Summary Minutes of the
U.S. Environmental Protection Agency (EPA)
Science Advisory Board (SAB)
Committee on Valuing the Protection of Ecological Systems and Services
Workshop on Different Approaches and Methods for Valuing the Protection of Ecological Systems and Services
April 13-14, 2004, Four Points Sheraton, 1201 K Street, NW
Washington, DC, 20005

Committee Members: (See Roster – Attachment A)

Date and Time: 9:00 a.m. – 5:15 p.m., Apri13, 2004; 8:30 a.m. - 3:30 pm April 14, 2004 (See *Federal Register* Notice - Attachment B)

Location: Four Points Sheraton, 1201 K Street, NW
Washington, DC, 20005

Purpose: The purpose of the Workshop is for the Committee to discuss the desired characteristics and desired outcomes of knowledge, methodologies, practice, and research for valuing the protection of ecological systems and services that will help EPA better understand and communicate those values. The Committee will hear presentations from several of its members and from scientists within EPA and outside the Agency on examples that illustrate use of different major science-based approaches and will discuss these examples with presenters. The Committee will also discuss suggestions for its next steps in addressing its overall charge, to assess Agency needs and the state of the art and science of valuing protection of ecological systems and services, and then to identify key areas for improving knowledge, methodologies, practice, and research.

Attendees:

Chair: Dr. Domenico Grasso

SAB Members:
Dr. William Ascher
Dr. Gregory Biddinger
Dr. Ann Bostrom
Dr. James Boyd
Dr. Robert Costanza
Dr. Terry Daniel
Dr. A. Myrick Freeman
Dr. Dennis Grossman
Dr. Geoffrey Heal

Dr. Douglas MacLean
Dr. Louis Pitelka
Dr. Joan Roughgarden
Dr. Kathleen Segerson
Dr. Paul Slovic
Dr. V. Kerry Smith
Dr. Valerie Thomas
Dr. Barton Thompson, Jr.

SAB Staff: Dr. Angela Nugent, Designated Federal Officer
Dr. Anthony Maciorowski, Associate Director for Science, SAB Staff Office

Workshop Summary: April 13, 2004

The discussion generally followed the issues and as presented in the Workshop Agenda, (See Workshop Agenda - Attachment C). One member of the public addressed the Committee.

Introduction and Welcome from the SAB Staff Office

Dr. Angela Nugent, Designated Federal Officer (DFO) for the Committee on Valuing the Protection of Ecological Systems and Services, called the meeting to order at 9:00 a.m. and welcomed Committee members, Agency staff, and members of the public to the workshop. She informed the audience that the Committee was by law and EPA policy subject to the Federal Advisory Committee Act and that Committee members conformed to ethics regulations applicable to them as Special Government Employees.

Dr. Anthony Maciorowski, Associate Director for Science in the SAB Staff Office, thanked members, presenters at the workshop and SAB Staff. He emphasized the importance of an interdisciplinary approach to providing advice to EPA on new, science-based approaches for valuing the protection of ecological systems and services.

Purpose of Workshop and Introduction of Members of the Committee and Agency Workshop Presenters and Key Staff

Dr. Domenico Grasso, Committee Chair, welcomed Committee members and emphasized the importance of the information gathering workshop. He asked committee members and invited speakers present (Dr. Joseph Arvai, Dr. Thomas Brown, Dr. Randall Bruins) to introduce themselves.

Dr. Grasso than spoke of the Committee's overall charge: to assess Agency needs and the state of the art and science of valuing protection of ecological systems and services, and then will identify key areas for improving knowledge, methodologies, practice, and research. He reviewed the activities that occurred at the October 2003 workshop, where the Committee heard presentations from all the major EPA programs and from two regions about: the major types of EPA decisions involving valuing ecological systems and services, current EPA tools, and EPA's needs.

Dr. Grasso described his work with the Committee's Steering Group (Drs. Freeman, Mooney, Segerson, and Thomas) to build on the ideas and suggestions provided by the Committee after the October workshop.

He emphasized that the meeting was a "Workshop," not a "review meeting." The purpose was to gather information about different methods that will help the Committee make recommendations about the knowledge, methodologies, practice, and research that will help EPA better understand and communicate the value of protecting ecological systems and services. He emphasized the importance of the rubric (Attachment E) developed by the Steering Group for Committee members to use to capture their thoughts during the presentation of examples, and as a prompt for discussion.

He described the Workshop format and emphasized that the general discussion times were set aside to discuss themes and issues that cut across the many examples presented.

Presentation of the Channel Island National Marine Sanctuary No-Take Zone Analysis and Committee Discussion

Dr. Joan Roughgarden, Committee Member, presented an analysis developed by a scientific advisory committee that analyzed the fraction of area within the Channel Island National Marine Sanctuary that should be reserved for no-fishing zones and the location of those zones. The scientific advisory committee, as well as another committee of economists, reported to a marine reserves working group of stakeholders. The process enjoined ecologists and economists from achieving inter-disciplinary cooperation. The economist group was charged with identifying costs, while the scientific advisory committee was charged with providing recommendations for reserves. The stakeholders were then positioned to adjudicate conservation values not expressed in economic terms against costs expressed in economic terms.

Dr. Roughgarden described how her group tried to produce a synthetic perspective. She demonstrated the maps developed by the committee, which associated economic and conservation values associated with each geographical subunits of the marine reserve.

Dr. Roughgarden produced calculations of extinction probability, based on the size of fisheries in channel island. From that calculation, the Committee established an overall fraction of the marine reserve area to reserve as a no-take zone to provide yield to fishermen. The committee decided that if the reserve set-aside were 30-50% of total area, the extinction probability would be 2-3%, which was the maximum probability of extinction acceptable to the committee.

The committee found that its proposed advice was useful in meeting with fishermen, who came to understand that the reserves set aside were necessary to assure future catch and income.

Once the committee's proposed fraction to be set aside was identified, the committee, then selected the locations for the "no-take" zones. The analysis relied on simulated annealing to identify the areas that would produce the largest conservation values. The committee analyzed different configurations and selected the appropriate mix of zones that would produce the overall reserve set aside of s 30%

While the scientific committee developed its preferred solution, the economists developed estimates of the of maximum potential loss of commercial fisheries. at the no-take zones identified. The economists then derived cost calculations. They did not calculate the value of the ecological reserves.

The recommendations from the advisory committee went forward to the group of stakeholders and was passed almost unanimously, except for lack of support from a representative of recreational fishermen. The recommendations then went to the Governor and were passed at the state level.

Dr. Roughgarden then reviewed the questions asked in the rubric developed by the committee. The choice of approach, on the ecological side, was a-production function approach, which developed back-of-the-envelope projections for extractive services from fisheries. She viewed the economists as providing static accounting of activities.

The rationale for the choosing the production function approach was the need to forecast how fish population dynamics would change in response to policy. The policy question called for the recommendation of an optimal strategy, based on the responses of the biological system.

The source of value was extractive services only. The analysis did not try to value biodiversity directly. The Committee assumed that biodiversity would be protected, if the reserves were sustained. There were not good alternative policy instruments to protecting the reserves. The alternative, implementing harvesting quotas, was, in her view, difficult to enforce.

She noted that uncertainty was accommodated with modeling. Modeling allowed generation of policy-relevant population dynamic numbers. Information proved more useful than a data-intensive, static approach, which, although it may provide a number, often proves irrelevant because the numbers soon become obsolete.

She noted that there was participation by stakeholders in the public meetings of the committee. The approach was reproduced in many places and is transferable to other situations. The analysis of the committee was not externally peer reviewed. The analysis did lead to a decision which was quite significant.

One thing she would do differently in the future is to have economists and ecologists collaborate. Rather than work in processes that assume ecology and economics are irreconcilable and that use stakeholders are needed o weigh merits of those experts' different views, economists and ecologists should work together in committees.

She noted an institutional factors that promoted the use of the analysis. The environmental consciousness of the general community in Santa Barbara encouraged favorable editorials that made it difficult to view ecologists and conservationists as "hobbyists" trying to advance private value at expense of the public good.

Questions and comments from committee members followed, with responses from Dr. Roughgarden. Dr. Roughgarden noted that the committee's analysis did not have a spatially explicit production function. The production function approach was used for setting the overall 30% target. Once that target was set, the committee considered different habitats (e.g., sea grass, rocky shore, sandy shore) as equal habitat types. they introduced a penalty for fragmenting and a premium for squares that were contiguous.

A Committee member noted that there was no attempt to establish non-use values.

Another committee member noted that economists do capture production function approaches in their value calculations, even though such analysis was not done by the economist team in this case. She pointed out the importance of distinguishing between benefits and costs. Ecologists in this example were charged with estimating benefits and economists in benefiting costs. She suggested that economists should have participated on the benefits side and ecologists on costs. She urged that economists should not be associated solely with analysis of costs, nor should they be associated with static analysis.

One question involved the effectiveness of the "profit model" in influencing the debate. Dr. Roughgarden responded that members of the committee were unanimous about the 30% set aside, and that this unanimity had an impact because the committee was balanced in terms of expertise. It included local experts and, experts from a range of different disciplines relevant to the issue. The Committee's conclusions were also

strengthened by compelling evidence from closures of Newfoundland fisheries. In regard to the analysis of the "costs" provided by the analysis, she expressed the view that this analysis was limited by the perception that available data were limited, and an unwillingness to go beyond the static analysis of this limited data. She spoke of the importance of changing the "mental model" of fisherman and others concerning fish conservation. Rather than viewing conservation of fish as similar to conservation of water, she argued that both natural fluctuations and the ability of "fish to make more fish" need to be factored into people's thinking.

The Committee then discussed some of the implications of the spatial analysis conducted. One member noted that analyses of both economists and ecologists provided underestimates. Economists assumed no substitution on the production side -- that costs due to losses in the no-take zone could not be off-set by fishing elsewhere. Neither the ecologists nor the economists conducted an analysis of the non-use side. All the biases therefore run in the same direction.

Another member suggested that additional modeling and testing of criteria for where the 30% reserves should be located might be useful for preserving biodiversity. Different fish might be differentially suited for different habitats within the reserve. He also suggested that analyses of two different kinds of substitution might be useful topic for collaboration among economists and ecologists, i.e., spatial substitution (fish in location "A" vs. fish in location "B") vs. temporal substitution (substitution today vs. tomorrow).

Dr. Roughgarden noted that the ecologists did model the risk of overfishing in other areas. She acknowledged that her such modeling assumed that the maximum sustainable yield was being enforced by authorities and enforced effectively.

Another set of questions concerned whether it was necessary to build an empirical case to convince the community that 30% set-aside level was reasonable. Dr. Roughgarden stated that monitoring was increasing, but saw the task of convincing a community as different than building an empirical body of evidence. To convince a fisherman it is necessary to engage them at a personal level, to listen, and build understanding and trust. She also stated that the history of population dynamics dates to the 1920's and is one of the oldest subfields in the field of ecology. Detailed models exist for many organisms, but often policy decisions don't need that level of specificity Demanding highly refined science for a "coarse" policy decision is a burden on science and often not needed for the decision at hand.

Presentation of Mangrove-Fishery Linkages in Thailand Example and Committee Discussion

Dr. Ivar Strand, Professor Emeritus, University of Maryland, discussed an analysis of an example, set in Thailand, that used a production function approach to characterize non-use values. The analysis is fully described in a paper by Barbier, Strand and Sathirathai sent to the committee.

He emphasized that this example, like others he has conducted, addressed the question of value, which he defined as arising "from the difference between having the existing system or a different system." He put the analyzed values in perspective within a typology of possible categories of value. The analysis was limited to capturing the direct uses associated with recreational and commercial fish stock changes. Rather than using a damage function and/or a unit value approach, which assumes that consumers and producers do not respond to change in the environment, and a unit value approach that assumes minor environmental change, he used a production function approach.

In this example the approach focused on habitat change in Thailand, where mangrove forest area is lost and fish and non-aquaculture shrimp stocks decline, as shrimp aquaculture grows. He described how the cost per varied and the effect on producers' and consumers' surplus.

The approach drew on data documenting key relationships between mangrove forest decline and shrimp harvest. Fisheries biologists provided information about the carrying capacity related to mangroves and the related level of biomass. Such an analysis could be useful to EPA for studying how pollution affects growth rates and the related production function effects.

Economists then related the mangrove loss and resulting impact on biomass to catch, shrimp stock and inputs (amalgam of inputs used by fisherman) to derive the economic response. The analysis shows that as mangroves decrease, the cost curve rises (fewer fish per level of effort), price rises, and because elasticity is high, consumers pay more and buy less.

The analysis allows identification of a steady state equilibrium -- when the growth in the biological model equals the catch.

He noted that because of the developing country context, there was little information on costs, prices, and fishermen's efficiencies, as well as losses to predecessors. For fisheries in the United States, there would be better data. States differ in information collected.

He noted that the SAB committee might benefit by hearing an economist who specializes in recreational value speak, because the value of commercial fishing is typically less important than recreational fishing, especially in estuarine systems

Dr. Strand then reviewed the questions asked in the rubric developed by the committee. The goal of the approach was to estimate dynamic losses to consumers using the production function approach. The method was particularly useful to a developing nation context which has little data. The kind of value captured were "use" values. The analysis didn't deal with uncertainty in the classic sense. He noted that the method has been used in many contexts and is transferable. He was not aware that the results of this specific study had been used, although recently there has been a dramatic change in how Thailand addressing aquaculture issues.

A Committee discussion of this example then followed. Dr. Strand noted that the model could be adapted to use available information on costs or production function. The Committee remarked on the importance of the assumption about elasticity. In this example, assumptions about the elasticity of demand for commercial shrimp have a major impact on values that are derived, and that a wide range of elasticities is explored. Another member noted the importance of the institutional context, and assumptions about institutional mechanisms. Given unregulated fisheries in Thailand, protecting mangroves to foster native fisheries may "not buy you much." If the fishery were well regulated, on the other hand, the value would be much higher. The Committee briefly discussed whether examples should always assume current regulatory structures (in this case, a low value of preserving mangroves because of open access fisheries), or whether examples should explore several institutional contexts (in this case, different kinds of systems concerning fish property rights).

A related topic involved the importance of clearly identifying assumptions about strategic substitutions. If an analysis assumes a range of substitutions to be perfect in the absence of data, then the analysis may show, for example, that fishermen without a catch can find another job. He noted that a similar strategic substitution assumption was made in the Marine Reserve example, i.e., fish protected in one area were equally substitutable for fish in another area. Assumptions about substitution and complementarities are necessary for a variety of reasons. Members discussed how many strategic substitution assumptions are often well understood by analysts, but not well understood by others reading the analysis.

Committee members asked questions about the larger context for the analysis. Since the report only focused on "use" values, it does not capture other values associated with mangrove forests. The Committee noted that Thailand is considering the general policy question of how much of the mangrove forest should be preserved and how aquaculture should be promoted. One member asked whether there is stochasticity in the

model and whether there is risk of extinction. Dr. Strand responded that there was not data on extinction.

Dr. Strand noted that the analysis did not include returns to aquaculture. Separate analyses conducted by his colleague, Dr. Barbier, have looked at returns to aquaculture, in comparison to the costs associated with lost mangroves. The Committee discussed how the example really involves two open access situation: open access to begin aquaculture efforts that destroy mangroves and open access fisheries.

General Discussion

Members of the Committee then began a general discussion of the Committee's charge. One member noted that all the studies provided to the committee omitted factors from their analysis, and rarely if ever provided the criteria for what was included and excluded. He noted that often decisions aren't dichotomous. In some cases, it is appropriate to provide lower bound information to decision makers. He suggested that the Committee identify criteria for what should be included in analyses.

Dr. Strand suggested that the dynamics affecting academic research often do not provide rewards for interdisciplinary analysis. One Committee member spoke of the need for funding ecological economics, so interdisciplinary academic research wouldn't be "on the side." Another member suggested that the needs for policy-driven research may be different than purely academic research within a given discipline. In his view, policy research always has a future-oriented variable where the "alternative doesn't exist and isn't observable." He asked: "how do we use the available research, even if it is a fairly an empty shelf? How do we use academic research developed in opportunistic way and adapt it to fit a policy situation?" He asked "How do we design a research program that helps us use existing research to inform policy questions we can't observe?"

A member responded that there was a tension between including available information and operating as if "some guess is better than nothing at all, or some information is better than nothing at all" and meeting the needs of a policy process where there is a credibility issue.

Another member interjected that whenever you're trying to predict policies, you're extrapolating. Economists may be used to that. In economics, one assumes economic systems are structurally stable and changes are marginal. He asked whether ecological systems were less stable, whether predictions were less "extrapolatable." and changes more major.

The Committee adjourned for lunch at 12:00 p.m. The discussion resumed at 1:00 p.m.

Presentation of NatureServe Decision Support System in Napa Valley and Committee Discussion

Dr. Dennis Grossman, Committee Member, gave a presentation of the method and tools his organization uses to assess biodiversity values across the landscape. He informed the Committee that NatureServe developed within the Nature Conservancy for valuing biodiversity, and then split off as a separate non profit scientific organization because so many different organizations needed the kinds of information NatureServe provides. Its principal activities involve: establishing scientific standards for the identification of conservation targets; biological inventories; ecological classifications; completing conservation status assessments; and maintaining this information in a network of biodiversity databases. NatureServe develops and maintains comprehensive and current databases for at-risk species and ecological communities in partnership with a network of over 75 Heritage Programs and Conservation Data Centers across the Western Hemisphere.

Dr. Grossman informed the Committee that NatureServe develops and uses a vast amount of information that is then made broadly available for conservation purposes. Detailed information on the taxonomy, distribution, and conservation status are tracked for over 90,000 plants, animals and ecological communities. NatureServe also maps the locations of viable occurrences for these conservation targets and closely monitors the status of those group that are most in danger.

NatureServe has developed a Decision Support System (DSS) that integrates conservation planning methodology in an effort to better integrate biodiversity knowledge into the overall landscape planning and assessment process. The DSS has modules that aid in the identification of the elements of biological diversity of interest and the assignment of conservation weighting and goals for each element. These weights and goals allow the development of an "element value layer" that provides a “topography” of conservation values for each element across the planning region. Element value layers can be stacked to show priority areas and analyzed with data on protected areas and conservation easements to identify additional places that must be protected to meet the stated conservation goals.

He described the application of this method to Napa Valley land trust and its subsequent use by county government. In this context, the system used defaults built into the methodologies concerning the minimum suite of conservation targets involving imperiled and endangered species and ecological communities (i.e., NatureServe uses a classification scheme for species ranking them G1-G5; NS advises a goal of preserving 100% of lands for G1-2 species and communities that are highly imperiled and endangered, and a goal of preserving 30% of land for G4-5 species and communities). The system was also used to identify the best examples of ecological systems, aquatic habitats, and rare communities. The system provides a visual means of communicating

data confidence (e.g., larger circles on the maps indicate lower degree of confidence about location of occurrences).

Conservation scenario modeling algorithms analyze this data to identify the amount and specific locations of lands needed to meet conservation goals and the marginal value of each lands for meeting goals. He briefly discussed a parallel effort where economists ran hedonic models in parallel with the DSS analysis to provide an economic factor in selecting priority conservation sites.

Dr. Grossman then reviewed the questions asked in the rubric developed by the Steering Group. He noted that his organization selected the method used because it needed practical tools for dealing with conservation planning and abundance information. The tools identify biodiversity and conservation values, such as richness, rarity, and conservation attributes. The method is highly quantitative. It accommodates uncertainty by allowing users to choose an appropriate level of uncertainty and stay within bounds. The method is data intensive and is being replicated and transferred to many places. The methods are currently being published.

The Committee then engaged in a discussion of the presentation. The first question concerned the nature of the value addressed by the Decision Support System. Dr. Grossman confirmed that in his presentation the term value referred to rarity, threat, and representativeness of the biological and ecological diversity, and confirmed that it reflected physical attributes.

In response to a question about methodology for weighting conservation values, Dr. Grossman responded that NatureServe does not use a complicated algorithm for stacking. Instead, it adds the raw data for stacking values.

In a response to a question about the differences between the NatureServe approach and the Channel Island example, Dr. Grossman said that the NatureServe Decision Support System applies conservation goals to specific habitats, not just to the total area. His analysis would integrate information relating species to their habitats, not just to the total area. He also noted that the model was flexible enough to include migratory pathways and predator prey relationships. He envisions that the next pilot study for the system would be the Greater Yellowstone Ecosystem and will focus on wide-ranging species and ecosystem connectivity issues.

Presentation on Coastal Resource Loss in Thailand and Committee Discussion

Dr. Thomas Brown, USDA Forest Service, presented an example using a paired comparison method that he introduced as different from presentations earlier in the Workshop. The method involves the public and provides a relatively simple way to assess non-market and non-use values.

The method relies on questions requiring comparisons of items presented in pairs, and asks respondents to simply choose the item of each pair that most satisfies the stated choice criterion. He contrasted the method with his experience in contingent valuation, where he reported problems obtaining reliable answers from respondents when they were asked to value goods for which they lacked payment experience. In his experience, respondents often cannot relate to the questions asked because the questions rely on an absolute estimate of one's willingness to pay, rather than a simple comparison of the values of alternative items. In general, he said, people have trouble saying that they would pay a certain amount of money for a habitat change, but can deal instead with making a comparative estimate of preferences.

In his study of coastal resource loss in Thailand, his team studied four different types of resources being addressed and identified two different levels of damage (severe and partial) for each. Respondents were presented with pairs of loses and asked to respond by ranking options. Respondents were asked to choose the item of each pair that is more important to the respondent personally, to the environment, and to the community. The research found a high correlation across respondent groups regarding preferences. Results allows scaling of selected losses on a scale of one to ten, which can be interpreted as a scale of relative values.

Dr. Brown reviewed the questions asked in the rubric developed by the Steering Group. He reported that there was no explicit consideration of uncertainty in this kind of survey. The method was reproducible and transferable. The method requires the investigator to frame a question that compares two comparable choices; the public can then provide a simple comparative judgment. He characterized the research as exploratory and stated that he was not aware that the research results had been used in Thailand.

The Committee then engaged Dr. Brown in a discussion of his example. Dr. Brown discussed the "test/retest" reliability conducted on data. If a choice seems inconsistent with the bulk of choices, that choice would be posed again, along with others choices that were originally consistent with the bulk of other choices. Research has found that choices that were originally inconsistent, but only marginal, often change.

Committee members then asked Dr. Brown about variants of his approach: whether a choice could involve a certain loss of income and whether it then, in essence would become a contingent valuation question, and whether a choice could involve multiple options and become conjoint analysis. He responded that such questions are generally harder for respondents to interpret, especially when they deal with goods that respondents have little or no experience purchasing. He understood that practitioners of contingent valuation prefer that method, but he has developed more confidence in a simpler technique. He believes that the paired comparison method, when implemented

without including cost to the respondent as an attribute of the items, is useful because it is the simplest question one can pose. Paired comparison methods have been studied since the 1800's. He characterized it as the "best way to ask about complex stimuli," because it is important to keep the questions as simple as possible.

One Committee member noted the internal reliability of choices made. The correlation table presented indicates a reliability index across people. Members were interested in the high level of agreement on rank options and whether this correlation was unique to the group of respondents studied for this question.

A Committee member asked Dr. Brown "where do you think this method fits in a policy valuation domain?" He responded that the approach identifies more than use value and gives a more general impression about their level of concern. When a decision maker wishes to hear from a larger public, it would be useful to compare the values of alternative public groups, to gauge public acceptance of proposed projects or policies, or when decision makers wish to compare their own values with those of the general public.

Another Committee member wondered whether problems arise in the method from the set of choices that are omitted. The paired comparison method might omit a choice meaningful for a respondent that a dollar value would allow for. In the example described, the researchers make a set of assumptions about respondents' lives. He expressed amazement that very different groups of respondents identified choices that resulted in similar rankings. The restriction of choices in this method seemed important to this Committee member and similar to the importance of assumptions about complementarity and substitution that are made in other methods. "In this method, we don't know what a respondent is holding constant. We've made it constant."

Dr. Brown responded that investigators have the option to enrich the set of choices presented to respondents. The preference similarity among different groups may reflect the instruction that all respondents were given, to choose based on their judgment of what was most important not only for themselves, but also for the environment and the community.

Another Committee member expressed discomfort with data that revealed that respondents' choices demonstrated some circular logic (i.e., some individuals preferred choice a to b; choice b to c; and then choice c to a). Dr. Brown indicated that such a pattern sometimes occurred when the difference between choices was small.

Presentation of British Columbia Hydro-Power Example

Dr. Joseph Arvai, from The Ohio State University, introduced his presentation with a discussion of the "decision-aiding" approach used in his example. He began by describing decisions as involving multiple objectives and described value as measured in the context of making comparisons across options. He referenced Dr. Strand's definition of value as linked to a choice of "doing or not doing something" and as linked to multiple attributes.

In the British Columbia Hydro-Power example, the decision-aiding approach was used because the Provincial government required a stakeholder-based decision making process. The decision involved multiple objectives, some of which were process-oriented (e.g., meaningfully engaging participants), and some of which were "outcome oriented" (e.g., maintaining or enhancing salminid populations, opportunities for recreation, etc.) objectives. He noted that BC Hydro desired a high level of consensus for its decisions.

He described five major components of the decision-aiding approach: 1) clearly defining the problem that was to be the focus of the decision; 2) eliciting objectives from various stakeholders; 3) identifying options for management (e.g., preservation, sustainable extraction, development, etc.); 4) Establishing attributes of/measures for each objective; and 5) generating a matrix across these objectives and options for addressing the tradeoffs that selecting one option over another entails. The criteria for stakeholders' choice of attributes/measures for each objective were: to be predictive, measurable, understandable, and practical. In the decision aiding approach, value is not a function of any one measure, nor is it a composite of a set of scores. Instead, the value of a given option exists in the tradeoffs that people are willing (or in some cases, able) to make across not just their objectives, but also the level of achievement with respect to them. In other words, the decision to forgo some level of environmental protection in favor of revenue generation is not driven solely by these two objectives. Instead, the tradeoff is dependent on the *level* of environmental protection lost and *amount* of revenue gained. He noted the very different kinds of data (ecological, economic, cultural impacts, recreational impacts) and the interdisciplinary nature of the analysis, which is being used for decision making by BC Hydro. He characterized the strengths and weaknesses in the following ways. As strengths, the method accounts for multiple dimensions of value; explicitly addresses key sources of uncertainty; links choice of methods with the objectives of key stakeholders; and is explicit about the need to make tradeoffs. Weaknesses might be that the approach is time and effort intensive (2-3 days to 2-3 years); involves varying costs; is best suited to cases with a single decision maker; and involves elements of “art” and “science.”

The Committee then began a discussion with Dr. Arvai. One member asked about whether there were some uncertainties in the use of the method that relate to the

method itself. Dr. Arvai responded that experimental work reveals that the list of objectives and attributes developed by stakeholders evolves over time, but seldom as a result of gaming. Another member noted that a source of uncertainty might be the selection of stakeholders and experts. She expressed a highly suspicious view of people who try to narrow the set of stakeholders.

In response to another question, Dr. Arvai noted that the models used to derive attributes or measures involved analyses that represent values over a fixed time period (e.g., the Water Use Plans generated in the example had review periods at regular intervals). In this sense, it is not a truly dynamic modeling exercise. However, the approach incorporates the tenets of adaptive management to reduce uncertainty and increase learning over time. In response to a question, he noted that the example was based on insights from multi-criteria decision analysis, but was more user-friendly in that it did not rely upon complex formulae and computer models. In practice, he reported that user-friendly approaches are more effective in keeping stakeholders engaged.

Another question related to the protocol for trade-off analysis. Dr. Arvai responded that the approach uses very prescriptive tools (e.g., computer simulations, even swaps, swing weighting). Experts conducting the analysis don't make recommendations to the stakeholders as to *what* tradeoffs they ought to make. Instead they provide tools and guidance about *how* decision makers, stakeholders might make these decisions.

A member then noted that the choice matrix lays out several options and asked how the method takes account of the quality and reliability of data across different options. He asked whether the method has been used to study how the quality of the science or data influence how we make decisions.

Dr. Arvai commented on the current state of the art. In many cases, the time frame for the analysis encompasses the relatively near term (0-25 years). If the time frame were casting out over longer periods of time (e.g., 100 years), he suggested additional work be undertaken to develop more dynamic long-range model for system response. He noted that some objectives have attributes have very certain information, others do not. He suggested that the decision science approach was—in his view—currently not mature enough to have adequately monitored how data from post-implementation monitoring efforts validate attribute measures, predictions of response, and ensuing decisions.

Another member asked about the process of working with expert groups and stakeholders. Dr. Arvai described how he and other practitioners work with these groups to identify attributes and measures that will continue to be useful to them over time. A significant amount of time is spent working with stakeholder groups; some of these meetings take on a part-classroom feel as participants are brought up to speed—for

example—on designing measures (e.g., using constructive scales, natural measures, or proxies).

A member asked whether the approach would require construction of new models, if existing models did not provide the attributes or measures required to evaluate different options. Dr. Arvai responded that in many cases, there's a need (based on the objectives expressed by stakeholders) for data that has yet to be collected, or for a model that does not currently exist. The process would then require tasking an expert team (e.g., ecologists, economists) to build a model or collect the required data. If appropriate, a simpler solution may be to modify an attribute.

Several members of the Committee noted that the process may have an emotional impact on stakeholders; they have been changed as a result of their participation in the process. Dr. Arvai responded that his research on experimental water use plans studies this impact.

Presentation of Clinch River Example and Conceptual Approach from EPA-ORD Report Integrating Ecological Risk Assessment and Economic Analysis in Watersheds: A Conceptual Approach and Three Case Studies and Committee Discussion

Dr. Randall Bruins, EPA, Office of Research and Development, spoke about a case study in the Clinch Valley, developed under an EPA grant, that used conjoint analysis methods to develop an economic assessment of different management options for reducing risks in that watershed. He referenced the publication of that case study, within a set of three case studies published by EPA's Office of Research and Development in 2003 (*Integrating ecological risk assessment and economic analysis in watersheds: A conceptual approach and three case studies).* The three case studies (including the Clinch River Valley study) were based on three of the five ecological risk case studies conducted by EPA in the 1990's as part of its implementation of the Agency's ecological risk assessment guidelines. The goals of the ecological risk assessment were to identify key sources of risk, stressors, and ecological endpoints and to characterize the risks. In the Clinch Valley, the Agency was aware of an unusually high diversity of fish and mussel species, including many rare species. Sources of stress include urban areas, coal mining and processing, transportation corridors and hazardous spills, and cropping and grazing practices extending to the water's edge, and beyond. In the ecological risk assessment, the Agency studied, among other factors, various spatial correlations between land use or habitat quality on the one hand and biological integrity of the fish or benthic community on the other. The Agency noted that sedimentation, habitat degradation, and toxics were the most important stressors and that forested riparian areas tend to be associated with higher biological condition.

The programmatic goals for the economic analysis conducted under the EPA grant were general and exploratory: to use the ERA findings in decision-relevant

economic analyses. The investigator chose conjoint analysis approach, as opposed to contingent valuation, because they felt that people lack experience in "buying" environmental goods. Therefore, it is hard to make the contingent valuation task realistic. Conjoint analysis offered respondents the opportunity to choose among public policy options that, hypothetically, resulted in states of the world that would differ across attributes dealing with ecological quality, regional quality of life and cost.

The survey instrument developed described a choice of 3 – 6 attributes. The survey presented a series of choice sets involving different kinds of riparian buffers in which attribute levels varied independently. Inclusion of a payment attribute enabled estimates of willingness to pay for different choices and different attributes.

Dr. Bruins noted that the analysis was not directly used by a decision maker. It was conducted as a pilot project. Further research would be needed to clarify the usefulness of welfare estimates for decision makers in the Clinch River Valley. He noted the importance of matching the tools and models needed to the specific decision context in question, and asked the Committee to consider that question in the context of its own charge.

Dr. Bruins further developed these ideas by summarizing the results of the recommendations in the 2003 report for strengthening the integration of ecological risk assessment and economic analysis. The report calls for integration in several ways: 1) through interdisciplinary planning and problem formulation (with specific attention to the particular decision context and the use of integrated conceptual models); 2) specification of management alternatives to allow interdisciplinary analysis; and 3) use of quantitative analysis that relates ecological and economic endpoints. The report provides a conceptual approach for integrating ecological risk assessment and economic analysis in the context of watershed management. Dr. Bruins stated that this approach would foster such integration, both for decision contexts that required monetization and contexts that did not. He also briefly summarized the results of a recent ORD-OW workshop that examined how such an approach might apply to national rulemakings and watershed-level decisions.

The Committee then engaged Dr. Bruins in discussion. In response to a question, Dr. Bruins urged that ecological analyses should be conducted not just for the baseline but also for policy alternatives. Development of policy options requires early collaboration on the part of economists and ecologists in study

Another question concerned the sensitivity of the results of the economic analysis to the amount of information provided to respondents. Dr. Bruins responded that EPA wants to inform preferences, as well as measure them. In his experience, all contingent valuation studies provide information to people. There is a need to explain "a lot more about ecosystems" so people can understand consequences of choices.

Another member asked about the conceptual model proposed for watershed analysis. She was struck by the Agency proposing a process described as loosely similar to adaptive management. She asked "Could adaptive management be perhaps a dangerous introduction of human judgment?" and asked whether the Agency should not take special care to express humility in cases where decisions are wrong in the context of ecological risk assessment. Dr. Bruins responded that EPA does not generally have the option to leave systems pristine. Adaptive management is a valuable concept if it allows decision makers to gain information and to learn so as to inform future choices.

Yet another member referred to earlier work in conservation economics. One of the issues that crystallized early in that analysis was: is the action irreversible? If it is, then if we learn something and it is a negative outcome, there are no management options. We can't do anything. Any such approach needs to understand the conditional value of step that would be taken.

The Committee then briefly discussed whether it would be reasonable to propose that instead of adaptive management, an alternative might be to minimize human intervention, because of skepticism about the possibility of becoming better and better at adaptive management. One member noted that there are different concepts of adaptive management (for example, differing interpretation of Kai Lee version vs. Carl Walters) and each has very different assumptions and implications. Another member noted that the kind of ongoing economic analysis that Dr. Bruins suggested in support of watershed decision making did not involve "regulation of ecosystems." Instead, it involved regulation or management of people, because people affect ecosystems. He noted that many ecological systems and resources cannot be treated as intact ecosystems, isolated from and untouched by stressors outside their boundaries. He suggested that air pollutants, for example, affected ecological systems and resources generally. Most ecological systems are not as contained as marine reserves, and even marine reserves are affected by factors outside their boundaries. Another member stated that the number of cases where we can leave things along is almost none and represents, in reality, an empty set.

Dr. Bruins then responded to a set of different questions concerning the appropriate sequence of ecological and economic analysis. He acknowledged that the economic analysis for the Clinch River was a separate analysis that followed several years after the ecological risk assessment was completed and used the ecological risk assessment as an input. In his view, ecological analysis is often treated as an input to economic analysis because the latter is a tool for describing what people want. He stated that people have a stewardship role that requires making management choices.

General Discussion

The Committee's general discussion continued the discussion of dynamic modeling and adaptive management. One member asked "where are people in the models? within the ecological models? within economic models?" It is important to think about the behavior we're trying to explain in providing advice to the Agency about the analytical tools to choose.

Another member noted the importance of emphasizing that any sort of economic analysis is only one piece of information provided to decision-makers. The economic analysis should not "make" the decision and is only a factor to consider.

Committee members then discussed a theme that emerged from the examples that the institutional framework for the example and decision can influence what is perceived as "values" and is often overlooked. The type of valuation needed depends on the policy decision. A decision might call for a dichotomous choices, where you may just need a lower bound. A more complex decision might require an exact number. Another member spoke of the importance of looking carefully at what the decision process requires and to check whether effectiveness, not cost benefit, might be really required by a decision.

The Committee spoke briefly about the need to do a better job of dealing with the unintended consequences of actions. The question was asked: how do we bring in the value of these unintended consequences?

Another member noted that the process for valuing ecosystem services in the examples described has two purposes: the derivation of information about value and involving people in and educating them about a decision. In his view, both the substantive and the procedural aspects were important. He expressed interest in the Committee's addressing how to make the "valuing" exercise more valuable with regard to both substantive and procedural goals.

Another member noted that public surveys may have educational benefits even though they cannot engage people as intensively as the decision-aiding tools required. Such tools have a role in raising issues for people. He suggested that the Committee think about and provide advice about how surveys could make contribution to "moving the general public along in its understanding of ecosystem values."

Yet another member responded that the Committee might consider using decision-aiding or similar tools to identify the attribute set that might help to frame questions asked in economic surveys of ecological services, instead of the current practice of relying on a small group of experts. Lessons might be learned from group processes or from closer examination of the institutional factors affecting choice. He

mentioned the example of a decision on flow rates for the Glen Canyon Dam, where attitudes towards cowboys played a role in evaluation of options. Such a factor was never considered by the experts.

A member mentioned the possible contribution of the "Q technique" for bringing stakeholders together. Another member commented that risk communication also provides methods for eliciting attributes that may be important for valuation.

The Committee then shifted to a different topic. One member asked a series of questions: 1) how much do we know about biology?; 2) how much needs to be known to have sensible policies?; 3) where are there weaknesses in the science that impede decision making? Another member suggested reframing the questions as questions about "uncertain science."

Members of the Committee responded with a variety of comments. One member emphasized that "nature isn't is as controllable as we think it is" and that current science becomes outdated by future insights at a rapid pace. In her view, the Agency needs to consider the likelihood that 50% of current science understanding will not be relevant ten years from now because of events that cannot be anticipated.

Another member emphasized the importance of making reasonable assumptions for policy purposes and acknowledging them. One such assumption might be "if you can believe that marking species in space and preserving a certain amount of area around them" was the equivalent of protecting that species in that area. In his view, for policy purposes, given our limited knowledge, methods and tools need to be available for "people in the world they operate," and scientists and decision makers need to use "our limited knowledge in a humble way."

The group then discussed how the issue of uncertainty might relate to decision making. One member suggested advising a threshold for taking action. before adaptive management could cut in. Another member referred to the logic of the precautionary principle.

The Chair concluded the session by stating that issues of uncertainty have to be well accommodated. The challenge for the Committee is to advise the Agency how not to be paralyzed because of our lack of knowledge. The overall goal is to provide advice, to the Agency so that it can make decisions protective of human health and the environment

The Workshop adjourned at 5:15 p.m.

Workshop Summary: April 14, 2004

Opening Remarks

Dr. Nugent, the Designated Federal Officer, opened the Workshop at 8:30 am. The Chair, Dr. Grasso, asked her to give an overview of the major needs identified by EPA managers at the Committee's October 27, 2003 workshop. Dr. Nugent summarized her sense of the major needs presented to the Committee at that time. She had extracted manager's responses to two sets of questions posted to them before the October 2003 workshop. The first question was: What are the tools and approaches you need to improve how your program values the protection of ecological systems and services (Sub-questions were: What changes or additions would you like to make to your suite of tools and approaches for valuing the protection of ecological systems and services? What changes do you think would have the most significant impact on decision and policy making?). The second question asked: What advice do you need (Sub-questions were: What specific problems can the Committee help you resolve?; What would make the advice of this Committee most useful?).

Dr. Nugent distributed to the Committee a matrix containing extracts of presentations made by senior managers from EPA's major program offices and managers from two regional offices at the October meeting. (see Attachment D: EPA Managers Views on the Types of Scientific Advice on Valuing the Protection of Ecological Systems and Services that Would be Useful to Their Program; Information Extracted from Presentations Made at the Initial EPA Background Workshop, October 27, 2003).

Dr. Nugent suggested that "needs" for assistance fell into four major categories: 1) needs for valuation of ecological benefit options for national rulemaking; 2) needs for assessing values for regional decision-making for other purposes; 3) needs for assessing ecological benefits as part of the Agency's response to the Government Performance Results Act; and 4) needs to characterize ecological benefits for effective communication with the affected public about EPA actions.

Dr. Grasso noted that many of the managers also called for advice to strengthen ecological assessments.

Presentation of Blackbird Mine Hazardous Waste Site Example and an Overview of Habitat Equivalency Approach and Committee Discussion

Mr. David Chapman of Stratus Consulting provided an overview of Habitat Equivalency Analysis (HEA) and presented an example of its application. He drew on his consulting experience and experience working on natural resource damage issues for the National Oceanic and Atmospheric Administration.

He began by providing background information on the origins of HEA. It developed as a tool for natural resource damage assessment (NRDA). The purpose of NRDA is to make the public whole for injuries to natural resources that result from the release of hazardous substances or oil. The public is made whole through “restoration” (damages recovered must be used for restoration). The Oil Pollution Act of 1990 requires a determination of "How many additional public resources does the public require to be 'made whole" 'or the loss?" Resource compensation is the primary issue. He presented a resource compensation equation that related the net present value of an injury to the net present value of restoration.

For HEA to be an acceptable method for NRDA, there must be an analysis that shows the injured and restored resources and services are the same type, quality, and comparable value, If comparability is established the question becomes "how much restoration is necessary to offset interim losses." He listed four general principles for HEA: 1) it calculates compensation for interim lost services, with habitat/resource replacement as the form of compensation; 2) it calculates the amount of habitat/resource to be created or enhanced to provide the same level of services over time as were lost due to the injury; 3) it requires implicit assumption that the values per unit of lost services and replacement services are comparable; and 4) it simultaneously determines injury quantification and restoration scaling in one method.

Interdisciplinary analysis is essential to HEA to determine that values per unit of replacement services and lost services are comparable requires inter-disciplinary analysis. Mr. Chapman described HEA as the most common tool in natural resource damage assessment, and noted that it has gained wide acceptance with Principal Responsible Parties.

He briefly described the Blackbird Mine Case Study. The mining operation was a source of copper, cobalt, and arsenic pollution that affected water quality and salmon most particularly. For this project, an interdisciplinary team developed an injury assessment with three metrics for surface water quality criteria, resident fish, and anadromous fish. The focus of the restoration goals was on restoring salmon to the river, and both primary and compensatory restoration targets were set. The primary restoration goal was restoration of Chinook Salmon at a cost of $2.5 million to construct and operate replacement services. For compensatory restoration goals, the analytical team evaluated benefits of restoration actions through fish population models and identified that cattle impacts on riparian habitat and stream sedimentation were a major problem. In responses to a question, he noted that the law set 1981 as the starter year for annualizing injuries. In conclusion, he noted that HEA is not complicated mathematically and can be appropriate as a resource compensation method under specific assumptions. The difficulty and the challenge is in determining defensible input parameters, especially an adequate metric. HEA is not a economic valuation method applicable to standard policy benefit/cost analysis where the goal is to determine optimal (efficient) allocation of scarce resources

(e.g. marginal benefits=marginal costs). Finally, the cost of compensatory restoration projects is not a measure of the value of the resources to the public

Discussion with the Committee followed. In response to a question, Mr. Chapman noted that although the fundamental idea is compensation for replacement of lost resources, compensatory restoration can improve the quality of habitat at the site of the damages and elsewhere.

Another question related to possible applications of HEA beyond the Ocean Pollution Act. Mr. Chapman noted that it has been tried for the Army Corps of Engineers for wetland permitting in the development of mitigation rations. In those cases, it helps to identify the benefits of restoration process. He also noted that it has been applied as an indicator of value for an analysis supported development of EPA's regulations concerning cooling waters. The kind of questions it could inform are: "What would we need to do to offset the loss of fish? Could give you sense of what it would take to deal with losses?"

A Committee member asked for a clarification of "What are you compensating? Who are you compensating?" Mr. Chapman responded that the goal is to compensate the public. The government's duty is to protect the public's resource, to return resources to their original state and compensate the public for its injuries during the time when the injury happened.

Another member asked three questions. He first questioned where the economic assumption of the "law of one price," which assumes that the same good should sell for the same price everywhere, applied for natural resources for which there is a market. Identifying comparable values requires "huge assumptions" about equivalency. He wondered about the limits placed on this assumption in terms of the time, scope, scale or how far from the injured resource you'd be willing to place compensatory action. He then asked how annualization of interim losses makes sense for resource-to-resource compensation. As his third question, he asked about distinctions between primary and compensatory restoration, which an effect on the damaged resource.

Mr. Chapman addressed the third question first. He acknowledged that there are places where primary restoration wasn't going to occur and that some remedies can be primary and compensatory.

In regard to the second question concerning annualization, he noted that in the Blackbird case, some of the identified remedies already recovered the base stock level. To compensate for interim losses, the analysis must consider whether the recovery occurs through one "bulk" physical project or through the flow of benefits from a project.

To the first question, Mr. Chapman responded taking into account the discussion of comparable resources. He said that on-site and in-kind resources are preferred over

off-site and out-of-kind resources. He noted that there has been no good work on the elasticity of preferences in identifying comparable values.

One Committee member and the Committee Chair noted the written comments provided by Dr. Robert Stavins, member of the Committee, regarding HEA. In Dr. Stavins' absence, the Committee member noted that Mr. Chapman confirmed Dr. Stavins' view that HEA represented a cost of restoration, as opposed to a value of resource, estimate. She then asked Mr. Chapman if he considered that such a cost of restoration or other costs established in other voluntary transactions, such as settlement costs, relating to resources as a lower bound for a value estimate. Mr. Chapman responded that in private transactions, costs could be seen as a bound, but public goods and in using costs as such a lower bound.

Another member voiced the view that HEA, in providing compensatory restoration where an old ecosystem used to be but is now degraded, seems to "give more standing to nature than cost/benefit analysis." As such, it appears as a "pro-nature approach." Rather than focus on valuation for human utility, this approach says "we don't care what the benefit is to humans, we want to restore to level of the *ex ante* state."

Mr. Chapman responded that in the 404 wetlands programs, there are some applications that into account remedies that will or will not work, and consider what restoration will provide in the way of benefits.

Yet another member expressed relative comfort with comparable resources being identified within a common watershed, but wondered about equity issues identifying comparable resources in different watersheds. He viewed HEA as a tool that could be used to achieve positive environmental outcomes, that could look at a variety of upstream stressors as part of the compensatory damage analysis.

A Committee member asked about the process in which goals are identified, and asked, for example, how the goal of the return of 200 salmon of the same genetic stock was identified in the Blackbird Site. Mr. Chapman responded that a Trustee Committee with representatives of the National Oceanic and Atmospheric Administration, the U.S. Forest Service, the US department of Interior, and State of Idaho met to develop goals. They worked together with information from the National Marine Fisheries Services, which expressed concerns about maintaining natural stocks with genetic integrity. The individuals participating were familiar with the site, familiar with the resources in question, and the relevant law. The public was involved with eliciting restoration projects and in reviewing the final set of alternatives.

<u>Presentation of EPA's Environmental and Economic Benefit Analysis Supporting Regulations Affecting Concentrated Animal Feeding Operations (CAFO) and Discussion</u>

Dr. Sharon Hayes, Director of the Water Policy Staff at EPA, introduced the CAFO analysis by noting that attention at the highest levels in EPA and the Office of Management and Budget (OMB) has been recently devoted to regulations involving ecological resources. She then provided the Committee with a list of the desired characteristics of tools and methods for ecological benefits assessment in the hope that this information could guide the Committee in providing practical, useful advice to the Agency.

She noted the need for tools and approaches that are flexible (i.e., would provide alternative strategies when the original approach does not work); "cheap and fast;" and sound, credible and scientifically supportable, sufficient for the policy or decision purpose intended. She noted that for a recent regulation, EPA did not have the time or money to do original research, and so instead took the results of published research and conducted a meta analysis of non-use values. Because the published study parameters were not identical to problems under consideration, the Agency was not able to characterize non-use values for the regulations. Because the Agency couldn't justify transferability, the analysis was not used.

She introduced Dr. Chris Miller, who then began a discussion of the CAFO rule benefit analysis. Dr. Miller noted that in 2002 EPA published a final rule, replacing 25-year-old effluent guidelines dealing with pollutants flowing from feedlots and land applications. He quickly reviewed a range of benefits described in the analysis supporting the rule and then focused his presentation on recreational use and nonuse benefits providing $170-300 million in benefits per year. The methods supporting that analysis relied on the National Water Pollution Control Assessment Model, water quality indices, and benefit transfer derived from 1984 survey conducted by Carson and Mitchell. The approach was chosen principally because it was an efficient approach for estimating national-level "use and non-use" benefits. He described the survey, which used a contingent-valuation format referencing the water quality ladder that provides a scale for water quality index values (e.g., boatable, swimmable, and drinkable waters). The survey asked: "What are you willing to pay to raise the minimum level (of WQ) to where 99% or more of freshwater bodies would be swimmable (or boatable, or fishable)?"

Dr. Miller then reviewed the questions asked in the "Rubric" developed by the committee. He noted that the approach did not incorporate uncertainty analysis on the ecological side; on the economic side, however, it provided a range based on analyses of water quality indices vs. discrete uses. He viewed the strengths of the analysis as its direct estimation of benefits. There was no extrapolation. It accounted for use and some non-use values. A scientific linkage was evident and important between specific changes in water quality and economic analyses of those change.

In terms of shortcomings, he noted that the available contingent valuation survey may not capture all non-use values. The focus on recreation might not capture existence

and bequest value. The one-dimensional index of water quality also does not capture state service designations in many states and there are other limitations to the water quality model used. He noted that EPA is considering possibilities for integrating its model with those of other agencies and the possibility of conducting case studies with extrapolations to compare with applications of the national model He also noted that research underway at Harvard and Duke may provide useful valuation information at a more local scale. EPA is also considering conducting rule-specific primary valuation surveys to address regulation issues under Section 316B issues of the Clean Air Act, and that the Agency would welcome guidance as to appropriate scientific use of benefit transfer methods.

The Committee then engaged Dr. Miller in discussion. One member asked if the Agency began its CAFO analysis with the right unit of analysis. The National Water Pollution Control Assessment Model deals with stream reaches, but do those reaches represent the ecological unit and system that is effective for analyzing ecological impacts in this example? Dr. Miller responded that this question was very important. The CAFO rule required modeling 15,000 units that varied from ephemeral streams to huge rivers. The analysis modeled 835,000 reaches, which could be considered on average as reflecting the different water bodies at issue. If it were necessary to address different kinds of water bodies to understand ecological effects, in his view, that would point toward a case study approach.

In response to a question from a Committee member, Dr. Miller responded that the primary purpose for the analysis is confirming to guidelines under Executive Order 12866. The Agency generally considers OMB and the public as the audience. He then described the resources devoted to the analytical effort. A team of economists and environmental assessors worked on the rule. The water quality modeling cost $250,000.

Another Committee member asked questions about the role this analysis plays in the Agency. She remarked that the analysis seems to be seen as successful in valuing ecosystem services. She asked how the analysis was received and whether it was viewed as scientifically credible for regulatory support. Dr. Miller noted that the water quality model was peer reviewed, but that the benefit analysis *per se* was not externally peer reviewed. He also noted that the CAFO rule covered a large number of facilities. Involving fewer facilities might not be appropriate for such a water quality modeling approach.

The Committee Chair asked Dr. Miller to identify was biggest uncertainty. Dr. Miller responded that the characterization of water quality was the biggest uncertainty. It was not certain that the one-dimensional index used fully captures how people value water. Using a national water quality model also may not relate well to impacts in different ecological systems.

A Committee member noted that a key assumption in the CAFO analysis was that a change in the Water Quality Index represents a change in the ecosystem services provided by those reaches of river. He noted that there is no direct relationship between the index of water quality and ecosystem services or ecosystem effects. Dr. Miller acknowledged that the index values modeled in the CAFO benefit assessment did not capture all ecosystem effects directly, but indirectly captures the relationship between water quality parameters and recreational services. Dr. Miller noted that the index is based on research by Dr. McClelland who surveyed a sample of environmental professionals' confidence about the link between specific water quality parameters and ecosystem effects.

The Committee member noted, however, that the contingent valuation study used in the CAFO analysis focused on how indexes of water quality affects people. There is no evidence from that survey that respondents considered ecosystem quality as it is currently understood.

Another Committee member drew attention to the list of non-use benefits that are not included in the analysis. He noted that there may be important services, such as nutrient recycling and species richness, provided by ecosystems omitted from the analysis. Dr. Miller acknowledged that very many ecological services are omitted. The CAFO study only focuses on use and recreational services. There is a significant gap in reflecting the benefits of sustainability, diversity and richness. The Committee member noted the importance of the Committee making a contribution to development of methods for characterizing non-use benefits.

A Committee member asked about the potential of the National Water Pollution Control Assessment Model providing information on ecological outputs, as well as levels of pollutants. Dr. Miller responded that National Water Pollution Control Assessment Model has made improvements in modeling eutrophication, but even given those changes, the model still focuses on water quality parameters, not benthic organisms and phyto plankton or other aquatic organisms. He noted the need to make linkages to other models. There may be a need to fill the analytical gap between water quality modeling and the Agency's Index of Biological Indicators and fish populations, for example.

Dr. Anthony Maciorowski, Associate Director for Science for the SAB Staff Office, noted that the Committee was seeing a number of different methodological issues arising from several different historical developments in the Agency's water program. He noted that under the Clean Water Act, the Agency sets water quality criteria for chemicals. These criteria are set, in part, according to their effects on organisms. Water Quality Standards are the chemical measures set up to protect 95% of organisms 95% of time. In addition, EPA has biological criteria, the Index of Biological Integrity , and other criteria that developed as methods in EPA's Office of Water and are not used in the CAFO analysis.

A Committee member then noted that there was no overall uncertainty analysis in the document. He asked whether there should be an uncertainty analysis whenever costs and benefits are set out as fixed numbers. He asked whether the Agency had criteria for when uncertainty is too great and when the analysis falls apart. Dr. Miller responded that the Office of Water wrestled with the issue of uncertainty analysis and how to present it. He suggested that it would be helpful to have guidelines or advice for how such analysis should be conducted and presented. He noted that although the Carson and Mitchell survey was old, it did provide standard errors, which could have been integrated into an uncertainty analysis. He noted that for a later benefits analysis (the "meats analysis"), the Agency attempted a Monte Carlo analysis, which raised more statistical questions than useful information.

The Chair asked whether the CAFO analysis was used in setting criteria, developing options to meet a target, or in choosing among options. Dr. Miller responded that it was not used for that purpose. Instead the analytical team provided benefits to compare to costs for the engineering option provided to them, in accordance with the goal of developing technology options that are economically achievable under the Effluent Limitation Guidelines program.

Presentation of Approach To Valuation of Ecological Benefits in EPA's First Prospective 812 Analysis of the Benefits Associated with Implementing the Clean Air Act and Committee Discussion

Before the presentation began, the Chair introduced Dr. Robert Driscoll, Chair of the newly formed Ecological Effects Subcommittee of the Advisory Council on Clean Air Compliance Analysis, who had joined the Committee's discussions.

Mr. James DeMocker from EPA's Office of Air and Radiation (OAR), gave a presentation on EPA's efforts to value the benefits of protecting ecological systems and services in the context of the "812 Analysis." He began with the statutory language in Section 812 of the Clean Air Act amendments of 1990, which called on the Agency to:

> "provide a report to the Congress on the incremental human health and environmental benefits, and incremental costs beyond current clean air requirements of the new control strategies and technologies required by this Act. The report shall include, for such strategies and technologies, an analysis of the actual emissions reductions beyond existing practice, the effects on human life, human health and the environment (including both positive impacts and those that may be detrimental to jobs and communities resulting from loss of employers and employment, etc.), the energy security impacts, and the effect on United States products and industrial competitiveness in national and international markets."

He noted that EPA's core mission, and the core mission of OAR, includes ecological protection. The question of ecological benefits always come up in the context of the 812 Analysis, but the Agency has encountered difficulties in characterizing and quantifying those benefits. He presented the goals of the ecological assessments conducted for the 812 Analysis as: 1) providing a broad overall characterization of the range of effects of air pollutants on ecosystem structure, function, and health; 2) extending existing data to estimate the magnitude of economic benefits from the 1990 Clean Air Act Amendments (CAAA); and 3) applying and expanding the growing body of information available to assess the impacts of air pollutants on ecosystems

To illustrate the difficulty the Agency has encountered in quantifying ecological benefits, Mr. DeMocker provided a bar graph illustrating the quantitative benefits assigned to ecological effects as compared to mortality benefits for 2010, as derived by the Agency for the First Prospective 812 Study, which covered the time period 1990-2010. The central estimate for mortality was approximately $100 billion, while the central estimates for the three ecological benefits monetized (acidification impacts on recreational fishing, commercial timber measured through producer surplus, and nitrogen deposition measured in three estuaries) was barely visible on the chart, and less than $1 billion. He emphasized to the Committee that the point of the bar graph was that the Agency believed it was "missing a lot" by its inability to quantify and monetize ecological benefits more fully.

He noted that the Agency has used a 3-step approach for characterizing ecological benefits: 1) identify and characterize ecological effects from air pollution; 2) develop and implement selection criteria for more in-depth assessment and quantification of ecological impacts; 3) conduct quantitative and qualitative analyses to characterize a portion of the benefits of the 1990 Clean Air Act Amendments. He summarized the treatment of ecological endpoints that were identified for the Second Prospective Study. Some effects were quantified; other effects were described qualitatively. Of the endpoints identified, only a subset were monetized. The economic benefit analysis followed basic principles of economics - an observable human response was needed to quantify the monetary values. The Agency found itself limited by available data and methods to service flows that are sources of material inputs and service flows associated with natural amenities that attract recreation. He briefly described several example analyses, including a displaced cost approach for capturing nitrogen reduction benefits. This latter example was omitted from the primary benefits estimation in the First Prospective Study because of methodological uncertainties and concerns from the Advisory Council on Clean Air Compliance Analysis (the chartered advisory committee established by Congress to advise EPA on the 812 analysis) about the appropriateness of the avoided cost method.

He also briefly described some of the ways in which uncertainties were presented in the First Prospective Study. For ecological benefits, as for other parts of that analysis,

the Agency presented a table showing potential sources of error, the direction of bias for overall monetary estimate, and the likely significance relative to key uncertainties in the overall monetary benefit estimates.

Mr. DeMocker closed his presentation with a discussion of planned improvements for the Second Prospective 812 Study. He noted that the Advisory Council on Clean Air Analysis had provided advice to the Agency in 2001 on its initial plan. The advice called for major attention to be given to improving benefits analysis for ecological effects. He also noted that in 2001 members of the Council Panel had some difference about how to improve the analysis. Some members supported continued use of established neoclassical valuation methods, even while they noted that 812 studies will continue to underestimate ecological benefits until there is available data on environmental effects of marginal changes in air pollution. Other members asserted that valuing the piecemeal marginal social benefits of certain ecosystem services is inadequate to achieve the growth of knowledge necessary for policy-making. They preferred a more comprehensive benefits measure, including consideration of applying placeholder values. He also noted that the Council Panel report advised the Agency to explore new approaches, such as the value of a statistical ecosystem.

In response to that advice and other needs, OAR is planning to update its literature review of qualitative assessment of the impacts of relevant air pollutants (including market and non-market service flows) and the evolution of ecological valuation literature with the goal of evaluating whether there is a basis for estimating marginal ecosystem service benefits relevant to the context of the 812 analysis. It is also planning a case study of an estuary to evaluate whether the literature provides a basis for estimating marginal ecosystem service benefits relevant to the context of the 812 analysis. The Agency also plans to explore the feasibility of incorporating estimates of ecological benefits in Computable General Equilibrium analyses as dynamic factor in household choices and benefit to natural resource based economic sectors.

Mr. DeMocker acknowledged that the Council was looking to insights from the Committee on Valuing the Protection of Ecological Systems and Services and to the Council's own new Ecological Effects Subcommittee to advice scientific thinking on the issues he had described.

The Committee then began its discussion with Mr. DeMocker. A Committee member expressed amazement that the monetary value of human mortality in the First Prospective Study dwarfed the assessment of ecological effects. Mr. DeMocker responded that he felt that he had "pushed the envelope." He had taken the known and accepted steps for characterizing ecological effects and had aggressively advocated for including ecological analysis, despite criticism that monetized ecological impacts would be overwhelmed by human health impacts, and were not worth the efforts to quantify.

The Committee member responded that she viewed the problem as not the lack of data or tools, but a "failure of imagination about what ecosystem do for people." She expressed appreciation for the needs of decision makers for marginal information, but she noted that it is important for the environment to be conceived as larger than a specific action. She noted that "focusing on tools, data and quantification, we can miss big issues."

Mr. DeMocker reflected that OAR felt a responsibility to characterize the full array of ecological consequences of implementing the Clean Air Act. The First Prospective Study described those consequences qualitatively because they were important for the benefit-cost analysis and monetized benefit information was not available. He noted, however, that in the context of the benefit analysis, the endpoints excluded from monetization get ignored.

He noted that the Advisory Council on Clean Air Compliance Analysis has encouraged in its current review of the Agency's plans for the Second Prospective Study, that OAR begin a "Learning Laboratory" to experiment with new approaches.

Another member then asked about the quantitative assessment of costs in the First Prospective Study. Mr. DeMocker responded that the central estimate of costs was $25 billion vs. a central estimate of $100 billion. The Committee member noted that from a political perspective, the Agency is generally justified in its air programs, based on health effects alone. Mr. DeMocker replied that the 812 Studies may be used for many more questions than the aggregate value of the Clean Air Act as a whole. They might be used to address program specific questions, such as "what is incremental benefits of a nitrogen deposition plan." He noted that with increasing requirements to conduct cost-effectiveness analysis, the Agency will be characterizing programs in terms of quality per some unit (such as life years for human health effects) and that it will need a metric and methodology for evaluating cost-effectiveness for programs with ecological effects.

A member asked for more information about the Council's recommendation to explore the concept of the "value of a statistical ecosystem." Mr. DeMocker responded that he does not understand the concept yet, but understands the general idea as an effort to capture the total resource pool that is at risk. The Agency intends to pursue a literature review as vigorous as that previously conducted for human mortality to see what could be adopted.

Another member reflected that there may be uses of the 812 Study where ecological values might have greater importance. One might consider whether the Clean Air Act is adequate or should be strengthened. Or the analysis might be used for another specific policy analysis.

He then asked about the criteria used to determine whether data or methods "past muster" and should be included in the 812 Study. Mr. DeMocker responded that the Agency must determine whether the data and methods are sufficiently valid and reliable to include in the primary analysis. The Agency relies primarily on models and data which have been peer-reviewed or published in peer-reviewed journals. In the case of the First Prospective Study, the Agency followed Council advice as to the data and methods to include. The Committee member then asked whether there is a clear threshold for reliability. Mr. DeMocker responded that the Agency considers any proposed data or method within the context of the overall assessment. If the assessment were to include numbers without credibility, then the integrity and legitimacy of the primary analysis would be questioned. Another Committee member then asked whether there was a spatial dimension or requirement to use concentration response functions. Mr. DeMocker responded that the Agency does not have "hard and fast criteria" for what is included in the analysis.

A Committee member currently serving on the Council identified two major dimensions of the Council's advice in 2001 regarding ecological benefits. One dimension of the discussion were the links connecting ambient air pollution, observed and measurable ecological responses, and changes in services. Another dimension was the suggested use of Bob Costanza's unit value as a placeholder, without discussion of how those links were to be made. He reiterated that the current Council is developing advice that recommends a "Learning Laboratory" and its relevance to developing methods for use in the 812 analysis.

A Committee member then asked Mr. DeMocker to confirm that the peer review regime for the 812 Study differs from requirements for the CAFO benefits analysis. Mr. DeMocker confirmed the difference.

Another Committee member asked Mr. DeMocker whether he was familiar with the Millennium Assessment, which might serve well as a s recent review of relevant literature.

The member also addressed the issue of "data quality" and the threshold for using data. He noted that there was a spectrum of data quality you could bring to any estimate and that it may be preferable to rank data quality, rather than set a threshold for what was "in or out." He offered to provide a paper on this aspect of data quality to the Committee and to Mr. DeMocker.

Mr. DeMocker then commented that OAR used approached data quality and uncertainty in the First Prospective Study in three ways. It provided the uncertainty tables; conducted sensitivity analyses on key variables and assumptions, and conducted several formal uncertainty analyses. OAR had considered a variety of ways to communicate uncertainty, some including color coding and arraying data in different

ways, but did not come up with a satisfactory strategy. He noted that discussion of data for the future must take into account OMB's new data quality guidelines, which are being interpreted and implemented.

Dr. Nugent stated that she would send Committee members a copy of the Council's 2001 advisory report on the Agency's plans at that time for a Second 812 Analysis and highlight the parts that addressed ecological benefits.

Opportunity for Audience Input

Dr. Bruce Hull from Virginia Tech provided a brief oral comment. He introduced himself as a professional who works with land owners, community members, and environmental managers. He made 5 points to the Committee: 1) he asked the Committee to remember that its charge called for advice on valuing ecological systems and services, and that some "values" like the flag, biodiversity, protecting nature are hard to assess and yet are part of public discourse and should be kept on the table; 2) he emphasized the importance of ecosystem value in affecting identities and the "qualities of place "that make communities thrive; they have real impacts, even though such values are difficult to assess in economic terms; 3) he urged the Committee to deal with the issue of uncertainty surrounding ecological assessments; 4) he urged the Committee to ensure that communications about uncertainty, especially in the context of valuing future conditions, be part of communications with the public; and 5) he asked the Committee not to consider the issue in purely "rationalistic," terms; he asked the Committee to consider collaborative processes to get communities involved in ways in which many values emerge.

The Committee adjourned for lunch at 12:15 pm and returned at 1:15 pm

Presentation on the Global Unified Metamodel of the Biosphere (GUMBO) and Committee Discussion

Dr. Robert Costanza, Committee Member, gave an overview of GUMBO, an integrated dynamic ecological economic model. He introduced it by identifying the following features desired for integrated modeling: 1) use as a consensus building tool in an open, participatory process; 2) operate at multiple-scales; 3) acknowledges uncertainty and limited predictability; 4) acknowledges values of stakeholders; and 5) simplify by maintaining linkages and synthesizing; and 6) adopt an evolutionary approach acknowledges history, limited optimization, and the co-evolution of humans and the rest of nature

Before he described the GUMBO model, he distributed a publication , *Integrated Ecological Economic Modeling of the Patuxent River Watershed, Maryland* (Costanza,

Robert et al., 2002. Ecological Monographs, Vol 72 pp. 203-231) to the Committee as an example of an integrated modeling effort at a much smaller scale.

The GUMBO model incorporates information from a variety of spatial scales (modules, site/patch unit modules, small watersheds, large watersheds, and global) and integrates natural capital, built capital, human capital and social capital.) The model inter-relates natural capital with human-made capital and aims to provide a "full world" model of the ecological economic system. Dr. Costanza showed how the model could provide information related to a range of goals for national accounting, which he placed into a matrix showing their frameworks, measures, and valuation methods. He illustrated the types of Indices of Sustainable Economic Welfare that could be derived with the model and how they were plotted over time. He noted that these indices include categories of welfare not usually captured in the Gross National Product.

He concluded by remarking that the efforts summarized represent a first cut at this highly integrated model, which represents a synthesis and a simplification of several existing dynamic global models in both the natural and social sciences at an intermediate level of complexity. The model could be used to look at range of future scenarios about future technological change, investment strategies, and other factors. It could be used could be used for addressing global sustainability, for considering the overall value of ecosystem services, or alternative future strategies to inform decision making.

The Committee then began a general discussion of the model and information presented. One member noted that the model represents a "great step forward" and promises to be very valuable. She asked about plans for its future use. Dr. Costanza responded that plans include expanding the circle of stakeholders who participate and it use it as part of whole global change process.

Another member noted that the "anthroposhere" was less differentiated than aspects of the non-human world. He asked whether there were plans to separate the anthroposphere for future analysis. Dr. Costanza replied that many different strategies are available. The model could be made more spatially explicit and operate at a country scale. It could also be agent based. Committee members noted that it would be interesting to show populations and their relative demands on the planets. Dr. Costanza noted that there is a plan for applications of the model in the Amazon and in Baltimore.

Another member noted whether the Patuxent analysis Dr. Costanza distributed might have been also useful for the Committee to discuss because it focuses on the issue of how analyses can relate to the local scale at a spatially explicit way.

A member asked about how the model accommodated uncertainty, and took as an example assumptions about likely increases in temperatures. Dr. Costanza replied that the model used assumptions held by most scientists. In response to a follow-up question

about how dissenting views were represented, Dr. Costanza replied that a dissenting view could be tested for its full model implications. He noted that to test whether assumptions are realistic, modelers ask "how much would you have to change other assumptions to make the model work?" if the assumption in question were true.

Another member provided several comments. She expressed appreciation for the complexity of the model and noted the importance of identifying the optimal level of resolution for the question at hand. She wondered how the model addressed technological change and asked if communications capital might take on more important role. She suggested that the modelers consider ways to make the output from the model more dynamic and exciting.

Yet another member asked Dr. Costanza to comment on how the unit values not used in the Agency's First Prospective 812 Study as placeholder values could be used Dr. Costanza responded that there seemed to be a relatively arbitrary cut-off point for inclusion of data or information. In his view, the cut off depends on goals of analysis. He noted that a Committee member earlier remarked that it was a mistake to exclude place-holder numbers (i.e., to set the cut-off threshold high) if you want to put the issue of ecological benefits on the table. He stated that there are ways to show "how good" any estimate is for a given purpose. There are techniques for communicating uncertainty and grading data.

In a follow-up question, another Member asked whether Dr. Costanza could suggest some ideas, either with the GUMBO model or the Nature publication or another model, to bridge the aggregation of services described there to the specific question of ecological services linked to the Clean Air Act.

Dr. Costanza responded two issues were distinct and problematic: 1) the impacts of changes in the Clean Air Act on services and 2) the value of services. He considered the first issue more problematic. He believed he could do some estimates "that wouldn't be quite good but could establish a range on forest health broadly defined." New data are coming out on these issues (e.g., fish populations, forest productivity). In his view, the limiting factor is how to communicate the quality of the assessment in ways. He expressed the importance of the Agency not pretending any analysis is "more rigorous than it is" In general, he suggested that EPA put more of its analyses on the table and still be honest about data quality.

General Discussion

Dr. Grasso began the general discussion by informing the Committee that the Steering Group planned to meet on May 3, 2004 to plan the June 13-15, 2004 meeting and to continue overall project planning. He reminded the Committee members that they had heard information about Agency needs at the October 2003 workshop. Dr. Grasso

noted that the June meeting was likely to include a request from the Agency for review of its draft Strategic Plan for Ecological Benefits. This document should contain additional information about the current state of practice within EPA regarding benefit assessment and efforts to value the protection of ecological systems and services.

Dr. Grasso then asked each member to identify briefly their thoughts about cross-cutting issues and suggested next steps for the committee. The ideas provided are listed below.

- Identify the most important criteria for valuing whether an approach is effective.
- Think through contexts appropriate for different approaches.
- Look at important differences between different approaches: stakeholders, public, experts; monetization vs. comparison. "Break down" approaches for efficacy in different contexts.
- Map approaches to different contexts.
- Keep in mind constraints for EPA.
- Examine the standards for acceptability of data and methods. Regulatory needs set high standards -- there are other areas where we don't have legal standards.
- Look at ways to characterize quality of data used.
- Presentation and communication of information so the quality of data is communicated and best use is made of data.
- Look at uncertainty.
- Question institutional assumptions; provide advice about what should be taken as baseline.
- Look at role of how valuation is done-- that the process of valuation may have important process benefits, as well as substantive benefits.

- Take actions/be innovative to get ecological benefits on table.

- Increase the set of effects that can be monetized.

- Refine Committee's charge so it is clearer. Is the Committee's mission defining research and development needs or identifying what to do with existing resources.
- Make recommendations that make sense within resource limitations.

- Committee should learn from the risk wars.
- Committee should look at alternative approaches -- learn from nature writers.

- In examining different approaches, evaluate ethical presuppositions behind these methods.

- Link optimal methods with decision paths.
- Classify how much each method tilts in terms of nature and classifying nature.

- Address the issue of burden of proof for establishing ecological benefits and who bears Address issue of data quality and uncertainty.
- Take a pluralistic approach-- no one right way -- Look at what are possibilities.

- Consider science-based alternatives to monetization. If there be important biological or social effects that can't be monetized because of hurdles associated with a particular context (e.g., 812 analysis) -- present them in their own terms. Find useful information to be presented as a companion analysis.
- Use a time scale for segmenting different parts of the Committee's report/charge
    - identification of suggested changes to be implemented now
    - things that could be developed in short term;
    - identify most important priorities for research in long term

- Take some risks and do something EPA cannot. Pick 2 examples (e.g., local water issue and national issue like component of Clean Air Act) and work them intensively. A Subgroup might work it intensively, and have whole committee critique it. Use that experience as a vehicle to expose "what we need to know."

- Find ways to encourage inter-disciplinary interactions for decision making.
- Focus on criteria for including information of various qualities. How to balance credibility needs vs. need to put information about ecological effects on table.
- Consider role of valuation in agenda setting.

- Sees Committee wavering on items below and seeks more clarity about what the Committee's charge/focus is:
    - wavering between economic approach with measurable, quantifiable criteria in terms of dollars vs. ecological impacts without dollars and cents.
    - wavering between providing analytical tools vs. identifying basic recent needs
    - wavering between anthropocentric and biocentric uses, if and how to put both on the table
    - Specific needs of Agency vs. philosophical discussions.
- Wants tools to help Agency to meet specific needs. Could look at cases, really classifying different needs and doing best job we can to id tools and research needed to fully addressed them.
- Need to identify ecosystems and scales appropriate for addressing certain issues.
- Needs to help Agency identify baseline conditions.

- Wants Committee to define more clearly ecosystem values, ecosystem benefits. Some efforts to quantify benefits to human health and welfare identify links to human welfare. Some values don't relate directly to human health and welfare, seemingly. Need to address these issues explicitly.
- Decision making criteria -- what are deeper norms -- for ecologist and economist.
- Don't divert from finding practical recommendations, but identify these deeper norms
- Ask what's the goal -- the typical drive is to identify all the relevant outcomes, to find an algorithm. Other approaches might limit what we measure...take a more considered approach.
- Notes that we're spending a colossal amount of time avoiding judgments and deliberations.

- Committee should recommend that EPA has basic research program in ecological economics. provide draft language for an RFP. EPA should take responsibility that knowledge they want to draw from should exist.
- Tools transfer -- have workshop like format-- similar to idea of learning lab where people

could come and interact, where tools would be developed. Like a master class in music.

- Sees two thrusts -- research and master classes and tools

- Where is the Committee at?...struck by how much we can agree on:
    - source of values differ (some utilitarian, some not) and we see them all as legitimate
    - no one tool can capture them all; many different kinds of tools needed
    - use of tools differs according to context
    - useful to map tools to sources of value and to context
- Where do we go from here? Need to move forward to address cross cutting issues and what to do about them.

- Need for a plan, need to focus on decisions agency needs to make:
- Sees basic types of contexts:
    - has an existing law provided adequate benefits
    - will a future law provide adequate benefit
    - in applying regulations to local decisions -- community based enforcements, choosing engineering options -- are they maximizing dollars for environmental performance
- We should ask:
    - Can we help Agency make better decisions today?
    - Can we help Agency make better decisions tomorrow?
- Agency as a mindset driven by risk. A bridge needs to be made between toxicological risk assessment and how it translate (or doesn't translate) to ecological benefits
- Concerned about calling for methods in advance of the science. Are there antecedents for better data quality/quick/cheap. For example, it is difficult to come up with value of statistical ecosystem.

The Chair asked Committee members to identify whether additional examples of methods should be brought before the Committee in its next meeting. Members suggested examining explicit comparisons of attitudes and willingness to pay and examination of a constructed value approach. Another member suggested comparing group vs. individual valuation also useful, along with constructed preference. Yet another member suggested focusing on traditionally used methods, such as hedonic pricing and travel costs, because those methods, like all methods, have limitations too. He also suggested looking at methods that focus on providing individuals with information that would help them perceive how ecological values are supportive of human welfare. He expressed interest in the Committee's examining how to deal with people not having perfect information.

Summary of Next Steps

Dr. Grasso thanked members for their participation. Dr. Nugent informed Committee members that the SAB Staff Office was planning to host the September 2004 Committee meeting in San Francisco.

The Workshop adjourned at 3:15 p.m.

Respectfully Submitted:

/s/

Angela Nugent
Designated Federal Officer

Certified as True:

/s/

Domenico Grasso
Chair

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by the Committee members during the course of deliberations within the meeting. Such ideas, suggestions, and deliberations do not necessarily reflect definitive consensus advice from the panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters, or reports prepared and transmitted to the EPA Administrator following the public meetings.

Attachments

Attachment A: Roster

Attachment B: Federal Register Notice

Attachment C: Workshop Agenda

Attachment D: Rubric

Attachment A: Roster

U.S. Environmental Protection Agency
Science Advisory Board
Committee on Valuing the Protection of Ecological Systems and Services

CHAIR

Dr. Domenico Grasso, Rosemary Bradford Hewlett Professor and Chair, Picker Engineering Program, Smith College, Northampton, MA
Also Member: Executive Committee
Environmental Engineering Committee

SAB MEMBERS

Dr. William Louis Ascher, Dean of the Faculty, Bauer Center, Claremont McKenna College, Claremont, CA

Dr. Gregory Biddinger, Environmental Sciences Advisor, Exxon Mobil Refining and Supply Company, Fairfax, VA
Also Member: Ecological Processes and Effects Committee

Dr. Ann Bostrom, Associate Professor, School of Public Policy, Georgia Institute of Technology, Atlanta, GA

Dr. James Boyd, Senior Fellow, Director, Energy & Natural Resources Division, Resources for the Future, Washington, DC

Dr. Robert Costanza, Professor/Director, Gund Institute for Ecological Economics, School of Natural Resources, University of Vermont, Burlington, VT

Dr. Terry Daniel, Professor of Psychology and Natural Resources, Department of Psychology, Environmental Perception Laboratory, University of Arizona, Tucson, AZ

Dr. A. Myrick Freeman, Research Professor of Economics, Department of Economics, Bowdoin College, Brunswick, ME

Dr. Dennis Grossman, Vice President for Science, Science Division, NatureServe, Arlington, VA

Dr. Geoffrey Heal, Paul Garrett Professor of Public Policy and Business Responsibility , Columbia Business School, Columbia University, New York, NY

Dr. Robert Huggett, Vice President for Research and Graduate Studies, Office of Vice President for Research and Graduate Studies, Michigan State University, East Lansing, MI

Dr. Klaus Lackner, Ewing Worzel Professor of Geophysics, Earth and Environmental Engineering, Columbia University, New York, NY

Dr. Douglas E. MacLean, Professor, Department of Philosophy, University of North Carolina, Chapel Hill, NC

Dr. Harold Mooney, Paul S. Achilles Professor of Environmental Biology, Department of Biological Sciences, Stanford University, Stanford, CA

Dr. Louis F. Pitelka, Director and Professor, Appalachian Laboratory, University of Maryland Center for Environmental Science, Frostburg, MD

Dr. Stephen Polasky, Fesler-Lampert Professor of Ecological/Environmental Economics, Department of Applied Economics, University of Minnesota, St. Paul, MN
Also Member: Environmental Economics Advisory Committee

Dr. Paul G . Risser, Chancellor, Oklahoma State Regents for Higher Education, Oklahoma City, OK

Dr. Holmes Rolston, University Distinguished Professor, Department of Philosophy, Colorado State University, Fort Collins, CO

Dr. Joan Roughgarden, Professor, Biological Sciences and Evolutionary Biology , Stanford University, Stanford, CA

Dr. Mark Sagoff, Senior Research Scholar, Institute for Philosophy and Public Policy, School of Public Affairs, University of Maryland, College Park, MD

Dr. Kathleen Segerson, Professor, Department of Economics, University of Connecticut, Storrs, CT
Also Member: Environmental Economics Advisory Committee

Dr. Paul Slovic, Professor, Department of Psychology, Decision Research, Eugene, OR

Dr. V. Kerry Smith, University Distinguished Professor, Department of Agricultural and Resource Economics, College of Agriculture and Life Sciences, North Carolina State University, Raleigh, NC

Also Member: Advisory Council on Clean Air Compliance Analysis

Dr. Robert Stavins, Albert Pratt Professor of Business and Government, Environment and Natural Resources Program, John F. Kennedy School of Government, Harvard University, Cambridge, MA

Also Member: Environmental Economics Advisory Committee

Dr. Valerie Thomas, Research Scientist, Princeton Environmental Institute, Princeton University, Princeton, NJ

Also Member: Environmental Engineering Committee

Dr. Barton H. (Buzz) Thompson, Jr., Robert E. Paradise Professor of Natural Resources Law and Vice Dean , Stanford Law School, Stanford University, Stanford, CA

SCIENCE ADVISORY BOARD STAFF

Dr. Angela Nugent, Designated Federal Officer, 1200 Pennsylvania Avenue, NW, Washington, DC, Phone: 202-202-343-9981 (nugent.angela@epa.gov)

Attachment B: Federal Register Notice

Science Advisory Board Staff Office; Notification of Upcoming Science Advisory Board Meetings

[Federal Register: March 24, 2004 (Volume 69, Number 57)]
[Notices]
[Page 13829-13831]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr24mr04-48]

ENVIRONMENTAL PROTECTION AGENCY
[FRL-7639-6]

Science Advisory Board Staff Office; Notification of Upcoming Science Advisory Board Meetings

AGENCY: Environmental Protection Agency (EPA).
ACTION: Notice.

SUMMARY: The EPA Science Advisory Board (SAB) Staff Office announces two public teleconference call meetings and one public face-to-face meeting of the SAB's Drinking Water Committee (DWC). The DWC will review the Agency's Drinking Water Research Program Multi-Year Plan.

The SAB Staff Office also announces a public workshop of the SAB Committee on Valuing the Protection of Ecological Systems and Services. The workshop will focus on different approaches and methods for valuing the protection of ecological systems and services.

DATES: April 5, 2004. A public teleconference call meeting of the Drinking Water Committee (DWC) will be held from 1 p.m. to 3 p.m. (eastern time). The purpose of this call is to provide the DWC with an overview of the EPA Drinking Water Research Program Multi-Year Plan and its regulatory context (focus is on EPA Long-Term Goal #1--Research on Regulated Contaminants)

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April 8, 2004. A public teleconference call meeting of the Drinking Water Committee (DWC) will be held from 1 p.m. to 3 p.m. (eastern time). The purpose of this call is to continue the overview of the EPA Drinking Water Research Program Multi-Year Plan and its regulatory context (focus is on Long-Term Goal #2--Research on Unregulated Contaminants and Innovative Approaches; and Long-Term Goal #3--Research on Distribution Systems and Source Water Protection).

April 13-14, 2004. A public workshop of the SAB Committee on Valuing the Protection of Ecological Systems and Services will be held from 9 a.m. to 5:30 p.m (eastern time) on April 13, 2004, and from 8:30 a.m. to 4 p.m. (eastern time) on April 14, 2004.

May 24-25, 2004. A public meeting of the Drinking Water Committee (DWC) to Review the EPA Drinking Water Research Program Multi-Year Plan. The meeting will begin at 8:30 a.m. and end no later than 5 p.m. (eastern time) each day.

ADDRESSES: Participation in the DWC teleconference meetings will be by teleconference only--a meeting room will not be used. The May 24-25, 2004 meeting of the DWC will be held in the Auditorium (Room C111C), U.S. EPA, Main Campus, 109 T.W. Alexander Drive, Research Triangle Park, NC 27709. The April 13-14, 2004 workshop of the Committee on Valuing the Protection of Ecological Systems and Services will be held at the Four Points Sheraton, 1201 K Street NW., Washington, DC 20005.

FOR FURTHER INFORMATION CONTACT: Members of the public who wish to obtain the call-in number and access code to participate in the DWC teleconference meetings may contact the EPA Science Advisory Board Staff at (202) 343-9999 by Friday, April 2, 2004, before the conference calls. Any member of the public wishing further information regarding the SAB or the DWC may contact Mr. A. Robert Flaak, Designated Federal Officer (DFO), U.S. EPA Science Advisory Board via phone (202-343-9988) or e-mail at flaak.robert@epa.gov, or Dr. Anthony Maciorowski, Associate Director for Science, U.S. EPA Science Advisory Board via phone (202-343-9983) or e-mail at maciorowski.anthony@epa.gov.

For information regarding the SAB Committee on Valuing the Protection of Ecological Systems and Services please contact Dr. Angela Nugent, DFO for the Committee. Dr. Nugent can be contacted via phone (202-343-9981) or e-mail: nugent.angela@epa.gov.

The SAB Mailing address is: U.S. EPA, Science Advisory Board (1400F), 1200 Pennsylvania Avenue, NW., Washington, DC 20460. General information about the SAB, as well as any updates concerning the meetings announced in this notice, may be found in the SAB Web site at http://www.epa.gov/sab.

SUPPLEMENTARY INFORMATION: Background on the Drinking Water Committee Review: The Safe Drinking Water Act Amendments of 1996 direct EPA to conduct research to strengthen the scientific foundation for standards that limit public exposure to drinking water contaminants. The amendments contain specific requirements for research on waterborne pathogens, such as Cryptosporidium and Norwalk virus; disinfection byproducts; arsenic; and other harmful substances in drinking water. EPA is also directed to conduct studies to identify and characterize population groups, such as children, that may be at greater risk from exposure to contaminants in drinking water than is the general population.

EPA's multi-year plan for drinking water research establishes three long-term goals. Within the scope of this MYP, EPA will: (a) By 2010, develop scientifically sound data and approaches to assess and manage risks to human health posed by exposure to specific regulated waterborne pathogens and chemicals, including those addressed by the Arsenic Microbial/Disinfectant By-Product (M/DBP) Rules and Six-Year Review Rules. (b) By 2010, develop new data, innovative tools and improved technologies to support decision-making by the Office of Water

on the Contaminant Candidate List and other regulatory issues, and implementation of rules by States, local authorities and water utilities. (c) By 2009, provide data, tools and technologies to support management decisions by EPA's Office of Water, State, local authorities and utilities to protect source water and the quality of water in the distribution system.

The DWC received an initial briefing on the DW-MYP at a meeting on December 10, 2003 which was announced in 68 FR 66095, published on November 25, 2003. The meeting agendas and charge to the DWC for this review will be posted on the SAB Web site (http://www.epa.gov/sab) prior to the meetings.

Availability of Review Material for the DWC Meetings: There is only one document that is the subject of the SAB review: EPA's Office of Research and Development's (ORD) Drinking Water Research Program Multi-Year Plan. This document is available electronically at the following URL address: http://www.epa.gov/osp/myp.htm#dw. For information and any questions pertaining to the review document, please contact Dr. Fred Hauchman, EPA-ORD, via telephone: (919) 541-3893; fax: 919-685-3247; or e-mail: hauchman.fred@epa.gov

Background on the SAB Committee on Valuing the Protection of Ecological Systems and Services: Background on the Committee and its charge was provided in 68 FR 11082, published on March 7, 2003. The purpose of the April 13-14, 2004 Workshop is for the Committee to discuss the desired characteristics and desired outcomes of knowledge, methodologies, practice, and research for valuing the protection of ecological systems and services. The Committee will hear presentations from several of its members and from scientists within and outside of the Agency on examples that illustrate the use of different major science-based approaches. The Committee will also discuss suggestions for its next steps in addressing its overall charge to assess Agency needs and the state of the art and science of valuing protection of ecological systems and services, and then to identify key areas for improving knowledge, methodologies, practice, and research. An agenda for the workshop will be posted on the SAB Web site (http://www.epa.gov/sab) prior to the meeting.

Procedures for Providing Public Comment: It is the policy of the EPA Science Advisory Board (SAB) Staff Office to accept written public comments of any length, and to accommodate oral public comments whenever possible. The EPA SAB Staff Office expects that public statements presented at the DWC meetings will not be repetitive of previously submitted oral or written statements. Oral Comments: In general, each individual or group requesting an oral presentation at a face-to-face meeting will be limited to a total time of ten minutes (unless otherwise indicated). For conference call meetings, opportunities for oral comment will usually be limited to no more than three minutes per speaker and no more than fifteen minutes total. Interested parties should contact the Designated Federal Official (DFO) in writing via e-mail at least one week prior to the meeting in order to be placed on the public speaker list for the meeting. Speakers should bring at least 35 copies of their comments and presentation slides for distribution to the participants and public at the meeting. Written Comments: Although written comments are accepted until the

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date of the meeting (unless otherwise stated), written comments should be received in the SAB Staff Office at least one week prior to the meeting date so that the comments may be made available to the committee for their consideration. Comments should be supplied to the appropriate DFO at the address/contact information above in the following formats: one hard copy with original signature, and one electronic copy via e-mail (acceptable file format: Adobe Acrobat, WordPerfect, Word, or Rich Text files (in IBM-PC/Windows 95/98 format). Those providing written comments and who attend the meeting are also asked to bring 35 copies of their comments for public distribution.

Meeting Accommodations: Individuals requiring special accommodation to access these meetings, should contact the relevant DFO at least five business days prior to the meeting so that appropriate arrangements can be made.

Dated: March 18, 2004.

Vanessa T. Vu,

Director, EPA Science Advisory Board Staff Office.

[FR Doc. 04-6568 Filed 3-23-04; 8:45 am]

BILLING CODE 6560-50-P

Attachment C: Agenda
EPA Science Advisory Board
Committee on Valuing the Protection of Ecological Systems and Services
Workshop on Different Approaches and Methods for Valuing the Protection of Ecological Systems and Services
April 13-14, 2004
Four Points Sheraton
1201 K Street, NW
Washington, DC, 20005

Purpose: The purpose of the Workshop is for the Committee to discuss the desired characteristics and desired outcomes of knowledge, methodologies, practice, and research for valuing the protection of ecological systems and services that will help EPA better understand and communicate those values. The Committee will hear presentations from several of its members and from scientists within EPA and outside the Agency on examples that illustrate use of different major science-based approaches and will discuss these examples with presenters. The Committee will also discuss suggestions for its next steps in addressing its overall charge, *to assess Agency needs and the state of the art and science of valuing protection of ecological systems and services, and then to identify key areas for improving knowledge, methodologies, practice, and research.*

Tuesday April 13, 2004

9:00-9:10	Opening of Workshop; Welcome from the SAB Staff Director	Dr. Angela Nugent, Designated Federal Officer Dr. Anthony Maciorowski, Deputy Director for Science, SAB Staff Office
9:10-9:30	Remarks from the Chair and Committee Member Introductions	Dr. Domenico Grasso, Chair Committee Members
9:30-10:15	Presentation of the Channel Island National Marine Sanctuary No-Take Zone Analysis and Committee Discussion *Focus: Ecological analysis supporting a theoretical production function approach*	Dr. Joan Roughgarden, Committee Member
10:15-10:30	Break	
10:30-11:15	Presentation of Mangrove-Fishery Linkages in Thailand Example and Committee Discussion *Focus: Production function approach, collaboration between economists and ecologists in valuation*	Dr. Ivar Strand, Professor Emeritus, University of Maryland
11:15-12:00	General Discussion	Committee
12:00-1:00	Lunch	

1:00-1:40	Presentation of NatureServe Decision Support System in Napa Valley and Committee Discussion *Focus: Geographic Information System identifying ecological significant areas*	Dr. Dennis Grossman, Committee Member
1:40-2:20	Presentation on Coastal Resource Loss in Thailand and Committee Discussion *Focus: systematic assessments of public values of different environmental losses*	Dr. Thomas Brown, USDA Forest Service
2:20-3:00	Presentation of British Columbia Hydro-Power Example *Focus: Group decision processes; decision-aiding concepts*	Dr. Joseph Arvai, Ohio State University
3:00-3:20	Break	
3:20-4:15	Presentation of Clinch River Example and Conceptual Approach from EPA-ORD Report Integrating Ecological risk Assessment and Economic Analysis in Watersheds: A Conceptual Approach and Three Case Studies and Committee Discussion *Focus: Conjoint analysis and proposal for integrating ecological risk assessment and economic analysis*	Dr. Randall Bruins, EPA, Office of Research and Development
4:15-5:00	General Discussion	Committee
5:00-5:15	Discussion of Plans for Second Day	Dr. Domenico Grasso
5:15	Adjourn	

Wednesday, April 14, 2004

8:30-8:35	Workshop Session Begins	Dr. Angela Nugent
8:35-9:30	Presentation of Blackbird Mine Hazardous Waste Site and Great Lakes Dredge and Dock Examples and an Overview of Resource Equivalency/Habitat Equivalency Approach and Committee Discussion *Focus: Habitat and Resource Equivalency Analysis*	Mr. David Chapman, Stratus Consulting
9:30-10:15	Presentation of EPA's Environmental and Economic Benefit Analysis Supporting Regulations Affecting Concentrated Animal Feeding Operations *Focus: Contingent valuation, avoided damage, consumer demand, willingness-to-pay*	Dr. Sharon Hayes Director, Water Policy Staff, EPA Chris Miller, Ph.D., Economist, Office of Water
10:15-10:30	Break	
10:30-11:15	Presentation of Approach To Valuation of Ecological Benefits in EPA's First Prospective 812 Analysis of the Benefits Associated with Implementing the Clean Air Act and Committee Discussion *Focus: Identification of broad range of ecological services and a subset monetized and quantified for valuation.*	Presentation of Approach To Valuation of Ecological Benefits in EPA's First Prospective 812 Analysis of the Benefits Associated with Implementing the Clean Air Act and Committee Discussion
11:30-12:00	Public Comment	To Be Identified
12:00-1:15	Lunch	
1:15-2:00	Presentation on the Global Unified Metamodel of the Biosphere (GUMBO) and Committee Discussion *Focus: Dynamic model that includes ecosystem services*	Dr. Robert Costanza, Committee Member
2:00-2:45	General Discussion	Committee

2:45-3:30	Identification of Additional Examples for Presentation and Discussion by the Committee; Discussion of Next Steps for the Committee's Work	Committee
3:30-3:45	Summary of Next Steps	Dr. Domenico Grasso
3:45	Adjourn	

Attachment D

EPA Managers Views on the Types of Scientific Advice on Valuing the Protection of Ecological Systems and Services that Would be Useful to Their Program

Information Extracted from Presentations Made at the Initial EPA Background Workshop

October 27, 2003

SAB Committee on Valuing the Protection of Ecological Systems and Services

Manager and Program	Comment
Jerri-Anne Garl, Director Region 5, Office of Strategic Environmental Analysis	**Additional Tools and Approaches Needed:** • EPA must support 2002 NCLD data set • Regions developed customized tools but need resources for ground truth/validation • Tools need more widespread use but must also meet EPA core program needs • CrEAM (R5) evaluates landscape health • Synoptic Model (R7) sets priorities to promote wetland health and function • GIS Screening (R6): cumulative impacts **Science Advice Needed:** • EPA needs to value ecological resources for cost/benefit analyses • EPA needs to develop a consistent set of questions to evaluate ecosystem health for use in core program offices. • SAB should monitor and inform all relevant parties on emerging ecosystem assessment work.
Cory W. Berish, Chief Planning and Analysis Branch	**Additional Tools and Approaches Needed:** •SAB Essential Ecological Attribute data layers to enhance the characterization of the landscape and ecosystem services provided. •National Ecological Framework to support regional program decisions with HQs, state and local needs. •Value index of landscape characteristics. •Geospatial tools. **Science Advice Needed:** - Can the Committee provide a fair value for any specified natural area based on the existing land cover characteristics?
Mike Shapiro	**Additional Tools and Approaches Needed:**

Deputy Assistant Administrator for Water	• More and better ecological effects information (e.g. which ecological endpoints are affected by which stressors) • Stronger linkages between ecological effects and economic services/uses that can be valued • Leaner, more flexible biophysical models (e.g. freshwater quality models) • Valuation methods that capture the full scope and magnitude of ecosystem changes • Sound alternatives/supplements to monetization that are scientically supportable **Science Advice Needed:** • In the longer-term, we have already addressed the 'low-hanging fruit' of environmental protection; we're now faced with more complex, costly solutions that need to be supported by better benefits assessments • Recommendations concerning methods, tools or data that help us get to the next level of ecosystem protection are needed
Steven Young, Associate Director, Analysis Division Office of Information Analysis and Access	**Additional Tools and Approaches Needed:** • Make ecological service values visible. • Provide scientifically-credible and easy-to-use capabilities to work with these values. • Support visualization and integration of ecological value information. • Experience with TRI has validated the power of providing relevant information to communities. **Science Advice Needed:** • Consider the roles and potential benefits of effective information management, policies, and technology – identify opportunities. • Be pragmatic in thinking through what should be delivered to decision-makers, especially specific, quantitative indicators.
Rob Brenner Director, Office of Policy Analysis and Review and Deputy Administrator, Office of Air and Radiation	**Additional Tools and Approaches Needed:** ▪ Monetization of ecosystem benefits resulting from reduced air pollution is the approach that gives ecosystem benefits parity with other types of benefit categories ▪ Monetization of ecosystem benefits is currently quite limited for OAR due to a variety of factors including: – Gaps in understanding of ecological impact of air pollution – Inability to measure marginal improvements in ecosystem services – Gaps in systematically linking ecosystem improvements to economic goods and services ▪ Characterization of ecosystem services sold in markets is most feasible currently – e.g., agricultural markets, forestry, commercial fishing ▪ Significant gaps in knowledge of non-market and non-use ecosystem services – Lack of multimedia modeling necessary to quantify improvements in ecosystem service in a regulatory context ▪ Models must be transferable to different regions of the country to obtain nationwide

	assessments ▪ Models must be executed in a limited time and resource framework – Minimal economic valuation literature exists currently… Studies are needed! – Ongoing work to update and enhance methods and approaches for ecosystem benefits ▪ (e.g., nitrogen deposition to US water bodies, forestry species and market approaches) • Although monetization of ecosystem benefits is desired within a benefit/cost framework, quantification of impacts is a reasonable next step ▪ Quantification of air quality changes and air deposition changes are currently available ▪ Quantification of the impact of improvements in air quality and/or air deposition to actual ecosystems is less readily available ▪ e.g., OAR is currently working with OW to better characterize water quality changes associated with reduced nitrogen deposition ▪ Development of multi-attribute ecosystem health indicators and their relation to air pollution would help both in quantification and valuation of air pollution impacts. **Science Advice Needed:** ▪ Some argue we should focus on expanding methods and data for economic valuation through benefit-cost or cost-effectiveness analysis ▪ Others argue economic data and methods will never give full and adequate treatment to important ecological service flows so other, non-economic paradigms are needed to characterize the value of ecological effects ▪ OAR interested in both approaches and in obtaining relevant SAB advice – Continue research in both ecological sciences and economics to bridge gaps in economic analyses of ecological effects – Explore other assessment methods to provide information on ecological effects currently assigned an implicit value of $0 ▪ e.g., "Natural Systems Impact Assessment" ▪ Strategies for facilitating communications across disciplines (e.g., getting ecologists and economists to understand each others needs and limitations).
Jim Jones Director, Office of Pesticide Programs	**Additional Tools and Approaches Needed:** ◆ First, OPP needs to have a more robust ecological assessment tools. ◆ Our assessments often are only able to measure environmental surrogates. To be able to put value on an environmental attribute, one needs to be able to adequately characterize the effects on that attribute.

	◆ In situations where we are able to adequately assess the effects on environmental attributes, we need better tools to: 1. Understand the existence value society places on protecting the attribute and **2.** Understand the range of economic consequence of the ecological risk **Science Advice Needed:** How to measure 1 & 2 above
Robert E. Lee II, Chief Economic and Policy Analysis Branch, Office of Pollution Prevention and Toxics	**Additional Tools and Approaches Needed:** •Smooth linkages between ecological and economic tools •Ability to assess implications of various actions in addition to baseline conditions •Tools that allow timely and inexpensive valuation of ecological services **Scientific Advice on Valuing the Protection of Ecological Systems and Services that Would be Useful to Your Program** •Effects of multi-media exposures to chemicals •Effects of endocrine disruptors •Effects of PBT chemicals such as PFOA, Mercury or Brominated Flame Retardants
Devereaux Barnes, Director, Office of Program Management, Office of Solid Waste and Emergency Response	**Additional Tools and Approaches Needed:** • Encourage the development of tools that assist in the development of ecological risk endpoints that can be quantified and tools for assessing non-monetary benefits. • Encourage the development of tools that assist in the valuation of items such as aesthetics, watershed values, and recreational values. **Science Advice Needed:** • Ecological risk methodologies that link adverse impacts to economic valuation techniques • Approaches for scaling individual/community impacts to larger scales (e.g., habitat and watershed impacts) • Monetization methodologies • Appropriate discount rates • Published reference materials
Geoffrey Anderson, Director,	**Additional Tools and Approaches Needed:**

Development, Community and Environment Division EPA- Office of Policy, Economics, and Innovation	How would knowing the value of an ecosystem service change development decisions, patterns, or practices?

Attachment D

Rubric for Use by Members of the SAB Committee on Valuing the Protection of Ecological Systems and Services During Workshop Showcasing Approaches and Methods for Valuing the Protection of Ecological Systems and Services (April 13-14, 2004 Workshop)

For each example:

A) Choice of Method
   1) Was objective for use of method made clear?
   2) Did choice of method involve comparison with other approaches? Was rationale for choice of method explained?
   3) Why was method selected?

B) Nature of Method
   1) What sources of value does this method capture?
   2) Was method quantitative? What was quantified
   3) How was uncertainty accommodated?
   4) How data intensive is the method?
   5) How available are the data needed?
   6) Was there public participation? To what degree? How?
   7) Was the method reproduced at another time/place? How do results compare?
   8) Was the method peer reviewed?

C) Use of Method
   1) Did implementation of the method meet the original objectives or were the objective modified
   2) How transferable is the method?
   3) What would Committee member do differently in using this method?
   4) What would committee member do differently in meeting the objectives expressed? Would the member use this method?
   5) Was method used in concert with other methods to assess value?
   6) How were results of methods used, if at all?
   7) What were the institutional factors that enabled this method to be used? What factors were impediments to its use?