

Comments from Member of the SAB Committee on Valuing the Protection of Ecological Systems and Services (C-VPESS) for Teleconferences on March 26, 2007 and possible contingency teleconference for March 27, 2008 – (Alphabetical Order)

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Comments from Dr. William Ascher

March 20, 2008

Dear Buzz, Kathleen, and Angela,

Given that the meat regarding the strengths and limitations of specific methods are now migrated to the web (I think that this is regrettable, but I understand it as a reasonable way to address what seemed to be intractable controversy), I have no major substantive problems with what remains in the report. It is well written; the redundancies are far fewer (though “ask the people what is important to them” is an oft-repeated mantra), and the cases are well integrated.

In light of the fact that much of the methodological discussion is moved to the web, I don’t see why the survey appendix should not be as well. If the issue is length, I don’t see why this commissioned work, rather than the committee’s work, should be privileged.

I have some suggested revisions; the non-trivial suggestions are bolded.

Best,

Bill Ascher

p. 4 line 22: Is the reference to “Daily” supposed to be “Herman Daly”? The references between “Cu” and “Daniel” are missing.

p. 4 line 25 delete one of the double commas.

p. 5 lines 12-13: Delete colon; replace semicolons with commas

p. 8 line 16: Add after “well-being: “(which encompasses both physical well-being and psychological gratification”) As it stands, the implication is that only physical well-being is considered.

p. 13, line 8: Saying that constructed values can reflect both self-interest and community-based values” without a parallel statement in the preceding section that (at least some) economic values can also reflect community-based values implies that economic values can only reflect self-interest.

p. 31, lines 4-7: These two tasks seem to be out of order, in relation to the prior statement that finding out what the public regards as important should guide the examination of bio-physical responses, as well as lines 17-18 “a projected bio-physical effect might suggest human-social values that were not initially considered”—implying that the human-social values normally would come first.

p. 37, line 9: Because the conceptual diagram does not enter into policy decisions, it is misleading to say that it is “essentially a decision tool;” it can be said that it is “essentially an orientation tool to help...”

p. 41, line 24: at least one word is missing at the end of the line

p. 46, line 1: “mean” instead of “means”

p. 58, line 6: separate the words “link” and “the”

p. 65, line 6: no need for a reference here.

p. 72, line 18: Change “There are a variety” to “There is a variety”

p. 73, line 2: Word missing between “related” and “ecosystems”; probably “to”

p. 74, line 8: Change “sue” to “use”

p. 78, line 6: delete comma after “including”

p. 78, line 8: Change “pay for houses with...” to “pay for houses or other directly-purchases items with...” This is warranted by the fact that hedonic pricing can be based on prices other than just homes—e.g., one can calculate the value of safety by doing a hedonic analysis on car prices.

P. 90, line 3: “Blackbird” and “Mine” should both be capitalized as proper nouns.

p. 98, line 1: “set of criteria is” rather than “set of criteria are”

p. 99, line 11: There is a variety” rather than “There are a variety”

p. 101, lines 4 and 5: commas instead of semicolons.

p. 104, lines 28 and 29: The sentence is quite redundant with the preceding paragraphs, and can be completely eliminated. The second sentence in the para can be the lead sentence.

p. 110, line 29: Unbold the first word—this bolding is not used for emphasis previously

p.111, line 19: same

p. 111, line 26: “making” instead of “makings”

p. 115, line 12: Sometimes “EPA” is used without the “the”; sometimes it is. This should be consistent.

p. 115, line 22: Replace “careful” with “carefully-assessed”

p. 116, line 7: remove colon

p. 120, line 12: close parenthesis at the end

p. 121, line 19: Change “current” to “currently proposed”

p. 127, line 8: random utility models have been neither defined nor described.

p. 127, lines 25 and 27: Sometimes “meta-analysis” is as one word; sometimes as “meta analysis”. This should be consistent.

p. 130, line 29: Add comma after “estimates”

p. 139, lines 28-29. Because relegating the non-economic methods to a separate section would marginalize them, the sentence should end after “the methods used.”

p. 141, line 12: “making” instead of “makings”

p. 145, line 7: To avoid the impression that this sentence deals only with local rather than state, county, or other sub-national levels, change “local” to sub-national”

p. 149, lines 21-23: delete colon; change semicolons to commas.

p. 153, line 18: “processes” rather than “processe”

p. 153, lines 19-21: remove colon; change semicolons to commas.

- p. 164, lines 3 & 4: commas instead of semicolons.
- p. 166, line 17: “its” instead of “their”
- p. 171, line 13: “characterization” rather than “characterizations”
- p. 186, line 27: “ecosystems” rather than “ecosystem”
- p. 190, line 15: “linkthe” should be “link the”
- p. 190, line 20: “There is” rather than “There are”

Comments from Dr. Ann Bostrom

Insert as a separate section either after 4.2.3 or after 4.2.6. The closing sentence in the third paragraph is taken from page 73, lines 17-10:

Valuation methods assume an informed public or a well functioning market, which in turn assumes informed choices. One structured approach to assessing how informed people are about the consequences of specific decisions and their decision-relevant beliefs is a mental models study. How people understand relevant causal processes - that is, in this case, their mental models of ecological services - can be critical to their judgment of the outcomes and effects of environmental programs, and influence their preferences among alternatives.

Mental models studies for risk communication explicitly compare causal beliefs with formal decision models in a three-pronged research process (Morgan et al, 2002). First is the construction of an expert decision model, generally through systematic, formal decision analysis involving scientists and other topical experts, individually or in groups. Following this is the analysis of semi-structured interviews with individuals from the population of interest, and comparison of these to the decision model. Third is the design and fielding of a survey to test the reliability of findings from the interviews in a representative sample of the population of interest or the public at large. The interviews and surveys employ mixed methods, and assess both how decision makers intuitively structure and conceptualize their environmental mitigation decisions, as well as how they react to structured stimuli and questions.

Mental models research has been used to characterize mental models of hazards underlying a variety of environmental decisions, for example mitigating risks from climate change (Bostrom and Fischhoff, 2001; Bostrom and Lashof, 2007; Bostrom et al., 1994; Böhm and Pfister, 2001; Kempton, 1991, 1997; Lazo et al, 2000; Löfstedt, 1991; Read et al., 1994; Tschakert, 2007). Rigorous qualitative analyses of transcripts from individual narratives or focus groups can also expose subtle differences in individual beliefs and perspectives and the inferential bases of participants’ values.

Studies of mental models can usefully inform the design of concept maps for ecological models underlying valuations, to insure public understanding of endpoints, the design of valuation surveys, and the design of communications about ecological valuation.

Key references:

Bostrom, A., B. Fischhoff, and M.G. Morgan, "Characterizing Mental Models of Hazardous Processes: A Methodology and an Application to Radon," *Journal of Social Issues*, 48, 4: 85-100.

Morgan, M. Granger, Fischhoff, Baruch, Bostrom, Ann, & Atman, Cynthia J. (2002). *Risk communication: A mental models approach*. New York: Cambridge University Press.

Gentner, D., & Whitley, E. W. (1997). Mental models of population growth: A preliminary investigation. In M. Bazerman, D. M. Messick, A. E. Tenbrunsel, & K. Wade-Benzoni (Eds.), *Environment, ethics, and behavior: The psychology of environmental valuation and degradation* (pp. 209-233). San Francisco, CA: New Lexington Press.

Kempton, W. Lay perspectives on global climate change. *Global Environmental Change* Vol 1 (1991), pp. 183–208.

Zaksek, M. and J. L. Arvai (2004) Toward Improved Communication about Wildland Fire: Mental Models Research to Identify Information Needs for Natural Resource Management, *Risk Analysis* 24 (6) , 1503–1514.

Other references:

Bostrom, A. and Fischhoff, B. "Communicating Health Risks of Global Climate Change." In *Research in Social Problems and Public Policy*, special issue, G. Böhm, J. Nerb, T. McDaniels & H. Spada (Eds). *Environmental Risks: Perception, Evaluation, and Management*, 2001.

Bostrom, A. and Lashof, D. (2007). "Weather It's Climate Change (Chapter 1)." In Susanne Moser and Lisa Dilling (Ed.), *Creating a Climate for Change: Communicating Climate Change – Facilitating Social Change*. Cambridge University Press.

A. Bostrom, M Granger Morgan, B Fischhoff and D Read, What do people know about climate change? Part 1 mental models. *Risk Analysis* Vol 14 No 6 (1994), pp. 959–970.

Böhm, G., & Pfister, H.-R. (2001). Mental representation of global environmental risks. In G. Böhm, J. Nerb, T. McDaniels, & H. Spada (Eds.), *Environmental Risks: Perception, Evaluation and Management*. Greenwich, CT: JAI Press.

Lazo, J.K., J.C. Kinnell, T. Bussa, A. Fisher, and N. Collamer. 1999. "Expert and Lay Mental Models of Ecosystems: Inferences for Risk Communication." *Risk: Health, Safety, and the Environment* 10(1):45-64.

Löfstedt, RE. Climate change perceptions and energy use decisions in northern Sweden. *Global Environmental Change* Vol 4 (1991), pp. 321–324.

D Read, A Bostrom, M Granger Morgan, B Fischhoff and T Smuts, What do people know about global climate change? Part 2: Survey studies of educated lay people. *Risk Analysis* Vol 14 No 6 (1994), pp. 971–982.

Petra Tschakert, Views from the vulnerable: Understanding climatic and other stressors in the Sahel. *Global Environmental Change, Volume 17, Issues 3-4, August-October 2007, Pages 381-396*

Other comments on the report:

page 4 line 17 – birds and animals?

Page 5 lines 13-14 edit to read “and on the structure and functions of communities and ecosystems.”

Page 7 line 20: reference the methods appendix here.

Page 10 lines 6-18: This passage does not reflect the extant empirical evidence on how people use the term value and what kinds of values they hold.

Would the committee consider including at least part of this paragraph as a footnote, at least (proposed previously as part of the introduction to the old chapter 4): Various descriptions by sociologists and social psychologists as beliefs, goals, or even cultural imperatives, stable sets of values (e.g., benevolence, self-direction, security, hedonism, and others) have been identified across cultures and over time (Hitlin and Piliavin, 2004). Values have also been described along dimensions such as conservation versus openness to change, and self-enhancement versus self-transcendence (Schwartz, 1994). Values are sometimes conflated with attitudes (which are positive or negative evaluations of an object), traits (which are enduring attributes of personality), norms (which are situation specific) or needs (which are biophysical influences on behavior) (Hitlin and Piliavin, 2004).

Page 11 line 16: the “determined to be important prior to evaluation” is ambiguous and a little problematic. Where does the valuation process start?

Page 11 bottom: Table 1 in the proof that Angela sent around does not reflect the hierarchy shown in the draft, which makes it confusing. (see excerpt here):

Table 1: A Classification of Concepts of Value as Applied to Ecological Systems and Their Services.

Preference-based values
Economic values
Constructed preferences
Community-based values
Attitudes or judgments
Bio-physical values
Bio-ecological values
Energy-based values

Pages 12-13 – it would be helpful if these sections had somewhat more parallel structures. While the section on constructed preferences starts out with assumptions, the section on economic values doesn't. Move lines 10-13 to the beginning of the economic values section, to make it more parallel?

Page 12 line 21: Replace “premise” with “evidence” so that the sentence reads something like:

“In contrast to economic valuation methods which are based on assumptions of rational and stable preferences, values as elicited by those who study constructed preferences are based on substantial evidence that, particularly when faced with unfamiliar choice problems, individuals do not have well-formed preferences and hence values (ADD references back here – eg. Fischhoff, Slovic, Grether and Plott, Lichtenstein and Slovic, etc). “

Page 15 line 25: Any reason not to include a more accessible (eg. recent) reference along with Berelson? Lots are provided in other parts of the report.

Page 16 line 22: replace “must be” with “are”

Page 16 line 27: replace “must be” with “are” and “cannot” with “may not” If references are not provided on page 12, then they should be provided here, to guide those who wish to follow up on this.

Page 25 lines 1-4: shouldn't this list include stakeholder or public involvement early on? (as implied by line 13)

Page 26 lines 22 and 23 – typos

Page 28 line 29: edits surveys to read “surveys or interviews”

Page 28 line 30: delete “small”

Page 30 paragraph starting line 9 – if differences in underlying assumptions controlled and tradeoffs elicited explicitly, then values should in theory be possible to aggregate across methods, no?

Page 30 lines 18-20: This implies that the two are completely separate and distinct, which is not necessarily the case. If an economist and a psychologist both ask someone if they would pay \$10 for a specific environmental improvement, aren't the answers comparable, regardless of their underlying premises?

Page 34 lines 16-22: how else will the early identification occur unless there is early engagement of some sort (even interviewing) with involved or affected parties? Move lines 1-3 on page 35 to the top of the list, to clarify?

Page 39 line 8, should be section 5.3 (not 5.1).

Page 46 line 22 edit "advises" to read "encourages"

Page 52, lines 7-9, this still raises the concern for me that if proxies are used in other ways in the valuation process, they may be misleading.

Page 53 line 24, add here a reference to the Chicago Wilderness report card, which does a similar thing (available at <http://www.chicagowilderness.org/pubprod/index.cfm>). Could even use the Chicago Wilderness report preferentially, since that would help integrate the overall report a little more.

Page 57 line 12 – missing citation?

Page 61 chapter 4 - reference the methods appendix earlier?

Page 65 line 6 – missing/erroneous reference??

Page 66-67 - Would like to see mental models included in this table. Please consider adding the section described at the top of my comments, and adding in a line for mental models research explicitly in Table 2, either under measures of attitudes, (beliefs), preferences and intentions, or under decision science approaches. Measures of beliefs are a critical design tool for the valuation process.

Page 71 line 21 missing year in the reference. Should be 2000.

Page 73 lines 17-19: This is the only place in this chapter where anything much is said about beliefs. I suggest adding in the section proposed above, after this section. Move lines 17-19 to the new section.

Pages 74-75 - R.K. Merton's work on focus groups should be cited here. For example: Merton, R.K., Fiske, M., & Kendall, P.L. (1990). The focused interview: A manual of problems and procedures. (2nd ed.). London: Collier MacMillan.

Page 110 lines 13-16: Not sure these warrant separate lines each. Can you edit lines 12-16 to read: "including: (1) select content that takes into account the reader's prior knowledge; (2) group information in such a way that it facilitates storing that information

in memory hierarchically; (3) state ideas concisely; and (4) cite sources appropriately, and keep information up to date.”

Page 112 line 4 edit “effect” to read “affect”

Page 112-113 (line 31 on 112 through line 6 on page 113): Edit to read: Among the advantages of interactivity are that it supports: active (rather than passive) audience participation; tailoring information for individual users; assisting the assessment process; and visualizing risks under different scenarios (allowing users to ask ‘what if’ questions).

Page 115 lines 12-22: This paragraph is somewhat opaque. I think it was the “however” that threw me off in the opening sentence. It sounds like the committee is trying to distance itself from stakeholder processes, from the tenor of the paragraph as it now reads. How about this rewrite:

“To be effective, deliberative processes involving stakeholders must adequately address and incorporate relevant science, with the requisite financial and staff resources (SAB 2001). In using deliberative processes, EPA should take care to distinguish the use of stakeholder processes as input for valuation from their use as a direct aid to decision making. As noted by the SAB in 2001, stakeholder processes are appropriate as a decision making mechanism per se in only a modest subset of environmental regulatory decisions under select conditions, if at all.”

Page 117 line 22 – delete “Where feasible” ? or replace with “To the extent feasible”

Page 127 – some references still missing on line line 11

Page 129 – reference missing on line 13

Page 130 line 26 still says “CHECK”.

Page 145 and following, on regional decision making:

Page 149 line 27 change “illustrate” to “exemplify”

Page 151 DELETE lines 9-26: Because lines 9-26 are all speculation at this point (none of this came out from our discussions with Chicago Wilderness, to the best of my recollection; the section includes no references) I suggest omitting these two paragraphs. They detract from the lessons to be learned from the Chicago Wilderness. The strongest impression I received from our work on the Chicago Wilderness is that it is a model of the good things partnerships can accomplish. The partnership was heading toward valuation processes at a steady pace, and building up to them through science-based deliberations (just as the SAB 2001 report would endorse, I imagine). Some of the points about the partnership strengths demonstrated by Chicago Wilderness made in previous drafts (e.g., in the Sep 24 draft on page 172, lines 28-31) seem to be

missing from this version, which is perhaps what makes this section stand out more than it did in the previous version (?).

Page 153 line 16-19. Rewrite as “For illustrative purposes, suppose Chicago wilderness wished to characterize impacts on these ecosystem services in McHenry County based on three ecosystem services: minimizing flooding; maintaining or increasing groundwater recharge; and maintaining or increasing wetland communities.”

I don’t see why this section should refer back to deliberative processes in 6.1.3. While the points made here are important, Chicago Wilderness has employed deliberative processes of the sort that could be used as a model for prioritizing ecosystem services, and included such concerns (e.g., the role of wetlands in improving water quality in adjacent open waters” in its Biodiversity Recovery plan (see page 150 line 28-31).

Page 154 lines 18-21, edit to read: “Because it is a well developed partnership, as it moves forward to address valuation, Chicago Wilderness is in a position to demonstrate how open communications and dedication to participative processes can ensure that the results of such analyses reflect the values of the community, informed by the appropriate scientific expertise.”

Page 154 line 32 – sounds like this section (6.2.2.4) used to be in front of the discussion in the previous section regarding what valuation could do for McHenry County. Wasn’t the McHenry county discussion all in a box previously? The section might flow better if it was still in a box, rather than in line in the text.

Page 159 line 22 – missing citations – do you have these Angela? Or do you want help finding them again?

Page 191 lines 3-5 edit slightly to read: The success of ecological valuations depends on how EPA obtains and uses information about public concerns in the valuation process, and how it communicates the resulting ecological valuation information to decision makers and the public.

Page 193 Table 4 column 3, last point, edit to read [or something like this]: “..but should ensure that a summary of uncertainty is given as much prominence as the valuation estimate itself, with careful attention to how recipients are likely to understand the uncertainties. “

Page 193 Table 4 last column 4th point (as suggested above) edit to read: “To the extent feasible..” or “As feasible...”

Page 195 Table 4 4th column last row: should “regional” be “local” ?

Page 195 Table 4 last column 2nd point: Do we want to say follow best practices as discussed in the report? Or refer to the Chicago Wilderness as an example? This last sentence in the 2nd point makes almost it sound like there aren’t any effective stakeholder involvement practices at regional scales now.

Comments from Dr. Robert Costanza

I'm not happy with the general tone and several parts of the "Conceptual Framework" section. It seems to deviate quite heavily from the last draft I saw. Here we are at the end of the process, and we still have not ironed out some basic conceptual issues that should have been agreed to early on. Here's just one, (but a key) recurring one: does an ecosystem service only have value when individuals perceive it to have value? Or do we take a broader conception of value as a "contribution to human well-being" whether individuals perceive it or not? The current document is not clear on this point, but leans heavily toward the former. If a tree falls in the forest and nobody hears it, does it make a sound? The answer to this depends totally on how one defines "sound." If it's defined as the perception of sound by a human ear, then obviously no, if it's defined as a biophysical phenomenon resulting in the patterned movement of air, which may or may not be perceived by anyone, then obviously yes. Likewise, how we define value colors the whole discussion in the rest of the document. The current draft leans very far toward the "sound is perception" side of the spectrum. I personally lean much more toward the "sound is a biophysical phenomenon" side of the spectrum and am not comfortable with the "sound is perception" definition. For example, pg 10, lines 6-9: "People assign or hold all values" and the following discussion imply that without perception there is no value. Pg. 15, lines 14-25 gets close to the nub when it states that "Although valuation should be informed by the best available science, it ultimately seeks to reflect the values that would be held by a fully informed general public, not merely the personal values or preferences of scientists or experts." But what values would be held by a fully informed general public? Would not a good approximation be the values held by the most fully informed of the current public, i.e. the scientists that know what is going on with these systems and services? How else would we estimate the values that would be held by a fully informed general public? We could, of course fully inform the general public through education and outreach – a valid goal, but that seems a very expensive and long term effort. And would not the end product of this effort be the communication and recognition of the information held by the scientists to the general public anyway? The underlying message in the current draft is: no perception, no value. The entire document is colored by this definition and I don't agree with it. There are many other issues in the conceptual framework part of the document, but I'm really done with this

Comments from Dr. Terry Daniel

Comments on C-VPES Draft 3-11-08

Terry Daniel

First, the compilers/editors have done a great job of pulling together a coherent document out of many pieces and parts created over the years of work by the members of the committee. Many of the sections have been revised and redirected so often that it is a wonder that there was any comprehensible text left for the editors to use. I am a bit

ambivalent about the need for an executive summary, but I suspect that some summary or overview will be hard to avoid for a report of approximately 200 pages.

Tone

The overall tone of the report seems appropriate, and successfully advocates for multiple value and multiple methods without appearing to be overly critical of any particular method (old or new). Overall the report comes off as professional and objective and as well-intended to help improve EPA policy and decision making regarding protection of ecosystems and services.

Major messages and recommendations

The case for an “expanded and integrated approach to ecological valuation” is well made. The description of what the committee sees as needed to accomplish this new approach is laid out clearly. The specific components of the expanded approach, the broader set of values to be included and the broader set of evaluation methods required to address them are described well enough at a general level. There may be some readers who are disappointed that there is not a more detailed presentation and even a step-by-step recipe for application of some of the methods. But the committee was correct in deciding against attempting such a “methods manual” approach, and the report is clear that this was not our intent.

There are numerous recommendations that EPA increase staff, add steps and components to their analysis and decision making processes, and extend research efforts. All of these have merit, but it seems unlikely all can be accomplishable in the face of current and foreseeable budget limitations. It is appropriate for the committee to point out all of these needs, and we should do what we can to urge and to provide support for the agency’s efforts to secure the resources necessary to achieve effective protection of ecosystems and services. As we have often discussed, it would be helpful if we could more clearly prioritize the recommendations that require new resources, or the reallocation of current resources, to help the agency make the difficult tradeoffs that are implied. Our previous efforts suggest that this may be a daunting and even contentious task (and it is understandable that our fearless leaders may not now have the stomach for it). However, if we were only able to reach consensus on the (2 or 3) “most urgent” needs it might be of greater use to the agency, and it might help to avoid having all recommendations homogeneously tossed into the “too hard” box. Perhaps we could pull out a list of the recommendations that clearly require adding (or substantially reallocating) resources such as personnel (e.g., expertise in ecological production function modeling, social science and economics, deliberative decision making processes, stakeholder involvement, communication, uncertainty analysis, ...), analysis and decision support activities (e.g., initial conceptual models, citizen involvement, measures and models of value-relevant ecosystems services, alternative valuation methods, refined and validated benefits transfer methods, ...) and research (e.g., develop needed ecological production function models, key indicators, web-based databases, documentation/publication of analyses/studies, ...). We might be able to come to some consensus of priorities within each category. In addition (or perhaps instead) we might also wish to highlight recommendations that do not necessarily require additional resources, but can be

achieved by doing current activities differently or by shifting emphases from one activity to another.

Major errors of fact or interpretation

There is not likely to be universal agreement among scientists, analysts and decision makers about many of the changes that we have recommended. There is controversy within the committee about what “values” need to be assessed and about what methods are best to assess them. Evaluating the protection of ecosystems and services is new ground, and we are unlikely to have correctly identified all of the issues and the appropriate approaches for addressing them. There are almost surely “errors” in our report. But we have been reasonably clear and responsible in this regard in the presentation of our analysis of the situation and our recommendations for improving evaluation practice in the Agency.

Organization

The decision to shorten the report by relegating the longer presentations of different approaches/methods to unattached web-accessed appendices seems generally reasonable and appropriate. In that context, however, it is much less clear why the survey methods presentation should remain as an attached appendix. Arguably the often detailed presentation of technical issues for survey research methods is of less direct relevance to EPA administrators and analysts than many of the other methods presentations. It is also not clear that the committee has devoted more time or has more intensively reviewed the survey appendix relative to the other methods sections. Attaching a special appendix on survey methods to the report and leaving discussions of other methods unattached will unavoidably signal a higher priority for (or greater committee commitment to) that method over the others. If that is the intent of the committee we should say so. If it is not, we should explain to readers of the report why this appendix was selected for attachment and the other methods discussions were not.

Whether the survey methods attachment remains attached or joins the other methods presentations in the web-accessed appendix, we need to better link the unattached appendices to the main report. The current reference to them appears in the middle of the report (on pages 62 and 65) and is easily overlooked—certainly neither will be remembered by the time the reader gets to the end of the report. The reference on page 65 describes the unattached methods presentations as having been “supplied by individual committee members” and directs the reader to the web address. The reader is then referred to the survey methods appendix, with no indication why it is attached rather than included on the web along with the others. Should the reader infer that the unattached appendices are not products of the whole committee and the attached appendix is?

None of the short methods presentations (chapter 4) cite or refer to the relevant longer methods appendices, nor is there any general reference to them at the end of the chapter. The introductory page for chapter 6 refers back to chapter 4 and to appendix A (survey methods) “for descriptions of individual methods,” but makes no reference at all to the other, unattached methods presentations. There were no references to the unattached

methods presentations in the discussion of applications to national, regional and site specific cases in chapter 6, nor in the concluding chapter 7.

A straightforward way to handle the appendices is to first separate the survey methods presentation and include it with the other web-accessed appendices. Assuming that the committee wishes readers to find and use the unattached appendices, references should be placed more conspicuously in the body of the report (they could be “hot links” in the electronic/web versions of the report). Additional references to specific relevant methods presentations seem especially appropriate within the respective sections of chapter 4, and at various points in chapter 6. In addition, after chapter 7 in the main body of the report we might have a short (page or two) “overview” of unattached appendices, including a general statement of what they are and how we expect the reader to use them. A very brief description of the contents of each method presentation could be presented. A single link could be provided to the full set of appendices, or there could be individual links taking the reader directly to particular sections. In either event, the first page (index) for the unattached appendices should repeat (perhaps even be a copy of) the overview and individual section descriptions, along with providing separate links to each of the separate presentations.

Some picky bits

P12, L16-19—[If relevant assumptions of economic theory are accepted](#), expressing economic values in monetary terms allows a direct comparison of the values of ecosystem services with the values of other services produced through environmental policy changes (e.g., effects on human health) and with the costs of those policies.

P15, L10-13--Individuals might respond to a survey, [make purchases, or otherwise](#) behave as if they place no value on an ecosystem service if they are ignorant of the role of that service in contributing to their well-being or other goals.

P15, L14—[There may be occasions where assessments of existing, uninformed attitudes and values held by the public are desired, such as for designing communications to improve understanding of ecosystems or services or to solicit public support for specific protection policies. In most cases, however, valuation should seek to measure the values that people hold and would express if they were well informed about the relevant ecological and human well-being factors involved.](#)

P16, L 32+--Requiring these individuals to express such values in monetary equivalents (e.g., in a [Contingent Value](#) survey ...

P28, L29-30--For example, surveys [or small focus groups](#) in which individuals indicate the importance of different environmental and other concerns might provide information ...

P29, L6-7--...Circular A-4 requires that benefits be quantified when they cannot be monetized; [bio-ecological or attitude/judgment-based](#) metrics provide potentially useful forms of quantification...

{to be consistent with the labels used in 2.1.3}

P37, L12-15--Later in the valuation process, EPA will need to use ecological production functions to generate more detailed analyses of key interactions, specific ecological responses to EPA decisions or actions, and resulting consequences to ecosystem services. ~~using ecological production functions.~~

P41, L24--...fairly accurately quantify above-ground carbon stores in various types of ecosystems such as [forests](#)...

P42, L5-6--Characterizing ~~of~~ the ecology of the system • Identifying ~~of~~ the ecosystem services of interest

P51, L11-- ... ~~of~~ measures ..

P52, L1--... not [outputs](#) of direct human importance.

P61, L12-15-- .. monetized [valuations](#) must be based on [appropriate economic](#) methods. [Other](#) valuation methods can still provide useful information in this context, but the role of these methods is limited by the need to follow the guidance in the circular (see section 6.1).

P68, L6-7--... ranked based on individual or aggregate indicators for use in evaluating policy options based on biophysical criteria [previously determined to be relevant to human/social well-being](#).

P69, L11-12--These methods can provide estimates of the [ecological](#) cost of producing a given good or service based on required inputs.

P71, L35-36-- ... of users of a service (e.g., water or recreation) within a given area, and the distance to the nearest vulnerable ([ecological or human?](#)) community.

P73, L29-30-- ... useful in the early stages of designing a survey to elicit value information from a broader [representative](#) sample of the relevant population.

P74-76 citations

Survey questions about ...

Bishop & Rohrmann 2003, move to Behavioral observation section

Gimblett, et al. 2001, move to Behavioral observation section

Wilson 2002, delete (unlikely readers will want to read this whole book, next reference covers it)

Individual narratives ...

Nisbett and Wilson 1977, delete

Behavioral observations

Brandenburg & Carroll 1995, move to Individual narratives section

P89, L 20—The price of **tradable emissions permits** under cap-and-trade systems will almost ...

{Assuming this intended to be a new method, separate from HEA.}

P91, L22--... the economic benefit-cost analysis of the CAFO regulations ~~offer~~.

P99, L9-10--The valuation approach proposed in this report calls for EPA to allow for the use of a broader suite of methods than EPA ...

P102, L13-14-- ... impacts of the relevant Agency decision or action , predicting the effects of these impacts on ecosystem services , and valuing the consequences of these effects.

P107, L1--5.1.4. Communicating uncertainties in ecological valuations

P115, L12-22

{My concern here is that the paragraph comes off as rather damning of “stakeholder processes.” Note that all of the methods we discuss require relevant science, necessary support, financial resources, time, and staff. Special care is certainly needed, but the real issue here is the role of stakeholder processes as input to the decision making process (usually accepted as proper and desirable, if not mandatory for public agencies) versus using stakeholder processes to actually make the decision (not widely accepted as appropriate—by decision makers or by the public). This distinction is not clear in the current text.}

P118

{Is there no conclusion or recommendation from the deliberative processes (5.3) part of this section?}

P133— {Where did we get figure 4? If members of the committee created it, that should be made clear (and they should be applauded). If not, we need to cite the source.}

P136, L2-4--Nonetheless, explicit identification of benefits in categories 2 and 4 can help ensure that non-monetized benefits receive sufficient attention in benefit assessments.

{Category 3 seems useful only to call out the need for additional ecological information. Perhaps the categories should be reordered, swapping places for 3 and 4.}

P138, L21-24--If the change relates to a service that is not important to people, the value of that change (~~i.e.~~, e.g., the willingness to pay for it) would be low regardless of the number of people living in the vicinity.

{ We have agreed elsewhere in the report that w-t-p is a measure of “benefit” rather than “value.” This sentence does raise an interesting question—if an important (negative) ecological change were threatened in an area inhabited by poor people who showed low or no w-t-p to avoid it, would there be any benefit to preventing the change? }

P140, L8-11--By also including key quantified but non-monetized impacts that are measured in biophysical units **or in terms of expressed social importance or attitudes**, along with indicators of economic benefits and a detailed description of the non-quantifiable impacts, the Agency can provide a more accurate and complete indication of total benefits as called for by Circular A-4.

P140, L31--... investments in research **in** at least three areas: ...

P195 , column 4, row 2 : EPA should experiment with a range of valuation methods because **site specific** decision contexts do not prescribe use of economic methods

P201, L16-30

{ An important issue not clearly noted here is that the title of the survey, that named source/investigators, introductions and other “context” information should not bias who decides to participate in the survey, or how participants interpret and answer the questions posed. For example, the same set of questions might attract a different set of participants and a different set of answers when introduced as “the EPA wants to know” versus “the American Petroleum Institute wants to know.” }

Comments from Dr. A. Myrick Freeman

Dear Angela,

I have only read the Conclusions and recommendations sections of each chapter and skimmed parts of Chaps 2-4. So these comments are limited in scope and based on first impressions. Also, I have not had the chance to compare this with earlier drafts to see whether the current draft is consistent with the October draft and the comments that followed.

1. It seems to me that the effort to shorten the Report (and perhaps to reduce the scope for disagreement) has led to a watering down of some important points:

- I don't see any discussion of the difficulties in predicting changes in ecosystem service flows where systems are dynamic and have non-linearities. I remember providing language about this issue.

- I haven't seen an explicit statement that the results of different valuation methods are not comparable and can not be used for validity tests.

2. The point about different valuation methods being based on different premises and measuring different things is made. But it is not reflected in some of the recommendations.

- P. 35, it says: "In the context of national rule making, the Agency should conduct one or two model analyses (perhaps one prospective and one retrospective) of how the use of a wider range of methods might be applied." But if the methods measure different things, what is learned from this? And which other methods do we recommend that EPA try?

- P. 99, it says: "The valuation approach proposed in this report calls for EPA to allow for the use of a broader suite of methods than EPA has typically employed in the past for valuing ecosystems and their services." This implies that the methods are different ways of measuring the same thing. They are not.

- P. 99, line 18: Insert the phrase "the assumptions and value premises on which they are based," in this sentence.

- P. 190, lines 19-29, there should be a conclusion. "Therefore, it is important to recognize that different methods measure different things and might not be additive or comparable.

3. P. 191, line 6 says: "The expanded approach to valuation proposed in this report can and should be applied to national rule making." I can agree with this ONLY if it is limited to referring to the Expanded and Integrated Approach of Figure 1. I don't agree that the different _methods_ should be applied And by the way, this is a recommendation more than a finding.

I have to leave for the airport now. I'll take the report with me. But I will be out of touch (no internet access) until my return late on the 24th.

Best, Rick

Comments from Dr. Louis Pitelka

Comments on final draft from Lou Pitelka

Page 40, lines 18-20. I hate to bring this up but... The definition of an ecological production function has been a subject of some discussion in the past, and I agreed to the current definition/use. However, to say that "the relationships between ecological inputs and outputs" is the same as "between the structure and function of ecosystems and the provision of ecosystem services" is problematic because ecologists would rarely if ever define ecological inputs as the structure and function of ecosystems. Ecological inputs would be sunlight, precipitation, atmospheric deposition, pollution inputs, human

disturbance, etc. These inputs in turn determine ecosystem structure and function, and changes in the inputs alter structure and function. Going back to the analogy with economics, the more conventional definition of inputs seems to correspond with the economic inputs. The equivalent of ecosystem structure and function would be the economic system that exists in an area, not the inputs that support it.

I believe fixing this should be easy. NOTE that on page 59, line 4, the text uses “ecological responses”, not “ecological inputs”.

It does not matter to me how we define ecological production functions – as either steps 1, 2, and 3 from a half page up, or just steps 2 and 3 as we settled on, but the explanation should make sense in terms of conventional ecological use of terms. Perhaps the economic analogy is not helpful and the use of the term “ecological inputs” should be avoided.

Page 41, line 24. I think the word “forests” is missing from the end of the line.

Page 43, Figure 3. The bottom oval on the left should be “Global level”. “Global-change” is an apple. “Individual level”, “population dynamic” (level), “community level”, and “ecosystem” (level) are oranges.

Page 51, line 21. This subtitle is potentially confusing. It sounds like it is saying “Mapping the responses of ecosystems to ecosystem services” which is the opposite of what it means. Perhaps the subtitle should be “Mapping from ecosystem response to changes in ecosystem services”.

Page 52, line 15. Here again the word “inputs” seems to be used inappropriately. Given our definition of ecological production functions as steps 2 and 3 from the top of page 40), this should be “Indicators”, as the term is used here, are measures of key ecosystem properties whose changes...” The indicators that have been identified by the NRC and the Heinz Foundation are ecosystem properties, not ecological inputs. NOTE that on page 59, line 4, the text uses “ecological responses”, not “ecological inputs”. Ecological responses are changes in ecological properties.

Page 57, line 12. I am responsible for this statement but am not sure of a suitable reference. I know that the EPA STAR program has funded such work.

Comments from Dr. Joan Roughgarden

Dear Angela,

I immediately noticed that the reference citations to me have some errors (p 244, lines 20-30). They should read:

1995, Roughgarden, J., Can economics protect biodiversity? Pp. 149-156 in:

T. Swanson, Ed., *The economics and ecology of biodiversity decline*.
Cambridge University Press.

1995, Brown, G. and J. Roughgarden, *An ecological economy: notes on harvest and growth*. In Perrings, C., K.G. Maler, C. Folke, C.S. Holling and B.O. Jansson (Eds.), *Biodiversity Loss: Ecological and Economic Issues*, Cambridge, Cambridge University Press, pp. 150-189. (Reprinted in: J. Barkley Rosser, Jr., 2004. *Complexity in Economics, Volume III. The International Library of Critical Writings in Economics 174*. Edward Elgar, Cheltenham, UK, pp. 383-423.)

1996, Roughgarden, J. and F. Smith, *Why fisheries collapse and what to do about it*. *Proc. Nat. Acad. Sci., (USA)*, 93:5078-5083

1997, Brown, G. and J. Roughgarden, *A metapopulation model with private property and a common pool*. *Ecological Economics*, 22:65-71.

1998, Roughgarden, J., *Primer of Ecological Theory*. Prentice Hall, Upper Saddle River, New Jersey. 450 pp., illustr.

1998, Roughgarden, J., *Production functions from ecological populations: a survey with emphasis on spatially explicit models*. In: Tilman, D. and P. Kareiva, (eds.) *Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions*, Princeton University Press, pp. 296-317.

1998, Roughgarden, J., *How to manage fisheries*. *Ecological Applications*, 8(1):S160-S164.

2001, Roughgarden, J. and P. Armsworth. *Managing ecosystem services*. In: Press, M. N. Huntly, and S. Levin, (eds.) *Ecology: Achievement and Challenge*, Blackwell Science, pp. 337-356.

2001, P. Armsworth and J. Roughgarden. *An invitation to ecological economics*, *Trends in Ecology and Evolution* 16:229-234.

2001, Roughgarden, J. *Guide to diplomatic relations with economists*. *Bull. Ecol. Soc. America* 82:85-88.

2003, Armsworth, P. and J. Roughgarden. *The economic value of ecological stability*. *Proc. Nat. Acad. (USA)* 100:7147-7151.

The reference to these can be added to the appropriate places in the main body of the text too where the existing references are mentioned.

Always something more...

Hope you're well.

Sincerely,
Joan

Comments from Dr. Mark Sagoff

Our C-VPES Report extensively and I think successfully covers conceptual and theoretical issues related to “valuing” ecosystem services. I believe it could be better, though, if it included more specific examples of how the conceptual and theoretical framework could be applied. The report offers as examples of ecosystem services a list of general ideas, e.g., “flood protection, disease regulation, pollination, and the control of diseases, pests, and climate” (p. 4). The CAFO discussion adds the recreational advantages of fishable and swimmable aquatic environments. While it succeeds in invoking these general ideas, the Report could illustrate them and explain how to measure them with more specific examples.

Consider pollination. Is there a naturally-occurring pollinator that has a scarcity value? Are bee-keepers paid as a result of a human-induced pollinator scarcity to provide honeybees as substitutes for a pollinator that nature could or would provide but for some human-caused change such as economic development? Has the production of any crop decreased and its price increased because of the decline in a naturally-occurring pollinator? Is any wild pollinator population that assists agricultural production declining or under threat? We could use the change in crop price – or fees paid to apiarists -- as a measure of the foregone ecosystem service. It is one thing to invoke “pollination” in general as a valuable ecosystem service. It is another to provide even a single example of an actual economic loss or cost associated with the human-induced decline of a pollinator from background or naturally-occurring levels. Even one example of this – an actual or potential loss for a specific crop – would do a lot to show that pollination has an economic value as an ecosystem service that can be measured.

On page 41, the Report says, “Scientists are making rapid progress in understanding and defining ecological production functions for certain ecosystem services. One such service is pollination.” For this it cites “Kremens et al., 2007”; “Greenleaf and Kremens, 2006”; and “Ricketts et al., 2004.” None of these papers appears in the bibliography. No relevant papers by “Kremens” occur in the scientific literature. The Report probably means to refer, first, to Klein et al. 2007.¹ This paper argues essentially that agricultural production is often so intense that it overwhelms the ability of nature to provide

¹ Alexandra-Maria Klein, Bernard E. Vaissière, James H. Cane, Ingolf Steffan-Dewenter, Saul A. Cunningham, Claire Kremen, and Teja Tscharntke, “Importance of pollinators in changing landscapes for world crops,” *Proceedings of The Royal Society B* 274 (1608) (07 February 2007), 303–313.

pollination services – “populations of wild pollinators are frequently too sparse to adequately pollinate crops in agriculturally intensive environments” (at p. 309). If you crowd thousands of nut trees on acre after acre, you cannot expect nature to provide enough pollinators even if the rest of the world were wilderness. In other words, nature fails to provide the service because it could not possibly ever provide it. Managed honeybee populations are therefore used.

Greenleaf and Kremen (2006) do not suggest that wild bees pollinate sunflowers.² In a press release Claire Kremen explained that wild bees cause introduced or managed honeybees to forage farther by scaring them. "Wild bees make the honey bees more skittish so they move more frequently between the different cultivars. Each time they move, they have the possibility of transporting the pollen between the rows." Scaring introduced honeybees can be construed as an “ecosystem service” but this may be as good as it gets.

The third article, Ricketts et al. 2004, argues that even though coffee is self-pollinated, plantations situated near wild forests benefit from the pollination services of wild bees.³ It should have mentioned that the principal insect involved is not native but an alien African honeybee that invaded Panama and other South American regions about 25 years ago.⁴ It is not clear, however, that enough coffee is produced in the United States for the African Killer Bee to provide an ecosystem service of interest to EPA, even if it raises yields in South American countries.

It is simply untrue that scientists are making rapid progress in understanding and defining ecological production functions for ecosystem services, for example, for the pollination services wild nature provides. On the contrary, a National Research Council study published last year argues that scientists are in fact nearly clueless about which and what wild or unmanaged pollinators contribute to agricultural production. The study summary says, “*For most pollinator species, however, the paucity of long-term population data*

² Wild bees enhance pollination by honey bees’ pollination of hybrid sunflower, Proceedings of the National Academy of Sciences USA 103:: 13890–13895.

³ Ricketts, T.H., G.C. Daily, P.R. Ehrlich, and C.D. Michener. 2004. Economic value of tropical forest to coffee production. Proceedings of the National Academy of Sciences USA 101: 12579–12582

⁴ Smithsonian Institution. "Had Your Morning Coffee? Thank A Killer Bee; Smithsonian Scientist Shows Pollination By Exotic Honeybees Increases Coffee Crop Yields By More Than 50 Percent," *Science Daily* 13 June 2002).

and the incomplete knowledge of even basic taxonomy and ecology make definitive assessment of status exceedingly difficult."⁵ It continues:

Most other insect pollinators in natural and agricultural systems are not well characterized, taxonomically or ecologically, in part because of the lack of monitoring programs and in part because of a shortage of taxonomists. Overall, the paucity of long-term data prevents the documentation of population trends for almost all pollinator species. Although suggestive evidence of decline, extirpation, or extinction exists for some species, documentation of population changes is available for very few.⁶

The C-VPES Report succeeds in acknowledging that economic production often depends on ecological production. This is possibly all we can say – or that can be said -- because we lack ecosystem production function data entirely. The problem is to obtain enough empirical data to show how specific human-caused (or threatened) changes in particular ecological production functions have resulted or will result in specific changes in specific economic production functions. Many crops may well depend on threatened populations of wild pollinators – but where are the data? Which human-caused (or threatened) pollinator declines correlate with what changes in yields of which crops? Nobody has a clue. There is plenty of theory but there are no data.

Most of C-VPES Report discusses issues of theoretical interest, for example, how to conceptualize “valuation,” how to approach and assess uncertainty, criteria for choosing valuation measures, etc. It could do more, however, to cite specific and concrete instances in which markets fail to price ecosystem services more or less adequately. This will require data about particular services, particular ecological production functions. If we thought in terms of concrete examples, we might find ways to strengthen markets (by better defining property rights, for example) to avoid this kind of failure. By thinking about valuation as an abstract and theoretical problem, however, we may have missed the instructive role of concrete and particular examples.

Comments from Dr. Paul Slovic

Here are some comments on the C-VPES report. I'm very sorry that I will miss the calls on March 26 and 27. I will be traveling on those days.

First, I wish to express my admiration and thanks for the fine job of editing and revision done by Buzz and Kathy and whomever else contributed to the writing of this report. The sensitivity to the many different views of committee members is apparent and appreciated. Thanks very much!

There are many places in the margins of the document where I scribbled “Good!”

⁵ National Research Council, *Status of Pollinators in North America* (Washington, DC: NAS Press, 2007), p. 7. Italics in original.

⁶ Ibid.

I won't bore you with these.

Specific comments:

Pg. 8, line 7. Perhaps delete phrase "... who are often the dominant organisms" referring to humans. I didn't think it is necessary or even true. How do you even define dominant in an ecosystem?

Pg. 14, lines 21 and 22. Suggested change. The term valuation, in this report, refers to the process...

Pg. 18, line 31. Delete extra "the"

Pg. 20, lines 18-19 sees serious limitations...

Further thought: how serious is this limitation "from relying solely on previously approved methods"? Apart from the use of methods that have passed muster with OMB in particular circumstances, what does the term "previously approved" really mean? I think any past approval has been more passive (lack of protest) than active.

Pg. 21, lines 3-6. This important paragraph seems vague and weak. Can we say more about how seriously to take analyses done under limiting constraints? Do such limited analyses do more good than harm? How do we know?

Pg. 24, lines 19-20. recognize this broader purpose and to address it. Or, something stronger than "consider it".

Pg. 28. Section 2.3.3. I'm uneasy about this section. It gives too much deference to OMB Circular A4. I doubt that the drafters of Circular A4 had the depth of understanding of the complexities of valuation that are described in our report (note the harsh judgment that the National Academy of Sciences handed down in 2007 on OMB's guidelines for Risk Assessment). I believe that somewhere in our report we should challenge OMB, calling for a need to revisit circular A4 in light of our committee's findings. Why should national rule making be exempt from the valuation considerations we identify as relevant for other contexts. It's wrong! [Post-script: I see later on pg. 135 a very constructive attempt to deal with OMB in the short-run. This is good, but for the long-run, a critique of OMB is needed, I think.]

Pg. 29, line 15. What is the status of information gained by exploring supplemental approaches?

Pg. 29, line 22. Again what does exploring mean here?

Pg. 29, lines 24-25. Doesn't this call for appropriate validity "in all cases" apply to national rulemaking too?

Pg. 30, line 1-8. But doesn't such a validity check need to be done at least once in the course of certifying a method as "valid" for use? This is called "convergent validity" in psychometrics.

Pg. 30, lines 4-5. Yes, confidence can be increased. But it is also decreased if and when multiple methods produce very different values.

Pg. 30, lines 9-27. The key issue associated with using multiple methods is not aggregation (adding) but rather comparing the output of supposedly equivalent measures. If they don't agree, convergent validity is lacking. One or more measures, or the entire measurement protocol becomes suspect.

Pg. 30, line 25. How should information about non-economic values be considered separately? What does this mean? Do such values have "standing" in the deliberations equivalent to that afforded economic benefits?

Pg. 32, line 9-16. Different contexts for valuation will be governed by different laws,

principles, etc. Shouldn't we be arguing that these laws need to be reconsidered. How about a call for "harmonization" in light of the "wisdom" in our report?

Pg. 33, lines 20-23. I'm not sure this statement about risk assessments not providing information about the societal importance of consequences is correct. Good risk assessments should consider significance of adverse effects.

Pg. 35, line 4-16. Again this gives too much deference to OMB and economic methods. Yes, economic valuation is a "mainstay", but should it be? Is not economic valuation also in a developmental state? What does it mean to experiment with other methods? Just out of curiosity? Are they second class? Why? Why should such experimentation be done only in less prescriptive contexts? This implies second class status. I disagree. Some non-economic methods may be logically more defensible than some economic methods.

Pg. 35, lines 17-24. And the public can use expanded methods to educate EPA about the value of ecosystem protection. This "education" is a two-way enterprise.

Chapter 3.

This is an excellent chapter, pointing out many challenges to valuation arising from limitations of our scientific understanding of ecosystems and their services. The key question raised by this chapter is, in light of these limitations, how much confidence can we have in the results of a quantitative valuation effort? The answer goes beyond merely placing uncertainty bounds on estimates (Chapter 5). It speaks to more fundamental questions about the adequacy of the analysis as a guide to important decisions.

Pg. 58, lines 26-29. Shouldn't public input also be solicited to identify relevant services?

Chapter 4 Methods

Pg. 61, lines 12-20. Regarding prescriptions of OMB Circular A4, we should protest the limited role afforded non-economic methods and call for high-level critique of the OMB circular. [Note, I later saw in Section 6.1, a broader interpretation of the OMB Rule. That broader interpretation seems missing in this Chapter 4 section.]

Pg. 62, lines 7-10. "urges" sound weak. How about saying the committee believes it is necessary for EPA to develop criteria etc.?

Pg. 64, line 3-4. This important point is relevant to a concern I have about mediated modeling (see my reference to the text on pg. 114)

Pg. 64, line 18-21. Many studies have shown that willingness to pay measures often fail to meet this construct-validity criterion, see e.g. Desvousges et al. (1993). Measuring natural resource damages with contingent valuation: Tests of validity and reliability. In J.A. Hausman (Ed.), Contingent valuation: A critical assessment. Amsterdam, North-Holland.

Pg. 86, line 39. Gregory, Lichtenstein, & Slovic (1993). "Measuring environmental values: A constructive approach" belongs here.

Pg. 99, line 12. Again, what does experiment mean here. Experiment seems to be used throughout as a put-down, a relegation to second-class status. Is there any method so well established that it does not need further testing, evaluation, and refinement? Results of an experiment are unlikely to make it into "prime time" on the decision maker's agenda.

Pg. 99, lines 13-16. The fact that some methods have been used, does not make them valid.

Pg. 99, lines 21-22. Does the statement that EPA should only use valuation methods that are scientifically based preclude the application of informed, reasoned, qualitative argument and deliberation in the valuation process?

Section 5. Cross-cutting Issues

Pg. 102, lines 13 & 14. Commas needed after action and after services

Pg. 105, lines 16 & 17. No hyphen in covariance

Pg. 106, line 27-28. I disagree with the statement that expert elicitations should be used when Monte Carlo analysis is not feasible. Expert judgment is notoriously prone to bias and error. What experience would allow an expert to make good judgments in situations so uncertain and complex that Monte Carlo analysis is not feasible? Expert and Monte Carlo methods should be used in tandem, as is indicated at the bottom of page 106.

Pg. 107. A study by Branden Johnson found that, when EPA communicated uncertainty about its risk assessments, the agency was judged more honest but less competent. This poses a challenge to the communication of uncertainty. (Johnson, B. B., & Slovic, P. (1998). Lay views on uncertainty in environmental health risk assessment. *Journal of Risk Research*, 1(4), 261-279.)

Pg. 108. But if the uncertainties are great, shouldn't the valuation assessments themselves be questioned and given less weight in decisions? Especially if theoretical or model uncertainty is the cause?

Pg. 110, line 20. I suggest deleting summative evaluation and substituting "testing messages." The latter is clearer.

Pg. 112, line 4. Should effect be affect? The sentence is unclear.

Pg. 114, line 1-13. Those who construct models need to run them to determine what their implications are. Sometimes the implications are surprising and unacceptable to the modeler. For example, Slovic et. al. found that people preferred a convex function (their general model) to express the value of varying numbers of lives lost, yet made choices in violation of this abstract model. They hadn't realized that the abstract model implied choices that were unacceptable to them. In other words, the modeling needs to be interactive and mixed with examples of the model's specific implications. (Slovic, P., Fischhoff, B., & Lichtenstein, S. (1982). Response mode, framing, and information-processing effects in risk assessment. In R. Hogarth (Ed.), *New directions for methodology of social and behavioral science: No. 11. Question framing and response consistency* (pp. 21-36). San Francisco: Jossey-Bass.)

Pg. 116, line 23. Add after analysis: Limitations on the valuation exercise due to uncertainties, should also be explained.

Chapter 7: Conclusion

Pg. 190, line 21. Again, consider the word experiment. Is it clear what that means? Is it the right word? See my earlier comments.

Pg. 191, lines 1 & 2. What if there is not "some uncertainty" but "great uncertainty"? "How uncertain is uncertain enough" to prohibit spending time and energy on producing a non-defensible and potentially misleading analysis.

Suggested recommendation. That EPA commission the National Academy of Sciences to review our report and give guidance to EPA on these complex issues of valuation. The NAS should also comment on OMB Circular A4 as a guide to valuation much as they commented on the OMB Risk Assessment Bulletin (National Research Council, 2007).