, CA

CONSULTANTS

Alison G. Power, Cornell University, Ithaca, NY

Leslie A. Real, Indiana University, Bloomington, IN

SCIENCE ADVISORY BOARD STAFF

Ms. Stephanie Sanzone, Designated Federal Official, US EPA, Science Advisory
Board (1400), 401 M Street, SW, Washington, DC 20460

Ms. Roslyn Edson, Designated Federal Official, USEPA, Science Advisory
Board (1400), 401 M Street, SW, Washington, DC 20460

Ms. Wanda R. Fields, Staff Secretary, US EPA, Science Advisory Board, (1400),

401 M Street, SW, Washington, DC 20460

DISTRIBUTION LIST

Administrator
Deputy Administrator
Assistant Administrators
Deputy Assistant Administrator for Science, ORD
Director, Office of Science Policy, ORD
EPA Regional Administrators
EPA Laboratory Directors
EPA Headquarters Library
EPA Regional Libraries
EPA Laboratory Libraries
Library of Congress
National Technical Information Service
Congressional Research Service