



AN SAB REPORT: EVALUATION OF EPA'S WETLANDS RESEARCH PROGRAM

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
THE ADMINISTRATOR

EPA-SAB-EPEC-92-007

November 12, 1991
The Honorable William Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

SUBJECT: Science Advisory Board Review of EPA's Wetland Research Program

Dear Mr. Reilly:

The Wetlands Research Subcommittee of the Ecological Processes and Effects Committee of the SAB has completed its review of the draft report "Wetlands Research: An Integrated Risk-Based Research Strategy". The charge to the Subcommittee was to: 1) evaluate the research priorities in terms of Agency needs, 2) determine whether the risk-based framework was suitable for managing ecosystems and wetlands in particular, and 3) critique the objectives and conceptual approach of the strategy. The Subcommittee met once on July 16-17, 1991 in Corvallis to conduct this review.

The Subcommittee's overall evaluation of the Wetlands Research Program is very positive, because it is a relevant and innovative effort to meet many of EPA's needs for information on wetlands protection, mitigation, and restoration. The findings of the research program should also assist EPA program managers in dealing with such important issues as wetlands classification for regulatory purposes and use of created wetlands to mitigate wetland loss. As the research moves forward to document the ecological functions supported by different wetlands types under varying hydrologic regimes, it should ultimately provide a better scientific basis for decisions concerning wetlands delineation for regulatory purposes. In this regard, we caution that the current legislative and Agency debates over wetlands regulation and decisions stemming from those debates should not constrain or detract from the necessity of maintaining a strong commitment to scientific research that will have significant long-term benefits towards protecting and increasing the nation's wetland resources.

The Subcommittee noted many strengths in the program, including the efforts to develop a risk-based framework, a focus on landscape, and the proposal to characterize populations of wetlands by function. At the same time, however, we believe that the Strategy Document does not clearly explain these strengths, and it should be revised to address the concerns that we have identified in our report. In addition, the research strategy document should take special care to distinguish objective information about

wetlands functions from the societal values and subjective judgements that are added for regulatory applications. We are confident that the Wetlands Research Program can address these concerns because many of them were addressed in the oral presentations made to the Subcommittee at the time of the review.

The Subcommittee concurs with the program's geographic priorities, and if additional resources can be found, a project dealing with coastal seagrass should be added to the program, provided that it would not be funded at the expense of other projects in the program.

Although we expect the Office of Research and Development will address all of the recommendations presented in this report, we are especially interested in your response to these:

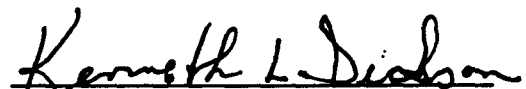
- o the need for a distinction between wetland functions and values;
- o a clarification of the relationship between the Wetlands Research Program and the Environmental Monitoring and Assessment Program to assure that the indicators for monitoring are compatible with the risk based approach in each program; and
- o the need to refine the risk-based strategy using consistent terms and concrete examples.

We are very pleased by the efforts of the EPA staff to apply the concepts of reducing risk and landscape functions to manage critical wetland resources. We appreciate the opportunity to conduct this scientific review and look forward to receiving your response.

Sincerely,



Dr. Raymond Loehr, Chairman
Science Advisory Board



Dr. Kenneth Dickson, Chairman
Ecological Processes and
Effects Committee



Dr. Allan Hirsch, Chairman
Wetlands Research Subcommittee

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ABSTRACT

This report presents the conclusions and recommendations of the U.S. Environmental Protection Agency's Science Advisory Board following a review of EPA's Wetlands Research Program. The Subcommittee supported the direction and the priorities of the WRP and recommended that EPA implement the WRP consistent with the strategy document and oral briefings they reviewed. The Subcommittee recommended that the strategy document be revised to clarify and concisely define the program and clarify other issues raised in the review. While the strategy was confusing and failed to explain the strengths of the program, the oral briefings provided important details that illustrate a risk based approach that is supported by the Subcommittee. Program strengths included: 1) its emphasis on synthesis and integration of wetlands research for the regulatory process; 2) the development of a risk-based framework; 3) the focus on a landscape scale; 4) the characterization of populations of wetlands by function; 5) a comparison of artificial and natural wetland functions; 6) a technology transfer; and 7) the emphasis on wetlands types that are in significant danger of loss. The Subcommittee further recommended that WRP further examine its coordination role with EMAP for the development of indicators. The Subcommittee also recommended that EPA add a research project dealing with coastal seagrass if additional resources can be found.

KEY WORDS: Wetlands Ecosystems, Functions, and Values; Landscape; Environmental Monitoring; Ecological Risk.

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1. EXECUTIVE SUMMARY

The Wetlands Research Subcommittee of the Ecological Processes and Effects Committee of the Science Advisory Board (SAB) reviewed the draft report, "Wetlands Research: An Integrated Risk-Based Research Strategy" at a meeting in Corvallis, Oregon on July 16-17, 1991. The report sets forth a five-year research program, building on the previous five-year wetlands research effort.

The Subcommittee's overall evaluation of the directions the Wetlands Research Program (WRP) is taking was positive, and we strongly support implementation of the program. WRP is a relevant and innovative effort to support EPA's needs for information on wetlands protection, mitigation, and restoration. The findings should assist in dealing with such important issues as wetlands delineation, wetlands classification for regulatory purposes, and use of constructed wetlands to mitigate wetlands loss. Further, the research program should assist EPA through providing a source of scientific expertise to the regulatory program, and we were pleased to note that there is a good, supportive relationship from the Office of Wetlands, Oceans, and Watersheds. We would caution, however, that the demand for short-term regulatory support should not detract from the need to maintain a continuing and longer term research effort, as is proposed in the Research Strategy, nor should current policy decisions on such issues as wetlands delineation and classification constrain the research program in its efforts to provide a better scientific basis for such decisions in the future. The Subcommittee recommends that the WRP and Wetlands Program Office develop a supportive and cooperative type of agreement that explains how resources can be focused on long-term research and how priorities will be developed to accommodate short-term needs.

The Subcommittee felt that the strengths of the program included:

- (1) its emphasis on synthesis and integration of wetlands research to provide information useful in the regulatory process;
- (2) its efforts to develop a risk-based framework;
- (3) the focus on the landscape scale;
- (4) the proposal to characterize populations of wetlands of similar type by function;
- (5) comparison of restored, constructed, and natural wetlands functions;
- (6) provisions for active information transfer to maintain an effective interface between research and regulation;
- (7) selection of wetlands types that are in significant danger of degradation and loss (bottomland hardwood, prairie potholes, western riparian habitats) as the

focus for proposed studies.

At the same time, however, we believe the Strategy Document itself requires substantial improvement and refinement; we felt that the oral presentations at the Review provided far greater clarity and justification for the research approach than did the Strategy document. We recommend, therefore, that the document be revised to:

- (1) clarify WRP's goals and objectives;
- (2) ensure that key terms, such as risk assessment, stress, stressors, dysfunctional, and others are used consistently;
- (3) provide concrete examples to make the strategy less abstract and difficult to follow;
- (4) clarify the relationship between wetlands functions and wetlands values;
- (5) more sharply define the risk-based approach; and
- (6) better define the relationship between WRP and EMAP.

We concur with the program's geographic priorities, and recommend that, if additional resources can be found, the project dealing with coastal seagrass should be expanded to a landscape scale. However, we do not recommend substituting work on this topic for the other areas already selected to receive priority.

2. INTRODUCTION

The Wetlands Research Subcommittee of the Ecological Processes and Effects Committee of the Science Advisory Board (SAB) met on July 16-17, 1991, to review the draft FY 1992-1996 Research Plan entitled "Wetlands Research: An Integrated Risk-Based Research Strategy" and to receive a briefing on ORD's Research Plan and the needs of the wetlands protection program of the Office of Water. This review was conducted in tandem with another review of research on Constructed Wetlands for Wastewater Treatment by a Subcommittee of the Environmental Engineering Committee of SAB. Both reviews were conducted at the request of the Office of Research and Development (ORD).

2.1 Statement of the Charge

The charge for the review of the Wetlands Research Program was provided to the SAB by Dr. Courtney Riordan, Director, Office of Environmental Processes and Effects Research within ORD. In his charge, he noted that the primary goal of this review is to critique EPA's wetlands research strategy. It is particularly important that the panel address the following general questions:

1. Are the Agency's highest research priorities addressed?
Will the information generated support the Agency's needs in development of sound wetlands protection policy?
Is the proposed research responsive to the regulatory needs of the Office of Water? What alternatives would you suggest?
2. Is the proposed risk-based framework suitable for assessment and management of risks to ecosystems in general and wetland systems in particular?
Does the proposed combination of studies best meet program objectives within resource constraints or should alternatives be considered?

In addition, he asked that the Subcommittee also consider the following set of secondary questions:

1. Does the research plan have a clear and explicit statement of objectives?
 - a) How can the scientific objectives be more focused or improved?
 - b) Is there a specific research strategy for each objective? Is the overall conceptual approach clearly defined? Is it scientifically sound? Are there better approaches? Is the strategy realistically achievable?
 - c) Will the specific research tasks, when completed, fulfill the research strategy? What are the weak links? Are there missing tasks?

- d) Are the contributions of each research task important to achieving program objectives?
Are there nonessential tasks in a project? Are there essential project components that are missing?
Are there fall-back options in case a task is not accomplished?
 - e) Are the major deliverables defined in terms of content and delivery date? Is the responsibility for producing each major deliverable clearly identified?
Do the outputs clearly lead to meeting the overall project objectives. Can the deliverable be completed in the allotted time and within the proposed budget?
2. Are each of the tasks focused in the most efficient way to answer the scientific questions?
 - a) Has the highest priority been given to addressing the most critical research components and tasks?
 - b) For each critical task, is the proposed approach to completing the task the most efficient and scientifically defensible within the budget and timeframe?
Are there alternative approaches that should be considered?
 3. Is each project linked to other projects to the extent required or desired? Are there linkages that should be developed?
 4. What is the likelihood of success of each proposed research project? Which ones are least likely to reach their objectives?
 5. Does the Wetlands Research Program build appropriately on research programs in other agencies? Are there opportunities for collaboration that have not been explored?
 6. What other changes would you suggest to improve the Wetlands Research Program and its component projects to address the stated objectives?

2.2 Subcommittee Review Procedures

Following the request for the SAB review of the Wetlands Research Program, the Executive Committee assigned the review to the Ecological Processes and Effects Committee (EPEC). A Subcommittee was formed to conduct the review consisting of members and consultants to EPEC and liaisons from the federal agencies that had significant research interests in wetlands. The Subcommittee received a copy of the charge, the draft research plan, and administrative instructions prior to the review. The Subcommittee met once on July 16-17, 1991 at the Corvallis Environmental Research Laboratory. They received briefings on the first day of the review and discussed their

concerns and recommendations and drafted preliminary statements on the second day of the review. At the conclusion of the review, the chairman presented a summary of the preliminary findings of the Subcommittee to the matrix manager of the Wetlands Research Program. Following the meeting, a draft report was prepared by the chairman and reviewed by the Subcommittee via the mail.

The Subcommittee addressed the primary questions in the charge directly, however, there was insufficient information provided to respond to all of the secondary questions. The Federal Agency Liaisons on the Subcommittee provided information on how WRP was coordinated and linked with wetlands research in other agencies. Information on budgets and delivery schedules was considered to be tentative, so the Subcommittee did not attempt to evaluate their adequacy or feasibility.

3. EVALUATION OF THE WETLANDS RESEARCH PROGRAM

3.1 General Evaluation

Our overall evaluation of the directions the Wetlands Research Program (WRP) is taking is positive, and we wish to express our strong support for implementation of the program. WRP is a relevant and innovative effort to support EPA's needs for information on wetlands protection, mitigation and restoration.

The program is undergoing a logical transition from its original focus on water quality, cumulative impacts, and mitigation to a broader conceptual scope incorporating a landscape perspective and modeling effort derived from previous work. There is evidence that the results of the original projects will be applied to the new directions. The needs of the Office of Water and the EPA Regions have played an important role in shaping the direction of the proposed research. The findings of the research should assist in dealing with such important issues as delineation of boundaries, categorization or classification of wetland types, and use of constructed wetlands to mitigate wetlands loss. The program provides for investment in an active technical information transfer activity which should continue to maintain an effective interface between research and the regulatory role.

We are aware that the Agency faces urgent political needs to address these issues now, and that some important decisions will have to be based on existing information. We would stress, however, the importance of allowing this core research program time to pursue longer term objectives which can provide information of fundamental importance to wetlands protection in the long run. The demand for short-term responses to problems in the regulatory arena, while very real and pressing, should not detract from the need for a continuing and longer term research effort, as outlined in the Research Strategy document. The research strategy is a very ambitious one in relation to the overall level of funding allocated to WRP. This emphasizes the need for highly focused effort if the objectives are to be accomplished. With some exceptions which we will note, the program generally has done a good job in this regard. At the same time, however, this leaves little flexibility for undertaking short-term responses to address immediate needs such as those posed by the wetlands delineation manual and the proposals for classifying wetland habitats, or others which may arise in the future.

We have no specific recommendations concerning solutions to this dilemma, but we urge the Office of Research and Development to address it and to take care that an appropriate balance be maintained. One possible approach would be to consider providing and sequestering additional resources specifically for support of short-term responses. In any case, while the program must continue to be responsive, this should not be done in a way that jeopardizes achievement of its fundamental, longer term goals.

EPA is the only federal agency with the responsibility to manage all environmental media and the landscape function approach provides a mechanism to place wetland condition in a broader environmental context - both the influence of other environments

(the landscape) on wetlands and the influence of wetlands on other environments (for example, water quality). But it is unrealistic to assume that the EPA Wetlands Research Program, especially with the present and foreseeable resource limitations, could effectively address all Agency information needs related to wetlands. Rather, the WRP should strategically focus on those needs which are particularly appropriate to the EPA's regulatory responsibilities, which fill critical needs not well addressed by the research programs of other agencies, and which build on EPA technical strengths. In this context, the focus of the program on landscape function and on risk reduction is particularly appropriate and is encouraged. In addition, the research programs of other agencies are not effectively addressing landscape function and the EPA program appears to be applying cutting-edge scientific advances in landscape ecology in the WRP. Furthermore the landscape approach builds on work previously carried out by this program on cumulative impacts.

The proposal to characterize populations of wetlands by functions is also an innovative and potentially very important approach to developing performance standards and design criteria for restoration and creation of wetlands and, indeed for the entire approach to wetlands regulation and protection. However, there are several problems which could occur complicate such an effort and need to be considered in the strategy document (see discussion in section 3.7).

The Subcommittee commends the WRP for its emphasis on synthesis and integration of information relevant to wetland regulation and management. This emphasis is appropriate for EPA's research program because it meets a critical need to base regulation on sound science that is not typically met through university basic research programs. While basic research is essential in providing the fundamental understanding that permits prediction and extrapolation of results from one system to the next, a pressing need exists to bring together the results and implications of such basic research and translate them into terms and guidelines that are useful in the regulatory arena. The Subcommittee does encourage the WRP to employ the talents of leading wetland scientists from the academic community and elsewhere through research grants and cooperative agreements to provide additional expertise and vitality.

The emphasis of the WRP on synthesis and integration is evident in the state-of-the-science reviews proposed within each sub-program, in the attempt to scale analysis up to the level of landscapes and regions, and in the use of a modeling framework to integrate and plan research. In most cases, the proposed reviews are timely from the perspective of the status of the science and regulatory needs. The selected areas reflect emerging areas of basic research where sufficient information exists on which to base a synthesis. Syntheses at this time should be instrumental in bringing current research results to regulators and in identifying key gaps in information pertinent to regulation. The Subcommittee recommends caution, however, that the demand for short-term regulatory research should not detract from the long-term need to maintain a continuing research effort, as is proposed in the research strategy.

While the Subcommittee's overall view, therefore, is a favorable one, we do have a number of concerns and comments about needs for clarification or refinement of the

Research Strategy document which are set forth below.

3.2 Adequacy of the Research Strategy Document

The Subcommittee felt that the oral presentations at the review provided far greater clarity and justification for the research approach than did the document, "Wetlands Research: An Integrated Risk-Based Research Strategy." The draft document is very abstract, redundant, and difficult to follow. In fact, the document, as presently constructed, leaves the impression that the research is too broad and unfocused.

The Subcommittee recommends that the Research Strategy document be drastically reduced in length to eliminate repetition and to provide an incisive report that more clearly and concisely defines the research program. Specific case examples (e.g., Big Bear) or empirical data should be included to explain and justify better the conceptual framework of the document, thereby making it less abstract and difficult to follow. In recommending that the document be rewritten, we would emphasize two points:

1. From an editorial standpoint, the document needs to be shorter, clearer, and more concise if it is to explain the program to such audiences as Agency decision makers and program staff.

2. The revision must address the issues outlined below. Otherwise the streamlined document will not be useful in guiding the program. Again, based on the oral presentations we received, we think that WRP staff are in a position to readily clarify the following issues. The rewritten strategy should:

- a. More clearly define the research goals and objectives.
- b. Clarify the rationale for selection of priority wetlands types and geographic locations.
- c. Assure that component projects actually contribute to a risk-based framework.
- d. Clarify how the functions of wetland populations (wetlands of similar type) will be determined; and assure that it reflects current scientific knowledge on wetlands processes.
- e. Clarify concepts and language that blur the distinction between wetlands functions and value judgements, and assure that the research is conducted in a way that maintains the distinction between scientific and policy judgments.
- f. Provide for precise and consistent use of key terminology, such as risk assessment, management, and reduction; effects and impacts; and stress, stressor, and response.

- g. Clarify the relationship between WRP and EMAP.

Each of these points is discussed briefly below.

3.3 Goals and Objectives

WRP's goals and objectives are not clearly stated in the Strategy document. For example, page 1 of the document describes what the research will accomplish. Page 11 sets forth the research objectives in somewhat different, more abstract terms. Page 16 outlines key deliverables in still another way. While all these statements are related, they are not entirely consistent and we are concerned that they may be too diffuse.

The Research Strategy is very ambitious in relation to the level of resources budgeted for the WRP. Unless the overall budget level can be increased, WRP will have to sharpen its agenda and avoid issues that are secondary or tangential to the primary objectives.

We recommend a more consistent statement of WRP goals and concrete objectives that clearly states what the WRP is going to set out to do in the next five years. This should assist in maintaining the program's focus and avoiding pursuit of too many directions.

3.4 Geographic Priorities

We agree with the general wetland types selected for the research program. Prairie pothole wetlands, bottomland hardwood forested wetlands and western riparian areas are all experiencing very serious losses, and are appropriate research topics for WRP. We do have several caveats, however:

1. The Strategy document does not provide clear justification for selection of wetland types. This relates to the lack of linkage between the risk-based strategy and the priority setting process, as discussed in Section 3.5 of our comments, below. There is insufficient description of the rationale for selection of these three types, from among the numerous critical wetland habitats. If, for example, the selection was based on such issues as level of information available, budgetary considerations, logistics and relationships with cooperating parties, as well as on broader based considerations of relative risk reduction, the document should clearly say so. Our concerns could best be answered by addressing the issues of how the study locations were chosen and their relationship to the risk based strategy.
2. We are concerned that WRP is only studying wetland systems dominated by permanent surface water and/or high groundwater and by obligate wetland plants. This certainly appears to be true for the characterization and restoration program. However, "drier" wetland types, for example, systems with near-surface saturation of 14-30 days, are among the most difficult to characterize and restore.

Scientific literature is extremely limited on ecology and restoration of these drier wetland types. For example, there is no discussion of these wetlands in EPA's "Wetlands Restoration and Creation" handbook. Yet, EPA has frequently required extensive mitigation for seasonal emergent and forested wetlands. We recommend that WRP consider broadening its perspectives and approaches to monitoring wetland sites to include systems that have shorter hydro-periods and greater dominance of facultative vegetation. Given the current political controversy over defining jurisdictional wetlands, and the fact that wetlands delineation requires drawing a line across a continuum from wet to dry environments, scientific information that can enable us to understand ecological processes and interactions along this gradient could assist in clarifying policy judgments over the long run concerning which areas should be included within "jurisdictional" definitions.

3. The document is unclear as to whether coastal wetlands are in the program or not. On page 11, coastal wetlands are listed as a priority. However, the text of the document and oral briefings indicate they are not included. This point should be clarified and justified.

With respect to the presentation made to the Subcommittee on the importance of coastal wetlands, we believe that an ongoing research program directed towards seagrass systems should be expanded to the landscape level. This would fill an important niche not now well addressed in other wetlands research programs. If additional resources can be found, we would recommend expanding such work within the WRP. However, we do not recommend substituting work on this topic for the other three areas already selected to receive priority.

4. There is inconsistent and fragmentary discussion of the inclusion of urban wetlands within the WRP. They are not included within the discussion of Priority Wetland types on pages 9-10, but an urban wetlands project is included in the text. As we understand it, a limited amount of work on urban wetlands has been included to address certain specific regional priorities. Urban wetlands have suffered extensive losses in many areas such as San Francisco Bay, New York, and Los Angeles areas, and these are areas the public wants to save and restore. A case can be made for including a stronger emphasis in WRP on how wetlands can be maintained and restored in developed areas, in conjunction with the constructed wetlands and water quality projects.

We recognize that this would be at a cost to the priorities that WRP has identified, and the Subcommittee is not recommending that resources be diverted from those efforts. We would recommend, however, that the rationale for including limited work on urban wetlands be clarified, as well as the rationale for not making a more significant effort there. This recommendation is also related to the following comments concerning the

need to describe the relationship between the program priorities and comparative risk.

3.5 Risk-Based Framework

The concept of developing and applying a risk-based strategy is a good one. Although the approach may not be related to "risk" in a strict sense, i.e., involving chance, probability, or uncertainty, the approach articulated is consistent with the SAB "Reducing Risk" report and the Agency-wide direction articulated by Administrator Reilly. However, it is not clear at all that a risk-based approach was rigorously applied in the development of the WRP, either in the selection of wetland types or in the identification of wetland functions on which research will be focused. A manifestation of the problem of having the risk-based framework drive the research rather than the existing research efforts, regional concerns, or individual scientific interests is found in the conceptual diagram of the risk-based strategy itself (Figure 1.1). The flows are unidirectional from the three component projects to the risk reduction project. However, as was stated in the oral presentation on risk reduction, risk assessment should guide as well as integrate research. Although the understanding of this need was clearer in the presentations than in the Research Strategy, the Subcommittee recommends that there be a strong and concerted effort to assure that revisit and redesign component projects actually better fit into the risk-based framework and demonstrate its applicability.

The formal development of a risk-based framework under the WRP also should be related to and integrated with the ongoing efforts within the Agency to develop environmental risk assessment methods (ecorisk guideline development).

3.6 Wetlands Functions

As previously stated, we commend the program's emphasis on synthesis and integration. It is important, however, that this work be based on sound scientific research on wetlands processes. We are concerned that the various hypothetical curves for stress/response and time/response may be over-generalized and may prove misleading in terms of actual or empirical experience. It is important to recognize that specific wetlands functions will generate different response curves under different environmental situations, and that aggregation may yield misleading results.

The Subcommittee felt that many of the "wetland functions" were not clearly described so as to be able to determine which processes were going to be selected and, more importantly, how they are going to be measured. The concept of function versus process (rates) needs to be cleared up also. The importance of hydrology, geology, and soil science does not appear to be adequately reflected in the discussion of wetlands functions; hydrology is the dominant and controlling factor for wetlands and the local geology is a key factor determining hydrologic regimes and features such as perched water tables which can be mapped and predicted. In addition, the WRP does not appear to include sufficient expertise in these disciplines among its staff.

The presentations helped greatly in answering some of these questions, but the document itself requires clarification.

3.7 Value Judgements

The Subcommittee is concerned with the use of language in the document in ways that confuse science and value judgments. While it is the role of research to address topics that have been identified as being of public concern, the ways in which the research is conceived and potential results should be phrased in scientific language, not in terms of normative judgments. Doing so gives the false impression of lending the "objectivity" of science to what should be political/social decisions. It also runs the risk of misinterpretation by decision-makers anxious for simple answers to what are complex issues. Scientists should utilize terms that are precise and amenable to evaluation against data that could be collected by others and interpreted against scientific standards of evidence.

For example, the Subcommittee is uncomfortable with the use of terms such as "high value" and "low value" wetlands, "promoters" and "demoters". Rather, scientists should aim to provide information in terms of measurable characteristics, which then can be used by decision-makers to form value judgments. In order to allow this translation to take place, it may be useful to think in terms of characterizing those wetlands functions that are "valued ecosystem components" (from Beanlands and Duinker, 1983) to which societal values can be assigned as a separate step. Clarification of the relationship between function and value is essential to the success of the Research Strategy.

The present discussion of "wetland function" versus "wetland value" (pp. 23-24) is confused. For example, the document includes fish and wildlife as "users" who derive value from wetlands functions. This confuses ecological functions and societal values. A more appropriate distinction would be to indicate that provision of fish and wetland habitat is a "function", whereas recreational fishing and hunting uses reflect societal "values".

To elaborate on this point, we offer the following examples:

1. Wetland delineation requires drawing a line across a continuum from wet to dry environments. Good technical information is necessary to understand ecological processes and interactions across the gradient, but the location of the line is, in the final analysis, a judgment call based in part on non-technical considerations.

2. Administrator Reilly has asked for studies "to identify and develop environmentally sound ways to classify wetlands according to their values and to set priorities for wetlands protection". This statement shows clearly both the need for good technical information about "valued ecosystem components" and the use of this information to assign "values" to different wetlands based on perceived utility to society.

3. Landscape level analysis and management requires (a) characterization or

assessment of the landscape of interest (technical), (b) goal setting and planning (judgmental, with technical advice), and (c) plan implementation (engineering/technical, with economic/social/political input).

Scientists can make statements about structure, process, pattern etc. in the environment, with emphasis on controlling processes and functions, magnitudes of processes, interactions of structure with function and with controlling factors. This information provides the scientific basis for judgmental decisions. In contrast, judgmental decisions are the purview of policy makers, regulators and a broad segment of the public, who must consider other issues in addition to technical ones.

The EPA Wetlands Research document must carefully and explicitly separate technical from non-technical steps in developing an approach to environmental risk reduction. For example, the designation of high, medium, and low classes of functions in the Synoptic approach described in Chapter 5, blurs the distinction between objectively determined functions and value judgments about the magnitudes of these functions. Great care must be taken to distinguish evaluation of the magnitude of ecological processes or functions from subjective "valuation." (Graphics shown in the oral presentation were much clearer in separating objective from judgmental steps than the written document).

We stress the importance of assuring that the WRP characterize the magnitude of functions of wetlands populations as distinct from their values to society. The current plan fails to maintain this distinction, which could result in misuse of the findings. There is an implied, if not explicit relationship between function and societal value. In most instances, the greater the magnitude of the function, the more valuable the wetland is assumed to be. However, any wetland has a number of functions, each of which may have a different magnitude at a specific site. To link overall value to function, therefore, implies a weighing of different functions, or in other words, a non-technical evaluation of the worth of different functions in a particular setting. We are immediately outside the arena of science into policy, politics, and social choice. Second, even if a wetland has overall functions that are minimal, this does not necessarily translate into low value. If, for example, this is the last remnant of a particular kind of wetland in an area, or is the only kind of wetland that can exist in the local environment, it may have societal value far beyond the magnitude of its ecological functions. Again, the decision to classify the wetland as high or low value is a social choice, not objective science.

We see no way around this kind of dilemma except the development of good mechanisms for making social choices. Decision steps are indispensable in wetlands management, but are, in general, poorly handled. As far as we are aware, no good process has been developed to allow decisions about wetlands management to be made in a rational manner, using the best scientific information available, and representing fairly the societal values involved.

The Subcommittee recommends that ORD's research address such process because advances there could make a significant contribution to wetland management, and is particularly relevant considering the emphasis given in the ORD document to landscape-

level analysis.

The Risk Reduction Project does involve making value judgments and setting goals. We support this initiative, but only if the process and criteria through which values are assigned to objectively determined wetlands function are made very explicit. Further, WRP should take steps to assure that individuals with background in such disciplines as economics, group dynamics, and conflict resolution participate in design of this work.

3.8 Consistent Terminology

The committee is also concerned that the WRP define its terms and use them in precise and consistent ways. Examples include terms such as "stress", "stressor", and "fringe" wetland. Failure to define "stress", "stressor", and "dysfunctional" and to use the terms unambiguously is not unique to this document but is common in the literature. References made to "risk assessment," "risk management" and "risk reduction" do not uniformly follow terminology used in the Agency and create some confusion. For this reason, it is imperative that the document be clear on its use of these terms.

In the case of "fringe" wetland, the WRP staff should note that its use is inconsistent with an established use in the literature. The WRP uses "fringe" in referring to "riverine" wetlands. Brinson (1990) distinguishes "fringe" from "riverine", and uses "fringe" to refer to lake shore and tidal wetlands where the flow of water is two-directional.

3.9 Coordination

We believe that the WRP has made very good efforts to coordinate its research activities with those of the Fish and Wildlife Service, the Corps of Engineers, and the Forest Service. Any important wetlands studies in NOAA should be considered as well, if this has not yet been done.

With respect to internal ORD coordination, we were concerned whether there was adequate coordination between WRP and the EMAP wetlands component, particularly on the topic of indicator development. The rationale for somewhat different approaches to wetlands indicators in the two programs was presented to us, but we were not entirely persuaded that the need for parallel approaches had been carefully examined or justified. In view of the relatively limited resources for the WRP, we recommend that, if this has not yet been accomplished, an in-depth review of relationships between the two programs be done with the objective of maximizing coordination. The relationships between the two programs and the information that each program will provide to the other should be more clearly reflected in the final Wetlands Research Strategy.