ESIPRI

ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES

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These Guidelines have been shaped and compiled on the basis of two earlier drafts and a formal reconciliation report (Appendix C). An initial working draft of this document was sent to several of the authors' peers and associates, requesting guidance and advice in its proposed methods, organization, and content. The general and specific comments received from a number of these individuals were very helpful in developing both the formal review draft and this current, completed, product. These individuals included knowledgeable and highly experienced scientists, resource managers, and technical writers: Thomas Atzet, B. Bruce Bare, Bernard Bormann, Kenneth M. Brooks, Kermit Cromack, Jr., William D. (Bill) Hagenstein, Don Ivy, Carl Johannessen, Stanley R. Johnson, Charles Kay, Nana Lapham, John Marker, John Menke, James (Jim) Petersen, Zane Grey Smith, Jr., Thomas J. Straka, and Richard A. Zabel -- several of whom have also provided permission to be quoted and cited in this report (see Appendix A).

This document has been significantly improved by formal reviews of the revised second draft of the Guidelines. Comments and suggestions received from Dominique M. Bachelet, Frank N. Dost, Donald F. Flora, Sharon Friedman, Paul R. Houser, Michael Newton, and Edward W. (Ed) Shepard were critical to the finished construction and content of this report and appendices (see Appendix B).

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INTRODUCTION

The Environmental Sciences Independent Peer Review Institute (ESIPRI) is a 501(c)(3) non-profit organization dedicated to maintaining integrity and improving the quality of science information used to develop natural and cultural resource policy decisions. ESIPRI's mission in pursuit of this goal is to provide thorough, independent, and transparent peer reviews and scientific assessments of environmental sciences information used to drive public policy at all levels of government.

Purpose and Background of ESIPRI Guidelines

The following Guidelines have been assembled specifically to address the purpose and mission of ESIPRI, and also represent the first successful testing and result of this process. The ESIPRI Guidelines describe a systematic method of conducting independent and transparent scientific peer review and assessment of environmental sciences information used to help form public policies. This process is intended to be useful in both evaluating the content of scientific information that is reviewed, and in directly improving the quality of scientific products based on this information.

The intended audiences for the Guidelines are: 1) ESIPRI directors, advisors, and reviewers; 2) current and potential ESIPRI clients; 3) students and teachers; and 4) interested members of the general public. An important ESIPRI strategy in these regards is to devote a major portion of its website to directly address student participation and public education opportunities. A second version of these Guidelines and Appendices is being prepared in hypertext (HTML) format specifically for such public review and student training purposes and will be directly linked to ESIPRI's Homepage as it is completed.

These Guidelines have been developed from the expert suggestions, comments and reviews of two earlier drafts by 19 senior scientists, resource managers, and technical writers (Appendices A and B). Their suggestions, corrections, and criticisms were in turn summarized in a formal peer review reconciliation report, with specific recommendations for this final product (Appendix C). Both review drafts were based directly on the work of Moghissi (Appendix D), which also remains the philosophical basis for this current report. The Guidelines are fully intended to be dynamic in both print and online formats. They are designed -- and expected -- to be regularly tested, reviewed, and updated as better information becomes available.

Need for Independent Peer Review

Peer review, as used in this document, is a critical evaluation of a project or product by qualified peers: typically individuals who are capable of participating in the review process through experience, training, and access to pertinent information. Independent peer review involves the exclusive use of qualified panelists and reviewers having little or no conflict of interest in regards to the outcome of the process; i.e., "independence" from the eventual results.

For purposes of ESIPRI, our current working definition for Environmental Sciences is: "a multi-disciplinary science consisting of those disciplines that study interrelationships between the living and non-living components of our planet." There is a common and recognized need for always improving the peer review process in all scientific disciplines, including Environmental Sciences. News items, as an example, often report on the poor quality of peer reviewed information in a variety of disciplines – on topics as diverse as nuclear fusion and red wine -- and scientific publications regularly speak to the many problems associated with the various methods described by this process. As Dost (2008: 445) states in one such example:

> *All of these papers have appeared in ostensibly peer-reviewed journals. All have surfaced in the public discourse on pesticides as valid scientific evidence of potential health risks. None has been subject to competent review, if reviewed at all. None should have been published in the form we see, if at all. Public policy should not be allowed to stand on bad science. I would be curious whether the collapse evident here extends beyond toxicology into other socially sensitive sciences.*

The "collapse" in the quality of toxicology science (and inferred resulting detrimental effects on public health and policy) described by Dost has also been observed in a variety of other Environmental Sciences disciplines as well, as suggested, and was a deciding factor in the formation of ESIPRI. Despite its noted failings and limitations, ESIPRI continues to support the idea that peer review – and particularly independent, transparent peer review – is the best system currently available for evaluating and improving the quality of scientific information. As Newton (2008: 439) observes:

> *Science extracts valid findings from scientific questions in the creation of new information. Proper peer review validates scientific findings by impartial referees. It is the centerpiece of scientific integrity. It is a demanding service, often uncompensated, that protects the public from poor information. It allows public confidence in scientific findings.*

> *Itprovides a model of accountability for our society. Peer review relies on an able and willing group of scientists with credentials for detailed analyses of scientific reports in their fields. The rewards to reviewers are satisfaction in contributing to science itself as well as opportunities for self-education on latest events in the given field. It is a control duty that comes with the responsibility and privilege of being a scientist.*

While Dost and Newton speak of the purpose and need for better peer review standards in the scientific community, it is the negative effects of poor information on public policy – as they also both describe – that is of more direct concern to ESIPRI. Yes, it is critically important to improve the quality and consistency of scientific reports, but it is just as important to involve the affected public in that process in order to better affect policy design and implementation (see Appendix D: D-16).

Reliability of Peer Reviewed Information

Although peer review dates back to the 1800s and perhaps earlier, the formal peer review process is a relatively recent aspect of scientific methodology: mostly coming into widespread use following WW II, in the 1950s, and principally among scientific journals and government research funding processes. That is, all of the scientific work performed by Galileo, Newton, Darwin, Curie, Carver -- and even so recently as Albert Einstein -- was not peer reviewed; at least not in the modern sense.

Despite the relatively recent advent of widespread use of scientific peer review, it is important to keep in mind its limitations. Dr. Kenn Brooks -- a founding member of ESIPRI -- states, for example (Brooks 2012: A-6):

> *Peer review does not verify the science being presented. It simply means that the reviewers believe that the information presented is of sufficient merit to warrant publication and consideration by the larger scientific community.*

The peer review process can never be perfect. There are numerous reasons for such imperfection, including the following (Moghissi et al. 2010: 54-59):

> *The subject is so specific that the number of potential reviewers is limited, or most reviewers have a conflict of interest;*
>
> *Peer reviewers are selected or screened by clients;*

> *No provisions have been made to separate societal objectives from science;*
>
> *The required qualification of the reviewers is insufficiently determined;*
>
> *Preconceived opinions of the reviewers impact the results of the review.*

It is important to clearly recognize that science evolves and that accepted knowledge often requires modification, or even major revision, over time as better information becomes available. As a result, skepticism, critical thinking, transparency, and good communication skills remain key ingredients of science -- and in particular when scientific information is a basis of public policy (Newton 2008: 441):

> *There is much justification for signed reviews. Accountability for high quality in reviews is jeopardized by anonymity. The presumption that anonymity minimizes recriminations needs re-examination. As scientists and authors, it is our job to welcome tough criticism. While peer review is not lenient, open and friendly communication between authors and critics will identify problems with a useful level of precision. In the process, reviewers also become teachers of rigor, an activity justifying much greater acknowledgement and support by university administrations. Accountability in reviews is a reasonable requirement.*

Primary Sources of Information

These Guidelines are based almost entirely on the suggestions and insights provided by the knowledge and experience of our principal reviewers (Appendices A and B), and as originally described and outlined through the work of Dr. Alan Moghissi and his associates (Appendix D). There has been no attempt to perform a thorough literature review for this document as the reviewers themselves are among the recognized experts in this field and have created their own collective body of published work on these topics.

References to specific publications – often those written by the reviewers themselves -- are included with these Guidelines on page 22, and also at the conclusions of Appendices D (p. D-18) and E (p. E-3). Quotes and other references to the written reviews are listed by author, date ("2012") and page number in Appendix A or B. The ESIPRI Environmental Sciences Peer Review Guidelines represent ESIPRI's first successful test and result of using the peer review process as developed and described in the following pages.

PROFESSIONAL SERVICES

ESIPRI has been formed with the specific intent of performing transparent, independent scientific reviews on products and/or projects in which environmental sciences information is used to affect public policies. At this time ESIPRI has no recognized direct competitor for such services, although somewhat similar services are offered by other organizations.

Identification of Potential Clients

Government agencies, industry, academia, foundations, and international organizations are the types of clients and organizations most likely to benefit by independent peer review and independent scientific assessment processes. However, clients can potentially be anyone who requests ESIPRI's services: the general public, legislators, special interest groups, businesses, individual scientists, attorneys, or other interested parties. Professional organizations offering similar services include:

Scientific/Professional journals. Journals have traditionally provided the peer review function for papers published by reputable scientists. They generally represent tight-knit communities of professionals who review each other's works; but much of the information ESIPRI will review is outside the stream of journal publication.

Academic institutions, such as National Academies of Science. These associations generally provide a much more rigorous approach to peer review than journals; however, access to their services is usually not possible for non-members.

Science-based think tanks. Many think tanks have the latitude to perform rigorous, high-quality peer review; however, they are often reliant upon funding from sources having a narrow, agenda-based philosophy, which can lead to a perceived or actual bias. They are not easily accessed by most individuals or other organizations.

Government convened scientific review panels. These panels are usually convened for a single purpose, working on a single major project. Once the panel meets its defined objectives, it is typically disbanded. Again, access to such a resource is strictly limited and prohibitively costly.

Businesses providing peer review as a fee-based service. These entities can provide a range of specialized peer review services based on their business focus (e.g., technical writing, text formatting, book reviews, etc.), but are often limited by scale, expertise and/or capability to conduct independent scientific peer review.

Independent Scientific Peer Reviews

Independent peer review consists of a critical evaluation of a study, a manuscript, the scientific foundation of a regulation, a project or program, grant submissions, a report making scientific claims, or any other document that includes scientific information. Typically, a minimum of three "peers" are asked to review a document; with a greater number for larger projects or assessments (Moghissi et al. 2010: 147). The qualifications of the reviewers, degree of independency, transparency of the process, and other requirements of peer review -- to ESIPRI standards -- are described in the following sections of the Guidelines.

Potential sponsors, clients, and other stakeholders (Appendix D: D-16) most likely to benefit by the independent scientific peer review process include the following:

Government Agencies. Numerous federal agencies, including Department of Energy, Department of Agriculture, Department of the Interior, and the Department of Defense, have programs or facilities requiring management actions based on scientific information. Other government agencies at the state or local level, as well as industrial facilities, face similar problems and needs. Implementation of independent peer review of scientific information during decision making processes has the potential to reduce error and significantly enhance desired outcomes.

Funding Proposals. Government agencies, industrial concerns, and foundations support research and development in specific areas of science and engineering. The amount of funding requested by applicants is often greater than available funds. Peer review provides a mechanism to evaluate the technical and scientific acceptability of specific proposals.

Project Analysis. In the development of large-scale projects peer review ensures that, during the design and construction of a project, the underlying science is sound and the chosen technologies are appropriate.

Internal Reports. The results of research and development are often published in the form of internal reports. The scientific acceptability of information included in internal reports can be peer reviewed much like publications of professional societies.

Science Papers. A large number of scientific products -- including technical memos, public reports, presentations, press releases, etc. – are typically not peer reviewed. Peer review has the potential to reduce error and improve the quality of these works, particularly those intended for use in developing policy.

Independent Scientific Assessments

In contrast to peer review, a scientific assessment provides a product to the sponsoring stakeholder. Simply stated, a peer review evaluates an existing technical project or product and makes recommendations, while an assessment generates an entirely new product based on a new study.

An independent scientific assessment consists of a critical evaluation of a topic (Moghissi et al. 2010: 47). In contrast to peer reviews, during the scientific assessment process existing scientific information and materials are systematically collected and critically assessed. The outcome of a scientific assessment is a document that provides the reader with the status of science concerning a specific topic. The process requires that a consensus be reached on often-contradictory information in the literature.

Government agencies, industrial concerns, and foundations, as examples, support research and development in specific areas of science and engineering -- scientific assessments provide a mechanism to help implement the requirements imposed by legislation, charter, and/or other legal or policy mandates. In particular, scientific assessments can also provide the client with review criteria, criteria for selection of reviewers, and other critical guides. Agencies and others also routinely undertake the implementation or construction of large-scale projects. Scientific assessments can be used to provide guides to the client on how to proceed.

Scientific Technical Reviews

Scientific Technical Reviews are used to more efficiently evaluate a project or proposals by individuals who are not necessarily peers or not necessarily independent of conflicting interests. Activities that benefit from technical reviews cover virtually the entire fields of science, engineering, business, and commerce. For example, many agencies do not use independent peer review or independent scientific assessments in preparing or evaluating Requests for Proposals or Requests for Applications. The sponsoring agency may decide to use technical review because the size of the contract is too small to justify the time and the cost of independent peer review. Similarly, the organization may find it appropriate to use reviewers who have a conflict of interest or may not necessarily be qualified as peers. In all of these cases, technical reviews provide a mechanism to accomplish the stated goal of the organization, and typically with more efficiency and less cost than a complete assessment or structured peer review.

Education and Training

ESIPRI is in the process of designing its new website to specifically accommodate students and other members of the public with an interest in learning more about peer review in general; and how it relates to environmental sciences in particular. The website is also intended to provide, by example, an instructional model for designing efficient, relatively inexpensive uses of the Internet to teach, communicate, research, archive, and/or discuss scientific subjects and topics of common interest.

The point was made by several reviewers that insufficient time is available to most scientists to perform the number of reviews they feel obligated to perform. Too, there are few opportunities for training graduate students and resource management professionals how – or even when and why – to perform peer reviews and scientific assessments. Newton (2012: B-35), for example, observes: "I have never heard a major professor insist that his students undertake technical/scientific reviews under his supervision. This is a problem that will not go away. I myself am guilty."

To address those concerns ESIPRI has adopted a basic strategy of using a combination of modern Internet communications and traditional peer review methods to: 1) expedite and enhance the scientific peer review process; and 2) provide for the efficient education and practical training of a future generation of reviewers. As a result, these Guidelines are also being prepared in Hypertext (HTML) format for Internet use and display, and will be linked directly to the ESIPRI Homepage. This online format will make public access to the Guidelines and Appendices easy to find, to search, to navigate, to download – and to discuss and criticize in a public forum.

The ESIPRI website design includes exclusive use of Plain English (Appendix C: C-21) in its original content; also the intended writing style of these Guidelines and Appendices. Other website design characteristics include intuitive organization, easy to use navigation aids, and an intended "permanency" – that is, the content of the website is also intended to be a stable, organic, and cumulative archive for long-term research and education purposes, and as a reliable source of reference materials.

Specific discussions are currently underway regarding the eventual use of the ESIPRI website for: 1) accredited online graduate-level courses in peer review, scientific ethics, and politics; 2) interactive student and public reviews of new and existing environmental sciences products and policies; 3) a series of thematic "blog-like" discussion forums (e.g., Friedman 2012a), with a focus on peer review and specific scientific disciplines; and 4) a searchable, comprehensive digital library of PDF files referenced or created during ESIPRI peer review and educational processes.

STRUCTURE OF INDEPENDENT PEER REVIEW PROCESS

Properly conducting a peer review requires an understanding of the inherent weaknesses of the process, and taking steps to address those problems. Moghissi and Anderson (2011: 4) address the fundamental issue of quality control by stating that a properly managed independent peer review process requires compliance with several key criteria. The four they consider most critical are:

1. Written Policies. These must be established to ensure that all parties involved in the process understand and follow the basic requirements of an independent peer review. These Guidelines are intended to serve that purpose to a certain degree; they are also intended to be dynamic so that key portions can be added, eliminated, or modified through time (see Appendix E).

2. Oversight Committee. An Oversight Committee is formed for each peer review process to oversee compliance with ESIPRI Guidelines, including the selection of reviewers. This committee must ensure that the reviewers are qualified, are suitably independent, and that formal ESIPRI peer review policies are followed throughout the review process.

3. Peer Review Panel. The Panel is formed by selection of the Oversight Committee and must consist of at least three qualified reviewers to consider the product or project under review.

4. Full Transparency. The peer review must be transparent so that Stakeholders (see Appendix D: D-16) can readily observe the process and obtain relevant information as it is made available. This process may also involve active Stakeholder participation in the review process when it does not jeopardize possible confidentiality requirements of specific projects.

The current ESIPRI strategy in this latter regard – full transparency -- is to make Internet communications the principal method of conducting reviews and assessments, educating and training students, and maintaining a series of public review and discussion forums. In recent years a number of emerging electronic science journals have begun "adopting a new, almost blog-based public peer review process" (Houser: 2012: A-13). Houser (ibid.) further describes an example of such an approach and summarizes with: "This can all be very easily facilitated using automated software that would systematically make the process publically transparent, and predictable"

Basic Steps of ESIPRI Peer Review Process

Each peer review is unique: members of oversight committees and peer review panels have different qualifications and individual constraints; review questions and criteria vary by project; operating costs and budgets may conflict; etc. Still, there are some identifiable steps that can be generally followed in order to ensure that the peer review process is conducted in as orderly and productive fashion as possible. These are the peer review steps currently endorsed for consideration and use by ESIPRI:

STEP 1. **Application.** An application for an independent peer review is made to the **ESIPRI Science Advisory Board** – where it is either accepted, rejected, or a request for additional information is made. Application can most readily be made via the ESIPRI website, or may be generated by independent written request to an ESIPRI Board Member, who can then advance the request to the Advisory Board.

STEP 2. ESIPRI Project Oversight Committee. Once an application for peer review is accepted, then an ESIPRI Project Oversight Committee is formed under the direction and guidance of the ESIPRI Advisory Board.

STEP 3. ESIPRI Project Peer Review Panel. The Oversight Committee is responsible for: 1) reviewing the accepted application, 2) developing initial review criteria to help guide in selection of an ESIPRI Project Peer Review Panel, and 3) formally appointing the members of the Review Panel. Table 1 (Friedman 2012: B-20) shows the types of reviews that are commonly performed and the types of reviewers that should be considered to participate in such reviews.

Table 1. Types of Peer Reviews and Potential Peer Review Panelists.

Potential Applicant	Type of Review	Scientists	Practitioners	Stakeholders	Statistics	Quality Controls	Public/ Internet
Independent Client	Research Proposals	**X**	**X**	**X**	**X**	**X**	**?**
Publisher	Manuscript	**X**	**?**	**?**	**?**	**X**	**X**
Agency	Scientific Assessment	**X**	**X**	**X**	**X**	**X**	**X**
Business	Technical Review	**X**	**X**	**?**	**X**	**X**	**?**
Landowner	Project	**X**	**X**	**X**	**?**	**X**	**?**
Organization	Program	**X**	**X**	**X**	**?**	**X**	**?**

X = Recommended
? = Situational

Questions regarding quality controls and public involvement in the review process via Internet communications – how much information to display, when to display it, and what formats to use – are also determined by the Oversight Committee

STEP 4. Formal Peer Review Process. The Peer Review Panel develops a formal series of criteria from those provided by the Oversight Committee, conducts the review, and creates a report of its findings, with recommendations (see Appendices C and E).

At this point the names and qualifications of Advisory Board members, Oversight Committee members, and Peer Review panelists may be made publicly available on the ESIPRI website, in addition to review criteria, reviewer comments and discussion, and recommendations. A decision may be made to delay posting any or all of the above until a later time for a variety of reasons (e.g., completion of the final product, security issues, etc.), to be determined by the Oversight Committee and agreed to by the Advisory Board.

Friedman (2012: B-22) describes a six-step review process similar to this series, but with a specific focus on "policy fitness." This is exemplified by the first step, which asks the question: "Is the research structured to answer the policy question?" This outline was later expanded to eight steps (Friedman 2012a), with a step being added for standard peer review (this Step 4 in the ESIPRI sequence), and another for required field verification of data. The principal difference between the ESIPRI peer review steps and Friedman's outline is the focus on specific scientific information driving policy vs. a specific policy being driven by scientific information.

STEP 5. Formal Decision. The Oversight Committee individually accepts or rejects each of the Review Panel's recommendations, making a brief written record of the reasons for its decisions. This record is also published online and eventually opened to public discussion. Authors and Reviewers may also publicly respond to Committee decisions at this time, and to one another's statements and reviews.

STEP 6. Final Report. After making formal decisions on the Review Panel recommendations -- and possibly considering any subsequent discussions on the parts of authors, reviewers and other stakeholders -- the Oversight Committee creates a formal report with final recommendations, comments and discussions on recommendations, and final decisions. These results are then publicly released to all stakeholders via online publication on the ESIPRI website.

ESIPRI Science Advisory Board

The principal function of this Board is to provide insight and guidance to ESIPRI Board Members. Specific duties include the acceptance or rejection of proposals for ESIPRI peer reviews or scientific assessments, and the appointment of a Project Oversight Committee to oversee accepted proposals. The current ESIPRI Science Advisory Board is comprised of active and former ESIPRI Board Members, including four scientists, two engineers, an international resources manager, and an accountant. A process is now underway to create an entirely new and separate Advisory Board, comprised of retired ESIPRI Board Members, top senior scientists, environmental engineers, and knowledgeable resource managers with good networks of other scientists and professionals. Under this revised formula, current ESIPRI Board Members would no longer serve in dual capacities as ESIPRI Science Advisors, but would be asked to serve as Advisors upon their retirement from the Board.

ESIPRI Project Oversight Committee

An oversight committee is formed to oversee peer review and scientific assessment of a particular program, project, document, etc. Its members are chosen on the basis of their qualifications: including education, knowledge (experience), professional contributions, and peer recognition. During the organization of an oversight committee every attempt should be made to ensure that all needed competencies and diversity of technical views are represented. The exact number of individuals who constitute a committee depends on the nature of the reviews and several other parameters. Typically, at least five members, and no more than 15 or so, should comprise a committee. Specific functions of the Oversight Committee include:

Oversees. As the overseer of the entire peer review process, the Oversight Committee enforces all relevant ESIPRI policies and professional requirements;

Questions. The Committee is responsible for framing initial review criteria;

Appoints. The Committee selects and approves peer review panel members;

Reviews. The Committee may review and/or approve peer review or scientific assessment reports in various stages of their development;

Reports. Upon completion of a peer review, the Committee individually accepts or rejects the Panel's recommendations -- making a brief written record of the reasons for its decisions -- and produces a summary report for public distribution.

Peer Review Criteria

The work of a Peer Review Panel is guided by specific questions or points; called review criteria, review questions, or lines of inquiry (see Appendices C and E). Generic review criteria used by scientific journals and funding agencies typically consists of three principal points: 1) scientific validity, 2) originality, and 3) scientific creativity (Moghissi and Anderson 2011: 8). Numerous other criteria may cover style, format, legal requirements, ethical considerations, and relevancy to the mission of the scientific journal or funding agency.

Houser (2012: B-30) advises:

> *Therefore, these questions must be phrased in a neutral, non-leading manner. The questions must be simple and easy to understand. I recommend that a standard set of example questions be provided to illustrate a generic unbiased approach. It is also important to sequence questions in a way that will not lead the panel to a particular conclusion.*

Possibly the most important aspect of any project is its consistency with established scientific and engineering principles and industry standards. The panel should verify that these standards are met or exceeded in the project under review, however the criteria are framed (Moghissi and Anderson 2011: 9). Other considerations for review criteria include:

Relevancy. All projects supported by a sponsoring organization must be relevant to its needs (Friedman 2012a: 2);

Competency. Those who propose to perform a project must have sufficient competency to be able to accomplish it;

Facilities. Those who propose to perform a study must have demonstrated access to facilities capable of completing the study;

Compliance. If a study includes a subject that requires regulatory compliance, this criterion must be considered during the peer review.

Cost. The cost of a decision for a given level of risk is subject to peer review.

Required Qualifications of Reviewers

The success of any peer review is directly dependent on the selection of qualified reviewers. Moghissi and Anderson (2011: 4-5) define a qualified peer reviewer as "an individual who is capable of performing the project, or that segment of the project that is being reviewed, with little or no study."

Dost (2012: A-8), however, takes exception to this idea: "I disagree with the idea that a reviewer should be able to perform with little or no study. A necessary qualification is the background and ability to find and evaluate the pertinent literature."

Both Dost (2012: A-8) and Moghissi (2012: A-24) generally agree, though, on the critical aspects that define a qualified reviewer:

Education. A minimum of a B.S. or B.A. degree in the biological sciences, engineering, natural resource management, environmental history, anthropology, or related Environmental Sciences field is usually required for any peer reviewer. Most reviewers will have advanced degrees as well.

Knowledge. Knowledge is obtained via a combination of information and actual experience. Because of recent major advancements in biological sciences, engineering, computer sciences, and related scientific fields, relevant professional experience can be equally or even more important than earned academic degrees. Consequently, significant practical experience in the area under review is also necessary. Table 1 (p. 10) shows the need for scientists as well as "Practitioners" (those with practical experience and knowledge) in the peer review process. Provisions are also made for statisticians and stakeholders in some types of review, but it is those with professional knowledge and academic training that are generally the most critical to the process.

Peer Recognition. Participation in activities that demonstrate recognition by one's professional peers is necessary to qualify as a peer reviewer. Examples of appropriate recognition might include receipt of relevant awards, election to office of a professional society, speaking engagements, media interviews, or public service related to professional background, etc.

Professional Contributions. The reviewer's contribution to their professional field can be demonstrated by publications (particularly those in peer-reviewed journals and professional magazines) and/or other such products as: community projects, patents, scientific reports, media exposure, educational curricula, etc.

Conflict of Interest

The "ideal" peer reviewer is someone who is completely independent of the outcome and has no conflict of interest with the process under review -- such a panel member is also someone who is intimately familiar with the subject matter but with no monetary or other personal interest in it. A guiding principle for conflict of interest in peer reviews, as defined by a team of the American Society of Mechanical Engineers and of the Institute for Regulatory Science (Moghissi and Anderson 2011: 6), is:

> *Those who have a stake in the outcome of the review may not act as a reviewer or as a participant in the selection of the reviewers.*

In order to comply with the spirit of this principle, every ESIPRI reviewer must sign a statement indicating a lack of conflict of interest in the outcome of the review (see Appendix E).

Note that although the subject of conflict of interest is complex, there are several key criteria for the evaluation of the conflict of interest of members of the Peer Review Panel. For example, conflicts of interest may also include friends, students, and competitors. Other conflicts might include past student/teacher relationships and former colleagues – particularly those relationships that may have existed within the past five or 10 years.

Houser (2012: B-31) recommends:

> *The ESIPRI conflict of interest policy is critical to the success of the review process. I recommend that this section be expanded to include practical examples of conflicts of interest, and consequences if a reviewer or committee member fails to recognize or disclose a conflict. Some practical examples of conflicts of interest are as follows:*
>
> *a. Student/teacher and mentor/mentee relationships have lifetime conflicts of interests;*
>
> *b. Colleagues from the same institution are conflicted, for a period of 5 years after departure;*
>
> *c. Colleagues working on joint projects or publications are conflicted for a period of 5 years.*

Peer Review Panels

The peer review of a scientific product or project is performed by a Peer Review Panel. The number of individuals constituting a panel depends upon the complexity of the subject to be reviewed or assessed. A typical panel consists of at least three individuals and, depending on the nature of the subject, may be significantly larger. Members of a panel are selected based on appropriate qualifications and competencies in the area under review (Moghissi and Anderson 2011: 6-8).

A key issue in transparency is the organization that evaluates potential reviewers in terms of their qualifications and independency. This criterion would require: 1) identification of the process used to select the reviewers; 2) how each of the four given requirements for qualification of reviewers are considered and weighed; and 3) a description of implementation of policies on conflict of interest (Moghissi and Anderson 2011: 7).

Peer Review Panels are commonly formed for the following purposes (Moghissi and Anderson 2011: 7-8):

Document Review. The Panel reviews a document to assess its scientific validity. This is the least extensive form of peer review and in most cases the interaction between panel members can be conducted electronically, making it unnecessary for the panel to meet.

Single Project Review. These Panels typically meet in person and perform a review of one project. Most information sharing during the process can be done electronically.

Multiple Projects Review. Panels are made up of at least five individuals who meet in person and conduct a review of either a single complex project or of several similar projects. Occasionally, these panels visit specific locations in order to review the planning, operation, and other aspects of projects on site.

Project Proposals Review. This type of peer review is commonly used to review grant submissions and other competing project proposals. No fewer than three people are required to review each submission.

Rapid Response Reviews. These provide a review of a specific and limited technical issue requiring a rapid response. This review requires that the Panel have access to unique infrastructure and specific personnel.

Peer Review Panel Reports.

Each member of a Peer Review Panel is expected to prepare a report containing the outcome of their review. The comments of the panel are subsequently combined into a single report containing some or all of the following parts (Moghissi and Anderson 2011: 9-10; Moghissi 2012: A-26; Appendix C):

Introduction. The introduction describes background activities that led to the preparation of the report. This section is typically no more than one or two pages in length;

Executive Summary. This part contains a brief description of the project and provides a concise summary of the project's criteria, findings, and recommendations;

The Process. This section contains a description of the peer review process used during the review;

The Project or Subject. For peer review purposes, this part describes a summary of the subject that was reviewed (for a scientific assessment, this part consists of several sections describing relevant information on the subject that was being assessed);

Criteria and Findings. This section contains the review criteria and findings of the Panel, including the positive and negative aspects of the product or project;

Recommendations. The recommendations of the Panel are derived from their criteria and findings, and are the true outcome of the process;

References. This section includes references to all documents used during the review or assessment. For Internet-based reviews, all referenced documents should be made available in PDF format;

Biographical Summaries. The qualifications of individuals involved in a review or assessment process are the basis of any credibility of the report might carry, so this section includes brief biographical summaries of all Panel members;

Appendices. Appendices might include comments by each reviewer upon which no consensus could be reached, the text of relevant regulations, other documents found to be helpful to the sponsor/client, etc.

Structure of Independent Scientific Assessments

Independent Scientific Assessments are generally more complex than peer reviews, but involve very similar procedures and considerations. A principal difference is that an assessment results in the creation of a new product -- typically a written analysis of a scientific subject. As stated earlier, a peer review evaluates an existing technical project or product and makes recommendations, while an assessment generates an entirely new product based on an evaluation of a topic. In further contrast to peer reviews, during the scientific assessment process existing scientific information and materials are systematically gathered and critically assessed. The outcome of a scientific assessment is a document that provides the reader with the status of science concerning a specific topic. The process requires that a consensus be reached on often-contradictory information in the literature (Moghissi et al. 2010: 47).

Objectives of Scientific Assessment

Often a business, industrial organization, academia, or a government agency must deal with an issue based on or involving scientific information. The objective of scientific assessment is to respond to the scientific need of the sponsoring organization asking for assistance. Accordingly, scientific assessments consist of a critical evaluation of a subject, which can include (Moghissi et al. 2010: 48):

> *Assisting the sponsoring stakeholder in resolving complex issues, or developing a status report on the state of science related to the issue;*
>
> *Advising the sponsoring stakeholder of an appropriate course of action to reach a stated goal;*
>
> *Assisting the sponsoring stakeholder in deciding alternative courses of action;*
>
> *Assessing existing scientific information on a specific subject and providing the sponsoring stakeholder with the results of the assessment.*

Process of Scientific Assessments

The process of identification of individuals who will be asked to participate in the scientific assessment is identical to the process used to identify individuals who participate in peer review, and as implemented by an Oversight Committee. Much like peer reviewers, members of an Assessment Panel must meet the requirements of

peer review by being qualified and independent, implying that they have no conflict of interest. Also in common with peer reviews, it is the responsibility of the Oversight Committee to provide initial project criteria.

The panel that performs an independent scientific assessment must: 1) search the literature; 2) critically review the collected information; 3) reconcile contradictory information; and 4) help determine the status of current science information. The outcome of such an effort is a report that responds to each question. If the anticipated outcome of the scientific assessment is a scientific answer, the work of the Assessment Panel is completed once the answer is provided.

Requirements for Multidisciplinary Projects

Multidisciplinary projects or subjects are of particular interest in contested areas of science. Consequently, the formation and operation of a Review Panel or Assessment Panel require procedures to ensure the integrity of these processes. Reasonable guidelines suggested by Moghissi et al. (2010: 59-61) include:

1. A Review Panel or Assessment Panel is formed, consisting of at least three individuals for each discipline. In practice, the number of disciplines would have to be limited to ensure that the process remains practical, but most multidisciplinary project can be typically reviewed by two to five disciplines – perhaps with some additional statistical and/or editorial assistance.

2. The three (or more) members of each discipline review their respective parts and prepare a report of their group findings and recommendations.

3. The outcome of each discipline's group deliberations is then presented to the entire Assessment Panel or Review Panel for reaching common conclusions on the product or subject.

Structure of Scientific Technical Reviews

Technical reviews may take on whatever form is necessary to benefit the work at hand. Scientific technical reviews are those reviews conducted in a systematic fashion and using scientific knowledge and methods to complete.

Scientific Technical Reviews are used to more efficiently evaluate a project or proposals by individuals who are not necessarily peers or independent. Activities that benefit from technical reviews cover virtually the entire fields of science, engineering, business, and commerce. For example, many agencies do not use independent peer review or independent scientific assessments in preparing or evaluating Requests for Proposals or Requests for Applications. The sponsoring agency may decide to use technical review because the size of the contract is too small to justify the time and the cost of independent peer review. Similarly, the organization may find it appropriate to use reviewers who have a conflict of interest or may not necessarily be qualified as peers. In all of these cases, technical reviews provide a mechanism to accomplish the stated goal of the organization.

Objectives of Technical Reviews

Frequently a business, industrial organization, academia, or a government agency must deal with an issue based on or involving scientific information. The objective of scientific technical review is to respond to the scientific need of the sponsoring organization asking for help.

For ESIPRI, an application for such assistance may initially be in the form of a request for peer review or scientific assessment, but the Science Advisory Board considering the proposal may recommend that a technical review be performed instead. This recommendation could be based on economic factors, time constraints, availability of local expertise, or for other reasons to the perceived benefit of the potential client.

Process of Technical Reviews

The process of identifying individuals who will be asked to participate in a technical review is much different than the process used to identify individuals who participate in peer review. Unlike peer reviewers, all members of a Technical Review Team do not have to meet the requirements of peer review by being qualified and independent, or by certifying that they have no conflict of interest. And, rather than an oversight

committee or science panel, the Technical Review Team itself may be the source of review questions and related criteria.

A Scientific Technical Review can consist of one or more of the following, whether applied independent of one another, or used as a sequence of steps:

Technical Advice. An evaluation of a project by one or more individuals who are not necessarily peers or independent. This may include local knowledge, professional experience, or a skilled individual with a vested interest in the outcome.

Technical Review. Virtually the same as Technical Assessment, but less comprehensive, consisting of a review of a product or project by individuals who are not necessarily peers or independent. May or may not involve the collection and consideration of relevant scientific literature.

Technical Assessment. Evaluation of a scientific subject by individuals who are not necessarily peers or independent, but also involving the collection and consideration of relevant scientific literature.

References

> *I think it gets into too much background information. There is a whole body of literature around peer review, but you can't cite the breadth of literature in this paper, so I wouldn't begin to go there; just cite the studies that are directly applicable to the review process.*
>
> -- Sharon Friedman (2012: B-18; C-26)

Dost, Fred N. 2008. "Peer review at a crossroads – a case study," *Environmental Science and Pollution Research,* Springer-Verlag. Vol. 15, No. 6: 443-447.

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Moghissi, A. Alan, Michael Swetnam, Betty R. Love and Sorin R. Straja 2010. *Best Available Science (BAS): Fundamental Metrics for Evaluation of Scientific Claims*. Potomac Institute Press, Alexandria, Virginia: 108 pp.

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Newton, Michael 2008. "More on peer review: quality control for a costly product," *Environmental Science and Pollution Research*, Springer-Verlag. Vol. 15, No. 6: 439-442.

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ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES

APPENDIX A. EMAIL SURVEY AND DISCUSSIONS: DRAFT #1 AND DRAFT #2

The following collection of comments has been excerpted from email correspondence with both formal and informal reviewers during the course of this process. Salutations, side discussions, and other unrelated writings have been edited from these excerpts; only materials specifically related to this review (and review process) have been retained. Slight corrections of spelling and typos have been made, and all of the responses have been re-formatted to a single printed style in order to reduce confusion caused by differing approaches to page numbering, labeling, and/or the use of bullets employed by the various writers. This provides the benefits of much easier to locate, reference, cite – or link – information when needed.

These reviews were performed by a wide range of highly qualified individuals, with the large majority being senior scientists in various fields of environmental sciences. Other reviewers were selected based on their technical writing skills or practical experience in natural resources management, public outreach and/or science education. Several of the reviews are only a few sentences long (sometimes in response to a specific query), while others are highly detailed and reference specific page numbers and phrases in the draft text.

Reviewers are listed alphabetically, but individual comments are listed chronologically after each name. Current residential locations of the reviewers include the states of Oregon (7), Washington (4), Virginia (2), California, Colorado, Nevada, and South Carolina.

A key difference in the following comments is the time in which they were written:

All of the comments were received from April 9 (Moghissi: A-23) until October 24 (Newton: A-32), 2012;

Thirteen of the reviewers sent a single, dated email as a review, while four of the reviewers (Dost: A-7; Moghissi: A-23; Newton: A-27; and Shepard: A-34) sent two or more emails – and with the latter two reviewers, Newton and Shepard, commenting on both drafts;

Comments posted on or before August 6, 2012 were in reference to the first, or "working" draft of the Guidelines, and regarded the initial "three questions" survey and/or a specific question from one of the coauthors (e.g., Atzet: A-3; Bormann: A-5; Johnson: A-19; Lapham: A-20; Straka: A-39);

Comments posted after August 6 were primarily in response to the second, or formal "review" draft of the Guidelines (e.g., Dost: A-7; Moghissi: A-24; Newton: A-29; Shepard: A-37), and were often more detailed and specific as to page numbers, topical content, and phrasing.

Thomas Atzet. PhD, Oregon State University, Forest Ecology. USDA Forest Service and USDI Bureau of Land Management Area Ecologist (ret.). Merlin, Oregon.

From: Tom Atzet
Subject: ESIPRI Final Peer Review DRAFT
Date: August 5, 2012 06:35:55 PM PDT
To: Bob Zybach

Occasionally I still get requests to do peer review. As your paper says, it requires a significant investment in time and self-control. Like Newton says, and this is an exact quote "there ain't nobody that is totally unbiased." Maybe I paraphrased that a bit, but that's why self-control is important during peer review. Also liked what your paper says: there are many papers that talk about the increasing abuse and misuse of science, including bastardizing the peer review process. Politics is an obvious culprit, but merchandising is not far behind. I think your paper will help put some structure on the organization and use.

When I first saw the title, I was expecting something a little more specific. For example, before you read either the abstract or the introduction, it is important to totally understand the methodology and analysis. If that fails, then the paper fails. Or another example might be: the objectives must be clearly stated in measurable terms, and you should be able to follow the objectives considerations throughout the paper. I have little tricks like that, that I use when I'm asked to review. The last thing you should look at, is who authored the paper. That in itself may make it difficult to be unbiased in your review. Anyway those were the kind of things, very in the weeds things, that I was originally looking for. What I found was more general, but appreciated.

B. Bruce Bare. PhD, Purdue University, Forest Management and Operations Research. Director, Institute of Forest Resources, School of Environmental and Forest Sciences, College of the Environment, University of Washington. Seattle, Washington.

From: Bruce Bare
To: Bob Alverts
Sent: Wednesday, June 06, 2012 3:58 PM
Subject: Definition of Environmental Science

I looked up a few definitions per our phone conversation.

1. The branch of science that deals with the physical, chemical and biological components of the environment and their effects on organisms. (http://www.biology-online.org/dictionary/Environmental_Science)

2. An interdisciplinary academic field that integrates physical and biological sciences, (including but not limited to Ecology, Physics, Chemistry, Biology, Soil Science, Geology, Atmospheric Science and Geography) to the study of the environment, and the solution of environmental problems. Environmental science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems. (http://en.wikipedia.org/wiki/Environmental_science)

3. Environmental Science is the study of the physical properties of the earth in order to better understand and protect our environment. (http://degreedirectory.org/articles/What_is_Environmental_Science.html)

4. Environmental science is the study of the interaction of the living and non-living components of the environment with special emphasis on the impact of humans on these components. (http://www.hartwick.edu/academics/majors-and-minors/special-minors/environmental-science-and-policy-minor/what-is-environmental-science)

5. The application of all fields of natural science toward solving environmental problems. (Environmental Science – Systems and Solutions. http://books.google.com/books?id=NJUanyPkh0AC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

I am sure you can find dozens more examples.

Bernard Bormann. PhD, Oregon State University, Soil Sciences. Senior Forest Scientist, USDA Pacific Northwest Research Station. Corvallis, Oregon.

From: Bernard Bormann
Subject: ESIPRI Review Draft & Civic Science
Date: June 29, 2012 02:33:20 PM PDT
To: Bob Zybach, Robyn Darbyshire
Cc: Bob Alverts

1. If you were asked to do a peer review of this document, or other similar document, what would you charge or believe to be a reasonable fee for those services?

Many in the science community do peer reviews without charge. EPA does pay for reviews and you might contact them or look on line about their rates. Otherwise I think you can set any price you feel reasonable. Even with a price, federal scientists will not be able to collect, given our ethics policy.

2. We believe such a review (at least for this document) could be done within a 4-12 hour time period, and completed within 30 days. Does that sound reasonable?

Depends on the length and complexity, and how much detail you want. I rarely spend more than 2-3 hours on a journal review.

3. If you were willing to perform a full peer review of the final draft, would you be willing to have your comments and a brief professional bio available for review by others and openly posted on the ESIPRI website?

I would, but you have the problem that you change the document presumably because of the reviewers comments, and the comments are for the previous version. I'd give the reviewer a chance to alter their review to match the final version. You also may need to publish the "reconciliation" which details the changes you made or not to each comment. If I was providing a review for someone I did not know well, I think I'd like to be able to approve the final version of my comments after seeing both the final version of the paper and the reconciliation.

Kenneth M. Brooks, Sr. PhD, University of Washington, Marine Biology. Owner and Senior Scientist, Aquatic Environmental Sciences. Port Townsend, Washington.

From: Kenn Brooks
To: Bob Alverts
Sent: Wednesday, July 04, 2012 5:46 PM
Subject: Review of 1st Draft Peer Review Manual

I've read the first half of your manual. It is a good start. However, the inclusion of efforts to review funding proposals and to provide review of projects is beyond the original scope of what was intended for ESPRI. Would these be pay for review? I do have two substantive comments.

1. Peer review does not verify the science being presented. It simply means that the reviewers believe that the information presented is of sufficient merit to warrant publication and consideration by the larger scientific community. If peer review verified the science then we would all be basking in the warm glow of cold fusion. The peer reviewed literature is full of contradictory papers presenting differing points of view. What peer review does is to point out glaring errors that disqualify the work for further consideration. That determination is typically made by the journal editor or in a few cases by an editorial board.

2. I believe that the manual should better emphasize the need for independence of both the referees and the reviewers. Review conducted by the author or agency is not valid peer review and I would prefer that the manual clearly state that.

Several typos and/or grammatical errors were observed. I'm sure you will correct those as you proceed.

Frank N. Dost. MS, Kansas State University, Physiology. Professor Emeritus of Agricultural Chemistry and Forest Toxicology, Oregon State University. Freeland, Washington.

From: Frank Dost
Subject: ESIPRI Peer Review DRAFT
Date: August 29, 2012 06:12:48 PM PDT
To: Bob Zybach

Here is a first cut of my review. I couldn't make it fit the form you included. Perhaps when I go through it again. My general impression is that you were so concerned that some detail might be lost that there is considerable redundancy.

I am going to be gone for a few days and will have another go when I get back.

Are you familiar with the group called Peerage of Science? It is a for-profit, and an interesting idea even so.

Initial comments, Zybach and Alverts:

I am concerned about the use of "peer review" in the title. As a point to begin argument, how about "Procedures for Independent Scientific Evaluation of Environmental Programs". I worry that purists who see each peer review as a new independent exercise, will feel that it is a cookbook.

By and large I see it as appropriate as you use it in the text.

The term has become applied to everything under the sun, to the point where its meaning has become lost. Wikipedia lists under this term chemistry, chess, film, history, LGBT studies, novels, conservatism. Hospital management, clinical services, "sham" peer review of MDs, review of fire protection designs all call themselves “peer review.” It is the title of a journal on trends in undergraduate education, and in one of the higher education periodicals it is a section telling who has moved to where in HE [Health Education].

Page 1. In the Introduction, the three basic applications of the method lists peer review and scientific assessment as independent entities, and as described on **page 19**, this makes sense. It would be useful to indicate here just where these terms are defined for the purpose of this document.

I think the first paragraph of the "Purpose of this Manual" might also have a place on the title page, to show just what the target is.

Second paragraph, purpose of this manual, add from **page 12,** "1. Written policies" : -in general. It is intended to be dynamic so that key portions can be added, eliminated or modified through time.

Page 2. Definition

Peer review: These paragraphs talk about peer review, but do not define it. Given the problems of all the processes called peer review, a specific definition to apply to this manual should be here.

Start with the first sentence: "This document---- Environmental Sciences." Then try combining the definitions of peer and peer review from the glossary: "Peer review, as used in this document, is critical evaluation of a project by individuals who are capable through experience, training, and access to pertinent information."

Experience is an important qualifier. (I recall a bridge job in my youth where the superintendent had an eighth-grade education and knew more than the CE [Civil Engineer]s, one of whom had less common sense than I did.)

The history, etc, is useful.

Page 3. My own view of "disciplines" is that they are highly specific sciences, like chemistry, genetics, etc. My own field of toxicology includes a mind-boggling array of disciplines. Environmental science is a field with multiple disciplines.

Page 4. Your definition of environmental sciences seems to meet that concern.

I like the inclusion of "fallacious information". Too often we either ignore it, or wait until it emerges in discussion, which is too late.

Page 6. I am having trouble with the last sentence of this paragraph. Societal objectives may decide why a project may be initiated, or where it is located, or what part of the community may have to be displaced. They have nothing to do with the quality of the work and materials, the competence of employed staff, or integrity of design. If a project is likely to cause physical or social damage, an ethical professional would refuse it. Ethical behavior may be outside the purview of science only in the sense that it should characterize the entire spectrum of human activity, including science. Or, to go back to the comics, remember Dudley Do Right.

This issue relates to the questions raised in the remarks about think tanks on **page 9**. Do you bend an assessment according to the agenda of the funding source?

Page 13. 3. Implication might be read into this sentence that the Peer Review Panel is constrained to examine only the questions put by the Oversight Committee.

Similarly, in "4", the Oversight Committee may be seen as directing the Peer Review panel, when it really should be on its own, once the task is defined.

Page 15. Required qualification. I disagree with the idea that a reviewer should be able to perform with little or no study. A necessary qualification is the background and ability to find and evaluate the pertinent literature. I doubt if anyone since Euclid has been able to personally encompass the existing knowledge about anything. (Although I could probably still judge the

optimal approach to getting the most high quality planks out of a cedar log.)

Also, see my comment re **page one** on lay expertise.

Page 17. Perhaps the discussion of kinds of panels should be qualified "as utilized by ESIPRI". I don't recall a prepublication review in which reviewers were communicating, or even identified to one another.

Page 19. Last line. See comments re **Page 13**.

Page 20. Coherence. -- current knowledge of the science relating to the subject. "Natural history" is often read as a broad view of biology. By the way, you may not be aware that years ago, a declining birth rate in Germany was found to follow a similar decline in stork nestings.

Page 21. I am having a problem with all of these definitions. Perhaps it is because all of these descriptions and criteria have become built in over the decades such that I don't consciously name them. At the same time it brings to the surface a feeling that there is too much emphasis on making sure that every concept has a discrete identity.

I know of no scientific discipline that is not evolving; that process will never stop. The degrees of certainty will vary for each question within a proposal; the reviewers have the responsibility to assess and describe the level of confidence in each case in such a way that a decision maker can act. There are obvious ethical implications here as well.

More in a week or so.

From: Frank Dost
Subject: ESIPRI Peer Review DRAFT
Date: September 16, 2012 07:54:48 PM PDT
To: Bob Zybach

Review of proposed Peer Review Manual

I have two very general concerns about this document: First, it attempts to provide a pathway for virtually every situation that might arise in evaluating a proposal or process, implying that professional judgment may not be up to the task of crossing uncharted waters. The danger in this is that should an unaccounted-for rational factor appear, it may be rejected because there is no category for it.

Second, there is so much repetition that I suspect that the manual could be half its present size.

Pages 29-32. I am having a struggle with Appendix B. It seems to me that much of this section can be boiled down to the philosophy of science, to be laid out in the introduction as the desired goal of the proposed work to be reviewed. However, I will comment here on the material as it is presented.

Fundamental Scientific Principles.

We are shown five principles. There are really only four identified here. Universal principles as shown here is a generalization with no specifics.

Perhaps my problem here is that I am an idealist; I can't imagine a good scientist who is not both open-minded and skeptical. An open mind allows one to examine that which is accepted wisdom and 'fact' with the sense that it is real and established, but perhaps there is something further that no one has thought of. The two ideas are not incompatible.

Perhaps it is necessary to state it this way, given the effort in this draft to lay out every prospect that may be encountered.

Classification of scientific information.

The classification of "Proven Science" is questionable. Such an idea leads to complacency, and in some minds an unaccounted-for rational factor may be rejected because there is no place for it on the shelf.

In toxicology we are constantly confronted with demands that safety must be "proven". It is thereby a prediction of the future, a philosophical impossibility. Where we use the word "safe" so casually really means that the probability of harm is so small that it cannot be distinguished from zero. The law of gravity is a useful example. If I drop something, I can assure you with great certainty that it will fall, but I cannot "prove" it until after it hits the ground.

I think the term "Established Science" would work better. Also, shouldn't the two categories in Class I be together. Applied science is an assemblage of pieces, each of which is an established discipline. Plant genetics is an essential piece of agriculture; it is an established science, although specific details will continue to emerge for the rest of time. The physical behavior of the steel strands in a suspension bridge is knowable and predictable based on metallurgy, physics and chemistry. (Having seen the collapse of the Narrows Bridge, sometimes the prediction doesn't work out.)

Under Evolving Science, perhaps the order of appearance should be reversed. First comes speculation, then a hypothesis, then reproducible aspects of science.

It seems too, that a category of "Decision-driven Science" or some such theme should include Rationalized Science, Correlation-Based Science, and Scientific Judgement. Decisions in the social arena are almost always based on what we know as of this moment, and rational prediction. We can't wait until knowledge is complete, which will come just after the end of the world.

Page 33. Consensus processed science is really a form of peer review. My experience in a number of efforts to reach a conclusion about the meaning of a spectrum of knowledge relating to a chemical or chemical class shows this clearly. The conversation and correspondence is a constantly narrowing process of mutual education, definition of conflict, acceptance of

arguments and eventual agreement on a conclusion, sometimes with an individual statement of partial or total disagreement.

I would suggest, then, that the reliability concept be reassembled:

I. Science Validated by Reproducibility

II. Independent Peer Review

III. Blind Peer Review

IV. Consensus

V. Informal Review

VI. Gray Literature

VII. Opinion

Page 34. The gray literature question is interesting. First, I would not include material prepared by government agencies, which is almost always prepared by competent people, often from outside the agency. Of course it should be examined critically, but it cannot be included with papers originating with advocacy or activist groups, which are all too often colored by belief, politics or flat-out ignorance.

Similarly, literature reviews appearing in good journals will have been through their peer review process. I would be disappointed to learn that my review of the effects of vegetation smoke may be "gray".

Sharon Friedman. PhD, University of New Hampshire, Genetics. US Forest Service regional planner and NEPA (National Environmental Policy Act) specialist (ret.). Boulder, Colorado.

From: Sharon Friedman
Subject: ESIPRI: Re: Review
Date: September 5, 2012 08:54:35 AM PDT
To: Bob Zybach

Bob, that is precisely why OPEN review is so valuable -- all of reviewers can disagree with each other and discuss why, and also generate ideas for incorporating both points of view instead of you trying to listen and interpolate. Which is the same reason collaboration is so valuable to the Forest Service.

As you can tell, I think honest disagreement and respectful discussion is the way to improve and add value. It's just that no one is usually paid to do that, so we are missing out on a lot, IMHO.

Yes, I would be willing to do more work for ESIPRI as I think what you're doing is really important, as I said in my review. If people only knew what really goes on in reviews at this point, they would probably lose any confidence in scientific products.

Paul R. Houser. PhD, University of Arizona, Hydrology and Water Resources. Associate Professor, Department of Climate Dynamics, George Mason University. Fairfax, Virginia.

From: Paul R. Houser
To: Bob Zybach, Paul R. Houser
Cc: John Menke, Bob Alverts, Marcia Armstrong
Sent: Tuesday, July 10, 2012 12:09 PM
Subject: ESIPRI Peer Review Manual

In preparation for our discussion later today, I have done an initial read and review of the draft peer review manual. In general, I find the document to be full of excellent concepts and directives. However, there are some issues:

1. There is a lot of repeated information.

2. There is a lot more definitions and conceptual information in relation to actual directives and procedures. It seems a lot of the procedures are left undefined, and that they will be determined by the oversight committee.

3. The document needs better organization and the real meat could be shorter. I suggest that the definitions and much of the philosophy should be relegated to appendices. I also think that the document needs a very clear statement of purpose and expected peer-review outcomes at the beginning. There also needs to be clear guidance on how a peer-review is requested or initiated.

More specific comments on these topics (these are just off the top of my head – may be incomplete or need more research):

What is wrong with the current peer-review process?

Scope of peer-review is not well defined – could be asking for a proofread by a secretary, or could be a full 6-month National Academy [of Sciences] review.

Peer-review is biased from the outset by how it is paid for – peer reviewers know that client wants a certain outcome.

Peer-review is biased by what questions are asked – for example "Will removing dams benefit fisheries?" will give you a different answer than "What is the best way to improve fisheries?"

Current peer-review practices are very private, not allowing the public to see/trust/respect/understand the process.

Peer reviewer conflicts of interest abound, and peer-reviewers are often selected or screened by clients.

Clients often are able to interact with the peer-review process, giving them opportunity to tweak or guide the outcome.

Many critical decisions are made based on internal science and reports that are never peer reviewed.

Just because its peer-reviewed, does not mean the peer-review was favorable, or that the client made any attempt to improve the decision or science based on the peer review science. There may be a need for a peer review to outright reject the document.

What is the end result you want your peer review to obtain? This needs to be defined early in the document.

To evaluate or validate science results?

To quality control scientific results? (reject science results below some threshold)

To improve science results? (implies some iteration and re-review process)

To mold science towards unbiased and trustworthy results? (also implies a multi-step process)

To fix science errors, or to eliminate bad science results? (requires a response from the scientists)

Offer clarity where scientific results or opinions differ?

Mold science PROGRAMS toward broad agendas that consider all reasonable alternatives to address a problem? (discount predetermined decisions)

What kinds of documents or science should be peer reviewed?

Science papers (technical memos, public reports, presentations, formal science literature, press releases, etc.)

Science plans and funding programs (requests for proposals, contracting plans, etc)

Project plans

Legislation and public agendas

A broad knowledge base of papers produced in a given topic (expert panel)

Should there be a threshold on what kind of document needs a peer-review? Perhaps the dollar/value that of the informed decision? In some cases, a decision memo can have huge monetary implications, but is rarely peer reviewed or even made public.

Transparent/public review?

Many new electronic science journals are adopting a new, almost blog-based public peer review process. This involves the paper being publicly posted, then for some fixed period of time (2-4 weeks), the paper can be commented on by the public at large. At the same time, a regular panel of peer-reviewers is tasked with preparing professional reviews, which are also publicly posted. After the review period is over, the authors are asked to publically respond to each review, which can be iterated with the reviewer. In the end, an editor or committee publicly assesses the peer review process and issues a final acceptability of the work.

This can all be very easily facilitated using automated software that would systematically make the process publicly transparent, and predictable.

Need for consensus?

Often an editor or a panel acts as judge or jury to sort through conflicting opinions. In this case, it looks like the oversight committee will do this. Perhaps an independent advisory board would help to keep the oversight committee in check?

How to avoid committee "softening" issues – committees often gravitate towards a common dominator rather than taking the minority concerns seriously. For this reason, it may be better to have a single editor in place?

Concerns about ESIPRI process:

Committee to develop review-specific questions can lead to bias in the questions and answers. May be better to develop more generic questions that just ask if this is good science, etc.

ESIPRI has identified three different classes of reviews (Peer Review, Science Assessment, and Technical Review) – most of the concepts and ideas are generic between these. It may be better to more briefly state any specific differences that need to be considered in each type of review?

I like the idea of forms (in an appendix) – you include a conflict of interest form. I might also suggest a standard form for each type of review, with extremely general peer-review questions about the merit, justification, methods, and validity of the scientific results.

Conflict of interest:

May want to add a lifetime COI for student/teacher relationships, and colleagues having done joint work within last 5 years.

Also expertise may be relevant, but biased – for example, there is an obvious conflict of interest when an engineer who specializes in dam removal is asked to review a dam removal

plan.

What are the consequences if a reviewer or committee member lies or forgets about a COI?

Process:

How would a stakeholder or agency ask for a peer review, and what guidance or information could they include? Would peer reviews ever be done for the public interest, or would they always be contracted and paid for?

Might ESIPRI ever get grant or donation funding to do random peer-reviews, or to do peer-reviews for important topics in the public interest? Perhaps a surcharge could be included for regular clients to support public-interest peer reviews? (this would help keep the whole process more honest)

Finally, you asked me some specific questions:

1. If you were asked to do a peer review of this document, or other similar document, what would you charge or believe to be a reasonable fee for those services?

a. Well, I do many peer-reviews for nothing – as part of my obligation as a scientist. In fact, peer-reviews help to keep scientists sharp on the most recent literature and cutting-edge ideas.

b. On the other hand, peer reviews take time and we are all very busy these days. So, some financial compensation is great motivation. I have found that I am much more likely to do a review that pays $100 than one that is $0.

c. In-person participation on committees is another issues entirely. Obviously, travel should be compensated, as well as some salary compensation – I have received $500-$700 a day for such work.

d. At DOI [Department of the Interior], we contracted a group called ATKINS global to review some 3500 pages of testimony and scientific papers as part of a scientific integrity allegation. ATKINS hired 3 outside scientists, met as a committee for several days, and produced a short report (~10 pages). The contract with the government was for $75,000. The whole process took about 2 months. I can provide more info on this if you are interested.

e. NAS [National Academy of Sciences] committees also charge a lot of their reviews – the cheapest I have seen is $50,000, and they go way up from there depending on the complexity of the review.

f. Keep in mind that government scientists, and some government contractors are prohibited from accepting payment for their reviews, unless they are explicitly not representing

their agency or are on vacation. They can get special permission to serve on committees, but this must be done with complete disclosure. It is very possible that ESIPRI will want government scientist reviews, so the policy will need to be clear.

g. In the end, I think the review fee could be on the order of a few hundred dollars for this manual.

2. We believe such a review (at least for this document) could be done within a 4-12 hour time period, and completed with 30 days. Does that sound reasonable?

Yes – this should not be an issue.

3. If you were willing to perform a full peer review of the final draft, would you also be willing to have your comments and a brief professional bio available for review by others and openly posted on the ESIPRI website?

Absolutely – I am willing to be named and have my comments be public. Peer–reviews are often done with full disclosure. But it may be proper to give the reviewer the choice.

At this point, I think the draft is not ready for the full review. Hopefully some additional proof-reads and major edits will have it ready by draft 2 or 3?

Don Ivy. Director, Coquille Indian Tribe Historic Preservation Office/Cultural Resources Program, Coquille Indian Tribe, Inc. (ret.). North Bend, Oregon.

From: Don Ivy
Subject: Coquelle Trails phone & ESIPRI Peer Review
Date: August 6, 2012 02:14:42 PM PDT
To: Bob Zybach

I read the peer review manual. Painful, but very readable and understandable for a lay audience. And helpful to those like me who have to read reports. Probably not helpful to all science writers however: some will surely grouse about the science and motives of technical writers of manuals . . .

Stanley R. Johnson. PhD, Texas A&M University, Agricultural Economics. Assistant to the Dean, College of Agriculture, Biotechnology, and Natural Resources, University of Nevada. Reno, Nevada.

From: Stan Johnson
To: Bob Alverts
Sent: Monday, August 06, 2012 1:53 PM
Subject: ESIPRI Peer Review DRAFT MANUAL

I have read the ESIPRI document carefully and find it to be very good. The one aspect that might be improved on is to provide for meetings of the Review Panels -- many times in my experience such meetings were very useful in getting to the issues associated with the review. There is possibility of such meetings in the document, but it could be more explicit.

Nana Lapham. BA, General Sciences, Western Oregon University. Technical Writer and Market Research Analyst, SBI Energy, Market Research Group, LLC. Salem, Oregon.

From: Nana Lapham
Subject: ESIPRI Review Draft & Civic Science
Date: June 29, 2012 10:28:28 PM PDT
To: Bob Zybach

I like the BA reference. ;)

So what is "CF"?!

In your bio the last sentence is an incomplete sentence.

Page 7. "Environmental Sciences, unlike Regulatory Science" (shouldn't both be plural?)

I like this: "Environmental Sciences is a multi-disciplinary science consisting of those disciplines that study interrelationships between the living and non-living components of our planet.(?)"

This sentence is confusing: A scientific, programmatic, or other areas requiring study or assessment.

Page 11. "the entire fields" is that ok? How about "the entire fields of many types of XX, including..."

Page 12. The Result. Are you going to flush this out? Just feel like you could poke a few needles in people here. ;)

I like the "full transparency" part. Yay!

Does it cost to get peer reviewed?

"Oversees. As the overseer of the entire peer review or technical assessment, the Oversight Committee enforces all relevant policies including compliance with professional and ethical requirements." Is this of the ESIPRI team or the one being peer reviewed?

Page 14. This sentence is confusing: "There are also specific criteria for investigators seeking funding who intend to use radioactive, chemical, or microbiological agents, competency of the investigators, and other requirements."

A peer reviewer can't have a BA - damn!!! ;)

Page 15. "Knowledge is achieved via a combination of information and actual experience." Would "acquired experience" be better here?

Hey on the signed declaration page for not having a conflict of interest, should there be

something about personal politics or beliefs? Oh, you did. How come the list in the opening paragraph is different than what is explained on the second half of the page? Oh, cause it's a draft. Got it.

Page 17. Shouldn't this be singular or plural but not both: "These provide a review of a specific and limited technical issue requiring a rapid response. This review"

Page 19. Should both be capitalized: "Evolving Science and scientific judgment." I had to look up the definition of purview - lol!

Page 20. "In 1965, Sir Austin Bradford Hill, and epidemiologist"

I don't know what this is "Dose-response: The dose-effect relationship must be consistent with the observed association." But your other readers will, right?

"Consequently, skepticism, critical thinking, and lack of blind acceptance of the results of an experiment or computations of a model are key ingredients of science." Sounds like you - you must be a . . . scientist!

Page 23. "evaluate a project or proposals by" should both be singular?

"Independent peer review consists of a critical evaluation of a study; a manuscript; the scientific foundation of a regulation; a program; grant submissions; a . . ." should grant submission be singular as well?

Page 25. "ideas, while cautious and being able to separate facts from fiction?" Should be "being cautious" . . .?

Nice decision to include a "Fallacious" category.

Page 29. "the experiment or other claims." Should both be singular?

John W. Menke. PhD, Colorado State University, Range Ecology. Rancher, Quartz Valley Red Angus; Range Ecologist, Department of Agronomy and Range Science, University of California, Davis (ret.). Fort Jones, California.

From: John Menke
Subject: ESIPRI Peer Review Manual
Date: July 10, 2012 02:07:35 PM PDT
To: Bob Zybach
Cc: Paul R. Houser, Bob Alverts, Marcia Armstrong

Paul's review is very timely for me. While I was an associate editor for the Journal of Range Management for approximately 5 years during the 1980s, I am so inadequately prepared to give you useful input on your document compared to the superior skills and contemporary insight and understanding demonstrated by Paul in his review that I cannot at this point provide useful suggestions.

Your mission is outstanding and such a manual and service is needed. However, I do not think your manual will displace existing quality journal peer review, but learning in Paul's statement about blog-based transparent review is totally new to me and appears at first assessment on my part to be outstanding. As a presenter of original research findings I as a scientist would welcome more ideas from any qualified person to make the research presentation and methods better.

I appreciated Paul referring to the dam removal 'peer reviews' we are dealing with; I have never been witness to such a biased effort to use 'peer review' for any purpose, especially where the purpose of the supposed additional studies was to aid a secretary to make a decision for an action when in fact the decision had already been made previously. If I were a government scientist given the responsibility to do research to aid such an impacting decision, and I found out after my thorough efforts that what I learned would not be used, I would whistle blow on that process immediately.

I read your document and concur with Paul's points. In reading the document I found myself wishing to read a 5-page narrative to begin with that capsulated the entire manual's content in brief with justification, content outline, and expected use for the manual. When I first learned of your efforts, I said to myself this manual could be as timely as Paul's whistleblower action on the Klamath River dams removal decision process. I think such a case study as an appendix item in your manual would add immensely to its usability.

A. Alan Moghissi. PhD, Technical University of Karlsruhe, Germany, Physical Chemistry. President, Institute for Regulatory Science. Alexandria, Virginia.

From: A. Alan Moghissi
Subject: RE: Peer Review, EPA, Forestry, and Science: Salem radio interview transcript
Date: April 9, 2012 05:55:55 AM PDT
To: Mike Newton, Bob Zybach, John Marker, Bruce Courtright, Larry Alexander, Bob Alverts, Carl L. Johannessen, Charles Kay, Sharon Beck, Marcia Armstrong, Jim Petersen

The issues identified by Mike [Newton] and the discussions with Bob Alverts the other day is the reason for the establishment of the Institute for Regulatory Science and my efforts described in numerous publications. Bob told me that you have not seen my recent testimony in a committee of the House of Representatives. Attached is the text of testimony. Bob suggested that the three of us (Bob Z and Bob A) prepare a Manual for Peer Review with the tentative date being May 1, 2012. I will try my best to meet that deadline.

From: A. Alan Moghissi
Subject: Peer Review Manual for ESIPRI
Date: May 4, 2012 06:45:58 AM PDT
To: Bob Alverts
Cc: Bob Zybach

Attached is a manual that was developed in cooperation with one of my students. Please consider this version as the point of departure. Let us talk about where we go from here.

From: A. Alan Moghissi
Subject: Peer Review Manual for ESIPRI
Date: May 6, 2012 05:51:20 AM PDT
To: Bob Alverts
Cc: Bob Zybach

Let us talk on how we revise the document to be a joint RSI-ESIPRI document. Let us get together when you are in town. Hopefully by then we can reach an agreement on the entire project.

From: A. Alan Moghissi
Subject: ESIPRI activities
Date: June 7, 2012 12:37:54 PM PDT
To: Bob Zybach, Bob Alverts, Bob Benze, Karl Duff, Norman MacLeod

The meeting with Bob Alverts was both enjoyable and constructive. Meanwhile I have received several messages from Bob Zybach. Let me summarize the conclusions with the meeting with Bob and suggest potential next steps.

1. Bob and I concluded that it would be more appropriate for ESIPRI to develop its own Peer Review Manual rather than coauthoring the manual with me and my student. You are welcome

to quote from the manual you received from me. At the end of your report you reference my report and indicate that you had permission from the author (me) to use some of the text for your report.

2. – 4. [removed: off topic].

5. In my opinion there is a major potential for good work by ESIPRI. However, it is imperative that you speed up you process.

6. Please distribute this e-mail to others who are members of ESIPRI or ESIPRI friends

From: A. Alan Moghissi
Sent: Tuesday, August 21, 2012 11:25 AM
To: Bob Alverts
Subject: Manual

I finally had a chance to look at your manual. After a brief evaluation it appears that you had adopted information from several reliable sources. I found no error in the document. Obviously I did not try to text edit or copy edit the document.

Let me now address where we go from here. Much like all open-access journals, the publisher of the new journal requires that all authors pay a fee of anywhere between $600 to $900 per manuscript. I find the number for all but government supported manuscripts to be too high. The only way to, at least partially, help is for me to set up the oversight committee and combine the potential costs of the Committee and the publisher.

I urge you to start the program, as quickly as possible by peer reviewing a smaller project and charge a relatively small fee. Government agencies assume a minimum of $50,000 for each review. I suspect that you can do with less. I would be happy to be of assistance once you have identified a client.

From: A. Alan Moghissi
Subject: Peer Review
Date: October 15, 2012 10:03:39 AM PDT
To: Bob Alverts, Karl Duff, Marty Cannon, Jerry Hutter, Bob Benze, Bob Zybach
Cc: Jim Petersen, Julia Rickard

In my discussions with a number of individuals from ESIPRI, I have gotten the impression that you are struggling to identify your pathway. You must make a fundament decision on the objective of ESIPRI notably how you intend to fund your activities. There are fundamentally two processes to fund your activities:

1. You provide services and get paid.

2. You try to seek funding form various organizations by writing reports, and otherwise promoting a cause.

If you decide to choose the first approach, you would benefit from some initial funding to start the process. However, with minor exceptions you do not need fundraising.

The Institute for Regulatory Science (RSI) followed the first approach and during its active life had, on the average, about one million dollars annual income. Initially, it was only me with my wife Barbara helping me and then we had a secretary and eventually we had 30 people. Our advisory group included Dixy Lee Ray, Fred Seitz, and several others with comparable distinction but we had no Board of Directors.

If you decide to choose the first option, you must concentrate your efforts on marketing. Ideally, you should have at least one paid peer review per month. I am suggesting that you attempt one peer review for 2012 and at least six peer reviews for 2013. In order to avoid the appearance that the results of peer review are based on the payment by the sponsor, I am offering the support of RSI by providing the oversight through the Peer Review Oversight Committee. In addition, by publishing the peer review reports in the journal *Regulatory Science and Technology*, I am hoping that the opponents of acceptable science will have much less ammunition to attack the results of the peer review.

In the following I am summarizing what needs to happen to make ESIPRI viable:

Requirements for selection of Reviewers

You need to start developing a database on potential reviewers. You also need to ask them to provide you with their CV [*curriculum vitae*] and these must be converted to standardized format. We developed the standard and would be happy to assist you. The selection of members of the Review Panel must be based on the totality of that individual's qualifications as follows:

1. Education: A minimum of a B.S. degree in scientific, engineering, a relevant field would be required for any Panel member. In practice, the Panel members are likely to have advance degrees.

2. Professional Experience: Because of the rapid advancement of science and engineering, often relevant professional experience is as important or more important than earned degrees. Consequently, significant experience in the area that is being reviewed or assessed is necessary.

3. Peer Recognition: Election to office of a professional society; serving on committees of scholarly organizations; relevant awards; and similar activities are considered a demonstration of peer recognition.

4. Contribution to the Profession: The individual's contribution to professional advancement may be demonstrated by publications, particularly those in peer-reviewed journals. In addition, patents and similar activities are also considered.

5. Conflict Of Interest: There are well-established processes for determining the lack of conflict of interest. These include financial, personal, institutional and others. The fundamental principle is: *Those who have a stake in the outcome of the review may not act as a reviewer or participant in the selection of the reviewers.*

Review Criteria

One of the primary reasons for lack of acceptability of peer review is the misunderstanding on the critical role to questions (review criteria) provided to the reviewers. Typically, the sponsor of a review provides the objective of the review and the ESIPRI should convert the objective into review criteria

Peer Review and Reports

A peer review report can be as short as a few pages and as long as several hundred pages. The structure of the report should be as follows:

Introduction: The introduction or preface describes activities that led to the preparation of the report. This section is typically short and no more than 1- 2 pages

Executive Summary: This part briefly describes the project or subject, and a summary of criteria, findings and recommendations.

The Process: A description of the peer review or scientific assessment process is included in this section.

The Project or Subject: For peer review this part describes a summary of the subject that was reviewed. For scientific assessment this part consists of several sections describing relevant information on the topic that is being assessed.

Criteria and Findings: This section of a peer review report contains the review criteria and findings of the RP, reporting the shortcomings and meritorious aspects of the project. This section of a scientific assessment report contains the findings of the AP responding to the assessment criteria.

Recommendations: The recommendations of the panel are derived from the findings of the panel and are the true outcome of the process.

References: Much like all scientific documents, this section includes references to documents

used during the review or assessment.

Biographical Summaries: The credibility of review or assessment depends greatly upon the individuals involved in the review or assessment process. This section includes biographical summaries of members of the panel and others who were involved in the process.

My Plans: In order to assist you I need to know the roadmap you intend to follow. If you decide to have at least one peer review this year, the RSI must rejuvenate its oversight committee. I must also plan for helping you during the initial period of your activities. I planned to contact other NGOs and use ESIPRI as an example on the relationship between RSI including the journal *Regulatory Science and Technology* on how they can use peer review and have the results published. Please let me know your plans.

Michael Newton. PhD, Oregon State University, Forest Ecology. Professor Emeritus, OSU College of Forestry, Department of Forest Sciences. Philomath, Oregon.

From: Michael Newton
Subject: ESIPRI Peer Review Manual: 1st DRAFT
Date: July 2, 2012 10:43:52 AM PDT
To: Bob Zybach, Robert Alverts
Cc: Mike Newton

Did you want me to do anything with the drafts you attached with this invitation, or should I just wait until I get a more polished version in 30-60 days?

Bear in mind that the peer-review process typically involves a mind-set of the reviewer rather than a bulletized checklist. The checklist you provide here is great training to orient the mind-set, so it is a useful approach. I don't know if such a document even exists somewhere, but I can't believe nothing like this exists in some form. Reviewer discipline is the most important single factor, I suspect, in reading a document slowly enough to really capture it message(s) with proper care to ensure the message does or does not agree with or violate existing principles, and how such violation manifests itself where that is the focus of the critique.

It takes many years to prepare for the writing of a scientific paper. The reviewer may have as many years invested in learning how to write in his field, but not in someone else's field or even in a closely related field. So it does take a good bit of soul searching to accept the review responsibility. Can I do a good job? Will I take whatever time I need to do this job well?

Of course, there is no possibility this self-examination will occur every time. We are paid to write/publish, and peer reviews are a significant time sink for which there is no credit. Yet we are expected to do 3-4 reviews for each paper we write. I have written hundreds of papers, and have reviewed a great many, but NOT even close to 3-4 for every one published even when I have served as Associate Editors for a couple of journals. There is something very wrong with this picture. My guess is that many senior scientists, the ones who have the heaviest obligation, do not do their (our) share. And the scientific community is not willing to lean on us older scientists to do this kind of work when we should be off rustling grants and leading "wonderful" programs. I think this is a problem that is not part of the review process as we know it, but surely is part of the system we work in. It needs to be dealt with if peer review is to work. I think every PR [peer reviewed] paper needs to have at least one review by a very well established scientist.

I addressed this to myself as a reminder a) to remember it while reviewing your manuscript, and b) to remind myself to do my share! I am glad you are doing this, and am glad to provide a review.

From: Michael Newton
Subject: Science Retractions
Date: July 5, 2012 10:35:30 AM PDT
To: Bob Zybach

I haven't gotten through most of the meat of your treatise. I may get past the first five pages in the substance of the document to find out why the "Pentateuch" sounds so much like a regulatory document. At this point, that is something you may want to look at.

My comment above comes from having to work with a bunch of EPA [US Environmental Protection Agency] and DEQ [Oregon Department of Environmental Quality] documents that go on and on about regulations without every getting to a rational analysis of what is to be regulated. In most instances, I think I could have suggested a two-page introduction that would simplify everything that followed and shortened the whole regulatory package into something anyone could follow and accept. Having said that, on page 6 and beyond, you get to the nitty gritty, and spread the peer review process much more broadly than just science writing, which is good.

Maybe I read too fast through the first few pages. Don't do anything in response to the above until I have gone through the rest, maybe learning the "why" of the first few pages.

You have undertaken a big job here. It is not without precedent, as you say, and perhaps that is one reason why this needs to be summarized as succinctly as possible, especially in the introduction. So much for a first impression. Ignore unless you can find something useful here.

From: Michael Newton
Subject: ESIPRI Friday 13th meeting
Date: July 17, 2012 10:44:03 AM PDT
To: Bob Zybach
Cc: Bob Alverts, John Marker, Bruce Courtright, Darrel L Kenops, Zane Smith, Barry Wynsma, Jim Petersen, Bob Benze, Karl Duff

I have just had an interesting experience, dealing with the legal action by veterans of various stripes suing for damages from Agent Orange. In winnowing through literally thousands of pages of published and agency paperwork, I have found nothing from EPA, and virtually nothing from epidemiologists regardless of fame, that establishes whether troops ever had contact with either the herbicides or their contaminants. Nothing. Yet our own National Academy of Sciences and Institutes of Medicine have put together volume after volume that bases assumed contact on one flawed model that says anyone within three miles of any application of Orange was exposed, even recognizing that nobody was in a sprayed area when the spray went down!

There is no way of verifying this hypothesis, so courts are accepting the assumption of contact on the basis of no positive data, and of de-minimus data showing that there is some contact only if people got wet with the chemical! Our government is looking at present awards of $40 billion per year to vets for this alone, and the manufacturers are looking at tort claims now from Korean troops with no evidence they were that near it. All on one assumption that has never been verified or even tested.

So there is a big job to do on scientific accountability when there are gaps in data (especially). I am totally disillusioned about integrity in our academic system.

Now on the specific issue of reviews, there is a huge hurdle to clear. That relates to university "prestige" being tied to publishing, especially in "prestigious" journals. (Please note here that Webster's Unabridged D. defines Prestige as derived from the same stem as prestidigitation, the work of magicians! So we have every faculty member writing like mad, hoping 2-4 people who are "experts" will verify the work and get it published. Well, how many understand the commitment to do 2-4 reviews for each paper he submits? I absolutely know that I have not come close to meeting that criterion even though I review a lot of papers. Where are the reviews coming from????

My sense is that very few reviewers take their job as a serious commitment to make manuscripts better. Many critics of my manuscripts are terrible detailers who may not even understand the general principles involved with quality in the paper. Terminology nitpickers. Analytical and procedural nitpickers are legit much of the time, but style-junkies are a waste of time. We waste so much time and junk so many valuable studies because of details.

And we write far too many papers. And that is an absolutely crucial problem.

On top of that, some of our federal agencies, among them regulatory agencies that MUST be accountable for high quality data to provide effective standards, often issue document after document based on poorly based opinions or politically driven hypotheses—and these documents are cited again and again, and are almost impossible to repeal or revise. Where accountability is critical, it is sometimes most remote.

So I have huge respect for those of you seeking redress for this problem. Concurrently, I would love to see regulatory agencies forced to have legitimate reviews as if going to scientific journals, and also see universities lose state funding if more than some modest share of their operating budgets is for federally sponsored research. That might give investigators a chance to catch up on their review responsibilities, and release some effort to verify government publications and regulatory documents where review is most needed.

You guys, along with the rest of us, have a mission perhaps too large, but on which we all depend.

Thank you so much for this emphasis on integrity in science!

From: Michael Newton
Subject: ESIPRI Peer Review DRAFT
Date: August 13, 2012 09:46:34 AM PDT
To: Bob Zybach, Mike Newton
Cc: Bob Alverts

Just to let you know that I have not finished my complete review. I have been through the first 22 pages, and am running into a perspective problem.

The peer review process is a very personal thing for both author and reviewer. When a scientist accepts a commitment to do a review, he agrees to immerse himself in the thought process the

author was in, and to think as much about the approach to the research/proposal/operational analysis as possible. The quality of the review will be directly influenced by the degree to which this immersion is successful.

Nothing in this analysis addresses the mind-set of the reviewer; the process-centered document of ESPIRI does not address this, hence it is very limited in what it can do about quality. The Manual cannot succeed in its purpose without this very critical concept as a critical component of reviews.

This manual seeks a quality control mechanism by putting quality control segments into the process. But it is process centered rather than science centered, and is thereby limited in what it can do. I have no objection to many of the stepwise features of the manual except that they appear to threaten greatly extended times for review to be completed. And that is a lethal problem.

The manual has attempted to fix a process that probably cannot be repaired under current academic cultures, and for several reasons. First, research institutions are so focused on grinding out papers that very few senior researchers have time to immerse themselves in someone else's thought processes. Second, the pressure to publish if far greater than the pressure to review, hence nobody gets credit for reviews—why bother to waste time on them??? Perhaps among the most serious problems is that scientists today are typically very narrow, if deep, in their fields, hence are limited in the way they are capable of judging broader implications of a research document or analysis of a proposal etc. The review process must address the issue of interaction with factors beyond the specifics of the document.

The manual also structures the review process as a step-wise process with too many steps, in my opinion; it implies that procedural steps are really important, hence must be observed. It reads like an EPA manual for regulatory action.

Those are my immediate reactions to the Manual in its present form. I am not sure how to fix the peer review problem, frankly. Reasons below explain sources of frustration:

1. Scientific disciplines are increasingly narrow, yet they must be linked to what goes on around them such that someone with a general background is an essential link to comprehensive science.

2. Doctoral programs have almost no linkage within the educational process that will help broaden a candidate's experience of judgment

3. Hundreds of thousands of scientific/technical documents are being written in response to the need to compete for grants; the peer review load is excessive.

4. For peer review load to be equally distributed, we all need to review 3-4 times as much as we publish. If we review 3-4 papers for each paper submitted, it slows production of new manuscripts even though it informs about current literature; the lack of rewards is a serious disincentive.

5. Finally, senior scientists logically need to bear responsibility for most peer reviews, meaning maybe a ratio of 6-10 reviews while publishing one. And that is not going to happen as long as senior scientists are totally occupied soliciting funds and generating their own manuscripts. This is a problem that cannot be fixed readily, and certainly not by increasing the complexity of the review process so it takes more time.

I will continue working on this, and see if I can come up with suggestions for a simpler guide. Because I am apparently not very efficient in this endeavor, there will be no charge for my time. I do hope the Manual can be shortened, and also acknowledge the very personal level of interaction involved in good reviews that cannot be guaranteed by a lengthy organizational structure.

It has been interesting to look at your approach; I am sorry I can't be more positive about the detailed approach.

From: Michael Newton
Subject: ESIPRI Peer Review DRAFT
Date: August 13, 2012 10:29:13 AM PDT
To: Bob Zybach
Cc: Bob Alverts, Mike Newton

As far as I have gone, I have proposed deletion of quite a bit of the process-based stuff, and what I need to do next is a prefatory statement about the mind-set of a reviewer.

The opportunities for fixing the cultural problems of over-specialization and grant-swinging focus to stay alive academically will continue to plague us. Without a change in that, there may be no remedy for quickie reviews and for lack of breadth in what we publish. I will see what I can do, but I promise that there will be no magic!

Regardless of the future of this manual, I sense that a one-page guide to reviewers AND THEIR DEPARTMENT HEADS would be a good idea, to be forwarded to proposed reviewers by editors. Without increasing the visibility of efforts to provide good reviews, credit will never be given toward tenure, promotion, etc. At the moment, the pressure for publishing and bringing in grant money is far higher than pressure for reviews. Just that one step to increase acknowledgement by administrators would be very helpful.

From: Michael Newton
Subject: ESIPRI Peer Review DRAFT
Date: August 14, 2012 12:31:59 PM PDT
To: Bob Zybach
Cc: Bob Alverts

I will stuff into a fat envelope a badly scarred draft Manual with my footprints all over it. I have proposed lots of deletions, but perhaps not taking into consideration the exact purpose of this effort, as defined by Zybach in this message. So I will not feel rejected if I have misconstrued what was intended. Not at all.

Regardless of whether my comments are useful, I suspect there are elements of it that may prove useful, so I hope you will at least think about why I may have done what I did, and why I may have suggested deletion of large chunks of it. The Prefatory Statement I am attaching here, and which I will enclose with the marked up copy, will provide some insight from someone (me) who does a lot of reviews as to why this process will never be neat and tidy. We are all just humans, each with our own judgment. And the proliferation of sub-disciplines will simply make the review process less and less likely to get good general assessments that guarantee breadth as well as depth.

I wish you guys every success in this venture, whether my remarks seem to indicate that or not. Our scientific system is really out of control, and much of it has lost an important element of judgment. We can't do much about that, and as long as universities pin their hopes and revenue on football and prestigious articles in Science magazine, quality will suffer. And inevitably, we are all in the game.

From: Mike Newton
Subject: ESIPRI Peer Review: Handwritten notes
Date: October 24, 2012 10:40:32 AM PDT
To: Bob Zybach

I don't mind public exposure of my comments where they can be understood. Obviously, these were made for the benefit of those who were immersed in writing the document, so the comments in many cases would not be logical to the casual reader.

That said, you certainly have my permission to use whatever will improve the value of the over-all document and process that it serves. I only ask that you be careful when doing so to ensure that whatever appears in a final document makes sense; some of those made on the spur of the moment may not be taken in a useful context! My goal was to help you all to reach your goals effectively. Some of these comments would not be helpful if taken out of context . . .

I did not keep a copy of your marked-up draft. This means I am unable to match these comments with what I sent you so as to respond appropriately to your request. Thus the above exhortation to use only those that help you to make your own points. My biases are not important, and my choices of words that I use with friends may not be read with my intended meaning. So, use what will help you make the intended points!

I think what you folks are doing offers a fine service, and my improved understanding of goal and process now leads to strongly positive impressions of your goals. Anything I can do to improve the review process is time well spent! You all have made a unique proposal that may eventually bury you with work if the mad scramble to publish or perish continues to accelerate!

Outside the specific context of your proposal, at the moment, my sentiments are that the race for grant money has weakened a lot of science, and definitely weakened the teaching function of our universities. I pray for fewer, and broader publications in our field(s). And increased emphasis on relevant teaching.

Edward W. (Ed) Shepard. MS, Washington State University, Forest Management. President, Public Lands Foundation; State Director Oregon/Washington Bureau of Land Management (ret.). Newberg, Oregon.

From: Ed Shepard
To: Bob Alverts
Sent: Sunday, July 15, 2012 3:21 PM
Subject: Review of 1st Draft Peer Review Manual

I've been going through the manual and think it is pretty good for a first draft. I do have a few comments and will probably have more later. We're heading out to New England tomorrow and will be gone until the first week in August, so I wanted to get you what I have now. One person you might want to ask to look at this is Dave Cleaves with the USFS [US Forest Service]. Dave and I talked peer review a few times when we were both in Washington and he has some concern with how some peer reviews are being conducted these days.

I reviewed the document from the perspective of an agency executive and how I would like to have the science used in interdisciplinary programs reviewed. For background, we asked a group of scientists to review the [US Bureau of Land Management (BLM)] WOPR [Western Oregon Plan Revision] to see if we were appropriately applying the science that some of them authored. We provide the scientists a list of questions to respond to (I think there were 4 questions). I did not consider this a peer review, but more of an assessment of did we interpret the science correctly. Some scientist provided critical feedback, which is exactly what we wanted. Some elected to provide comments on the entire plan and go beyond the questions we asked. Some were critical that we didn't choose to optimize the particular resource they were interested in. After some back in forth between the scientists and resource specialist, I believe we improved the final RMPs [Resource Management Plans]. I purposely did not participate, even though I knew many of the scientists, to avoid the perception of "management interference." However, when we published the report on the web, the headline became "BLM WOPR Fails Peer Review." We were even accused by one Oregon member of Congress of hiding the results because the review was so bad, despite the fact that we put it on the web.

My point is that we expected a critical review so that we could improve the plan. We wanted to be transparent and publish the results. The end result was that we did improve the plan or, at least were able to discuss the conflicting points in the EIS [Environmental Impact Statement]. That was positive. The negative was that the report was used by those that opposed what we were doing to poison the plan through negative news stories and rhetoric. I don't have to worry about this anymore, but if I did, I would have to think long and hard about doing it without some type of controls (like this manual is attempting to articulate) in place.

After my initial read of the manual, I still am not clear if what the BLM was attempting to do would be considered a peer review or a scientific assessment of environmental science. I think I could read from the manual that either may be appropriate. I found the document pretty clear on other reviews.

Some specific comments:

Definitions

Fallacious Science definition*:* I have a problem with this definition as I do not consider this science. After reading the discussion on page 24, where this is referred to as fallacious information, I understand how this is useful to include. Is there some way that this could briefly be included in the definition, maybe by reference to the discussion on page 24?

Full Disclosure: Consider something like: The revelation of all known information that may support or conflict with the findings of a scientific report. Also, the revelation of all known or perceived conflicts of interests, or biases of a reviewer.

Open Access:??

Proven Science: Consider - A scientific theory that has been shown through application of scientifically accepted methods and replication to be undisputable has a very high probability of being correct???????

Reproducible Science: Consider - Scientific experimentation where the results of an investigation are statistically reproducible when carried out independently by other investigators using the same methodology.

Transparency: Consider - Scientific investigation or review where all actions can be openly seen by independent reviewers.

Do you think s definition of gray literature should be included?

I don't know if my crack at these definitions is worth anything, but I offer them for discussion purposes.

Applications

I can read the section on Independent Peer Review to say that any document using science can be peer reviewed. I can see this for developing a regulation, e.g. setting thresholds for water temperature for the survival of coho, but not for management methods to achieve or not exceed the temperature. I would see the latter as using scientific assessments or even a technical review. Likewise, I can see how peer reviewed science could be used to inform decisions in a land use plan, but I'm not sure peer review would be effective in reviewing those decisions where the decision-maker must consider input from multidisciplinary "hard" sciences and, often from the "soft" sciences (politics) to make trade-offs to meet multiple objectives. Again, the latter would be more in line for an assessment in my mind.

One possible way to clear up my confusion (not sure others are confused with this) might be to provide more specific examples of where peer review vs. assessment vs. technical review is appropriate. An appendix with FAQs [Frequently Asked Questions] might also help.

Structure of the Independent Peer Review Process

I totally agree with Mike's statement. In addition, one of the points that Dave Cleaves and I talked about in the past is that, with all the R&D cutbacks, there are so few investigators that it is sometimes difficult to find reviewers that do not know the investigators and the work they are doing. This can lead to a concern that reviewers may not be too critical of a colleague for fear that they will know who the likely reviewers where and know that they may soon be peer reviewing their work.

Conflict of Interest Declaration Form

Under Intellectual Interest religious belief is discussed. Was this intended as literal, as in opposed to certain forms of medical treatment on spiritual grounds; or figurative, as in believing that an action is so abhorrent that it should never be carried out. If the latter is the intent, I recommend dropping the reference to religion.

Requirements of Multidisciplinary Projects

This is the section that, in my opinion, has the most application to agencies like the BLM or FS for reviewing land use plans. The disciplines that the agencies address in LUPs [Land Use Plans] are so numerous that it would, as suggested, make having 3 reviewers for each discipline too onerous. I agree that this would need to be somehow controlled. Perhaps a consensus panel could agree on the most controversial areas from plan scoping or from public or scientific comments and concentrate on those areas. Again, I'm still not certain if this would be better as an assessment or actual peer review.

Class II - Evolving Science

5. Scientific Judgment

I would suggest rewording the last sentence of this section to read: "However, this class is often tantamount to a collection of educated opinions." My thought is that the experts possess considerable experience that may not be captured in literature. Their opinion may rest in years of undocumented observations, so I think that their judgment is more than a guess.

These are my initial thoughts based on my review so far.

In response to your specific questions:

1. I really do not have an idea as to what one should charge for a review. I have only done this as a fed and was paid whatever rate I was graded at. My thought is that probably no less than the pay for a GS-12 [US General Schedule Grade 12: about $35 to $45/hour, January 1, 2012] would be appropriate for the hours actually spent conducting and documenting the review.

2. I think 4 to 12 hours on this document is appropriate.

3. Yes, I would be willing to have my comments on a final review posted on a web site. I don't think it would be appropriate to put comments on a review of a preliminary draft on a public web site.

I will be back around Aug 2 if you want to talk over any of my comments. Hope some of my comments help. I think this is an important undertaking.

From: Ed Shepard
Subject: ESIPRI Manual Review comments
Date: August 30, 2012 01:03:54 PM PDT
To: Bob Alverts, Bob Zybach, Jerry Hutter
Cc: Ed Shepard

Thanks for the opportunity to review the manual. As we discussed before, I think this is really needed. It is becoming more so as science gets "used" more and more by politicians and others to push their agenda. An objective, transparent process is needed. I found this version of the manual very readable and feel it should serve as a good tool as ESIPRI works toward its mission.

Zane Grey Smith, Jr. BS, University of Montana, Forestry. Forest Supervisor, Pacific Southwest Region, US Forest Service (ret.). Springfield, Oregon.

From: Zane Smith
Subject: ESIPRI Final Peer Review DRAFT
Date: August 5, 2012 10:54:56 AM PDT
To: Bob Zybach

Impressive and needed. An invaluable contribution to science.

Thomas J. Straka. PhD, Virginia Tech, Forest Resource Management and Economics. Professor, Department of Forestry and Natural Resources, Clemson University. Clemson, South Carolina.

From: Thomas Straka
To: Bob Alverts
Sent: Sunday, August 05, 2012 10:55 AM
Subject: RE: ESIPRI Peer Review DRAFT MANUAL

This is a very interesting manual. I glanced at it and did note a couple of things. I will pass them on, but these are just casual observations not formal comments. But you might find them useful. I would give it a better review but am off after tomorrow for making charcoal in Penn. Pat and I do this each summer. Plus, it turns out to be in the backyard of the Allegheny SAF [Society of American Foresters] Summer Meeting, so going to attend that also. So out of office for a week after tomorrow.

Your reference section has some problems. There are a number of acceptable ways to reference, but your way is kind of unusual. I write all the time, so it is second nature to me. I will rewrite some of the references in a more typical style for forestry.

Dearfield, K. L., and A. R. Flaak. 2000. *U.S. Environmental Protection Agency Peer Review Handbook* (2nd ed.). EPA 100-B-00-001. Washington, DC: Science Policy Council, U.S. Environmental Protection Agency.

Dost, F. N. 208. Peer review at crossroads—a case study. *Environmental Science and Pollution Research* 15(6):443-447.

Moghissi, A. A. 2011. *The Need for Regulatory Science Transparency at the EPA*. Statement before the Subcommittee on Energy and Technology, U.S. House of Representatives. November 30, 2011.

Moghissi, A. A., and M. A. Anderson. 2011. *Independent Peer Review of Regulatory Science Information*. Alexandria, VA: Institute for Regulatory Science.

Moghissi, A. A., Swetnam, M., Love, B. R., and Straja, S. r. 2010. *Best Available Science: Fundamental Metrics for Evaluation of Scientific Claims*. Arlington, VA: Potomac Institute Press.

Newton, M. 2008/ More on peer review: Quality control for a costly product. *Environmental Science and Pollution Research* 15(6):439-442.

And some very general comments;

Seems like you could have mentioned statistics a little more. More of the underlying support for peer reviewed claims come from statistics. Except for that short mention under correlation, you both don't say much on the subject. It is the fundamental tool.

There is a big distinction between customs in the social sciences and those in the "hard" sciences. You don't mention that. For a basic review, it seems that would be mentioned. Might bring that up in discussion of regulatory and environmental science early in the text.

The discussion on **pages 7 and 8** caught me off guard. You had been discussion peer review. Then you moved into stakeholders. Stakeholders are part of the decision—making process, but are necessarily peers. It seems like you broadened the subject from peer review to the peer review environmental and factors that impact the results of peer reviews. Anyway that material seemed out of place to me.

The discussion on **pages 20 to 21** on predictive models raised a red flag to me. As an economist, I would argue strongly against a couple of statements made there.

I would have no problem finding much literature disagreeing with the premise. I know where you are coming from, but we are getting back to my earlier remark on social science. You seem to be saying that only "hard" science is science. Social science does not qualify. The Nobel Prize Committee disagrees with you both, and does give a prize for this type of "soft" science in economics.

Bob, I read it quickly and found it informative and well-written. You wanted comments, so here are a couple.

Richard A. Zabel. MS, Washington State University, Adult Education. Executive Director, Western Forestry and Conservation Association. Tualatin, Oregon.

From: Richard Zabel
To: Bob Alverts
Sent: Thursday, July 19, 2012 9:28 AM
Subject: Review of 1st Draft Peer Review Manual

I read your draft from the angle of managing the process and keeping everything functioning. One of my most difficult business management operations is finding experts to volunteer their time to give presentations. Everyone is overloaded on their job and 'volunteer' time is almost non-existent. Your system will rely on an extensive body of reviewers, panels and committees. Your staff will need to dedicate considerable time to recruitment and volunteer management and your budget may need to include compensation for time involved in a review.

Second: it will be imperative that ESIPRI maintains a neutral reputation in the scientific community. Once ESIPRI is branded one way or another, reviewers will hesitate to be associated with it due to some perceived reputation.

Third: your staff will also have to dedicate considerable time to simply keeping everything moving ahead on a reasonable time frame. There will be lots of moving parts and each will need to occur within a short time frame.

Fourth: Unfortunately, one of your main selling points will need to be an answer to the reviewer question: what is in it for me? The reviewer has very limited available time and will want to know how they will benefit. The argument that this effort will lead to the overall betterment of our scientific knowledge and professional credibility will not sell.

ESIPRI
ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES

APPENDIX B. FORMAL AGREEMENT PEER REVIEWS: DRAFT #2

This appendix contains six formal reviews of the second ESIPRI Guidelines draft, performed by a wide range of highly qualified environmental scientists and natural resource managers. Each review was based on a signed agreement between ESIPRI and the reviewer, and under the following terms:

> *Reviewers: Please answer the following eleven questions regarding your review of the ESIPRI Peer Review Manual Draft. Short sentences and brief answers are fine. It is important to remember that signed and finished reviews will be made public on the ESIPRI website following completion of the manual, and that reviewer's words may be referenced or cited in other media in relation to this project as well.*

The following list of reviewers is comprised of five senior environmental scientists and the recently retired Oregon/Washington State Director of the Bureau of Land Management. These individuals include nationally recognized experts in the fields of geography, climatology, marine biology, forestry, wildlife, genetics and hydrology. They have also represented the scientific and resource management arms of several federal and state agencies and a number of leading research universities during the courses of their individual careers. Reviewers currently live and work in their respective states of Colorado, Oregon, Washington, and Virginia.

Slight corrections of spelling and typos have been made, and all of responses have been re-formatted to a generally uniform style in order to reduce confusion caused by the writers' differing approaches to numbering, labeling, and/or the use of bullets. Text formatting has also been standardized for the purpose of creating specific page numbers for formal citations and other references.

Dominique M. Bachelet. PhD, Colorado State University, Botany and Plant Pathology. Climate Change Scientist, Conservation Biology Institute. Corvallis, Oregon.

ESIPRI PEER REVIEW QUESTIONS

General Comment

This manual gives the overall feeling to the reader that what passes for a peer-review process today is gravely flawed and that this manual will shed much needed light on the right way to approach the issue. As a scientist, well aware of the limitations of the review process, I resent the tone of the manual to the extent that it assumes there is no such description of the peer review process outside the writings of Moghissi et al. and of this manual.

In fact the review process has been described and written about by many organizations such as the Ecological Society of America, the American Geophysical Union, the Society of American Foresters, and many others, all the scientific journals that request peer-reviews, and all agencies (NSF, NASA, USDA, NIH: see end of this review for sources) delivering funding for scientific research. All of them have been struggling with the various issues that come from the fact that human decisions are always in part subjective and that the best intentions can sometimes go awry. I did not read one quotation from any of those sources in this manual and I think that is an important missing part of a "review" such as this that intends to extract the best principles of the review process.

I am also surprised at the amount of material copy/collated verbatim from Moghissi et al. Despite permission from the authors I would consider this manual as mostly an exercise in undisguised plagiarism. Another problem with this is that Moghissi is clear in explaining that his goal is to address the peer review process specifically for **regulatory sciences** (Zybach and Alverts are well aware of this since they mention it clearly on page 3). But the manual by Zybach and Alverts does not make this claim and aims to encompass all sciences. Consequently the quotes from Moghissi are somewhat taken out of context since conditions for reviewing non-regulatory sciences can be quite different.

Moreover while reading this manual, the impression that grew in my mind was that ESIPRI and its manual were in fact focusing mostly on controversial issues, the so-mentioned "contested areas of sciences" more than anything else. This reduces the relevancy of some of the advice given. For example if Albert Einstein was to try and publish his famous equation, or Galileo a treaty about the shape of the planet, this manual would not be very helpful and would certainly squash any possibility of creative hypothetical science to be published or shared.

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

To improve its credibility and validity, a thorough discussion of what process already exists and why it is flawed would have been useful. There have been many articles in Science at least by Science Editors and others addressing the issues associated with peer review. Similarly in the last 5 years NSF has been testing new methods to improve the objectivity of proposal peer review.

Not a word of the hard work done by these groups is mentioned in this document. I think we could all learn from them.

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

The overall purpose of the manual is stated as "to protect/promote/restore the integrity of Environmental Sciences". But it is based on and generously borrows much text from the writings of Alan Moghissi who focused specifically on **regulatory sciences** while this manual does not. Thus quotations may be out of context for many non-regulatory sciences. The manual also states it will be used for "internal peer review process and *the basis for organizational functions*." Unfortunately it does not really explain what this means.

3. Is the overall organization of the manual clear and effective? (Why or why not?)

I have found many redundancies throughout the manuscript that could be dealt with to streamline the text.

4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (why and why not?)

Some sections of the document are stronger than others.

5. What portions of the manual should be expanded, condensed or deleted? (and why?)

a) Add comments to document the existing process and particularly the improvements that have been discussed by Science editors, NSF program managers, IPCC review committees.

b) Moghissi's quotes should be reduced and the essence of his writing condensed and interpreted to target the specific goals of this document.

6. In your professional experience, can you provide an example in which each of the 3 described applications (peer review, scientific assessment, and technical review) was or could have been used to advantage? Could have any of these 3 examples been improved with blind/anonymous review? (if yes, why and how?)

Note: To whose advantage? Science or the scientist?

* Double blind reviews have been shown to be much more impartial than single blind reviews. This is particularly true for young researchers and women (Reference in Science). I have had a paper rejected because it contradicted the results of a famous scientist who reviewed my paper. I am certain that double blind reviews would have been beneficial to the review.

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project?

(why/why not)

One cannot use the same criteria to review a model as to review a dataset collected in the field or the description of a new theory or method.

8. Does the manual include interesting insights into the peer review process? (examples)

It was very interesting to read/peruse Moghissi's various papers and the constraints of regulatory science.

9. What are the manual's two (or 3) main strengths? Why?

1. The desire by its authors to produce a useful document.

2. Its existence and the review process it is going through to improve its quality.

10. What are the manual's two (or 3) main weaknesses? Why?

1. Obvious and accepted plagiarism.

2. Lack of in-depth review (strength and weaknesses - examples) of other review process guidelines from agencies, journals, science groups (a table would have been appropriate).

3. Lack of original idea to improve the existing review process beyond what already exists.

11. What specific recommendations do you make for improving this manual?

1. Use more than one source of information to describe review (see answer to question 10) and conduct a thorough review of what works and what does not in the existing review guidelines.

2. Focus objectively on science issues rather than controversial issues that have economic or regulatory implications. Objectivity should be the main principle behind any science activity.

Specific comments:

It would have been useful for reviewers to have line numbers to be able to tag appropriately the detailed comments

In the **acknowledgements** section, end of line 5: replace their by his.

The authors use upper case letters where they may not be necessary: **page 1** - stakeholders, applications, structure … I did not understand why those words were capitalized. This happened throughout the document.

Page 1. "this manual serves as a current guide to OUR internal peer review process, the

basis of OUR …": Is ESIPRI composed of only Zybach or Alverts? If not it might be more appropriate to say ESIPRI's internal peer review process.

"the CLAIMED and APPARENT need for PROPERLY conducted peer review": this sentence contains terms that are not scientifically objective. The correct way to say this is There is a recognized need for always improving the peer review process (references to published articles here would be useful).

Page 2. 1st line: "the collapse . . . WAS (instead of were) the deciding factor in the formation . . .

peer review method (methodology is the general study of methods)

under Peer Review, 2nd line: CONDUCT instead of conducting

for the 3rd time it is mentioned under regulatory sciences that this manual is based on Moghissi's writings. Once should be sufficient.

Page 3. what does "engineering projects in which the TERMS are used nearly interchangeably" mean? What terms?

Page 4. under Environmental Sciences there is no reference to basic research. All the examples are applied. Basic research is often very helpful to collect new data or come up with new hypotheses that can have useful applications but that case is not included in this section.

what does "the round file of faulty scientific claims" mean? And why would fallacious information be the "positive result of peer review"? The **finding** of falsified information or incorrect interpretation or conclusions is usually due to peer review.

Page 5. The 1st and last paragraph contain the same text - reduce redundancy.

in the section on "outside the purview of science" the text reads: faith/religion "… areas that science cannot address": well in fact it can. Many may believe that the earth was created 6000 years ago but science tells us otherwise. The fact that some people refuse to pay attention to the facts does not eliminate the facts.

Page 6. define ethics that would be outside the purview of science. It is unethical to try and publish false information. It is unethical to give a bad review to a colleague competing for the same source of funding. It is unethical for scientists to assume others are ill intentioned (profit, personal fame) when they try to publish a new theory, new interpretations of existing data.

Page 7. stakeholders section - Is the scientific process now driven by stakeholders needs?

"initiators of a proposed action" are rarely decision makers.

Page 8. "Admin. Affected" - This is a poorly written section that did not seem to make a point and was repeating material from the previous section "personally affected stakeholders" (lower caps would be appropriate).

4th paragraph: could you suggest how one may raise enough funds to follow the various directions such as mailing invitations, hiring phone operators and door to door staff? Given the current level of research funding this is not really relevant.

5th paragraph: who sends the notifications?

Page 9. 3rd paragraph - why is ESIPRI reviewing "outside the stream provided by journal reviews"? This is where the goal of this document becomes murky. What is the purpose of this document then?

explain why do you think the National Academy of Sciences uses a "much more rigorous approach" - describe what the differences are.

give examples of reliable vs non reliable think-tanks (Yale, Berkeley, JPL …)

giving specific examples in this section would really improve it. Gov-convened science panels: There are plenty of ex. to choose from.

Independent peer review: typically 3 reviewers for manuscript but a lot more for proposals for ex. that have to go through review panel of usually 10-15 people.

Page 10. "scientific assessments are particularly useful in addressing /…/ scientific judgments" - what does that mean?

replace industrial concerns by corporate entities.

4th line from the end: replace guides by guidelines

Page 11. the scientific technical review is not clearly described. What is it about and how is it done?

Page 13. project oversight committee (POC): is this realistic to have one POC per project? Cost and number of reviewers needed seem prohibitive.

Page 14. oversight committee (OC): "all needed competencies and diversity of TECHNICAL VIEWS" - not sure what this means and an example would clarify this statement. Similarly "an numerous other parameters" in the next sentence is also vague and non informative.

Page 15. if it is a "peer review" why does it have to be "approved" by an oversight committee? Sounds more like censure to me if a peer review was not approved.

the sections Reviews and Reports describe the same thing.

If all projects have to comply to be consistent "with established scientific and engineering principles and industry standards" - how then does one get out of the rut and put forward "creative, original" methods/hypotheses/data interpretation?

Page 16. Conflicts of interest should also include friends, students, and competitors.

Page 18. Recommendations section - use final instead of "true".

revealing the reviewers' identity can cause retaliation following the review or the fear of retaliation during the review process.

Page 19. Objectives of Sc. Assessment - the 1st and last clauses (conducting state of the science report, assessing sc. information) are about objective assessments by experts while the two others advising and assisting in the decision process are beyond the scientific purview: it involves the scientist in the decision process rather than use the science results backed by the scientist's knowledge to help decision making.

Page 20. line 2: sometimes one cannot reconcile contradictory information - more research is needed or an in depth analysis of available information is needed to make 100% sure the facts have been recorded correctly.

correlation vs. causation - how can "issues related to C vs. C" be "a subset of models"?

criteria to address causation/correlation include coherence: what if current knowledge is insufficient and the scientist is developing new hypotheses?

Similarly what if observations are not available in sufficient numbers to give strength to the new concepts? Should this new science be stifled?

In terms of projections, how can there be consistency with simulating the future since repeated observations cannot be collected?

Page 21. define proven vs. applied science.

reproducible evolving science: how can it be reproducible if it is evolving? This is the case for models that can constantly get improved as knowledge expands. Tree growth algorithms are a case in point as growing conditions change with increased pollution (air and water), increased CO2 etc.

I have never seen this terminology - I, II and lower predictive models. These area not defined with any sort of examples that would clarify this hierarchy.

Define rationalized science.

Models are summaries of current knowledge that can pinpoint holes in understanding and foster more research/monitoring/data collection. They are constantly evolving as more knowledge is constantly acquired by field scientists as well as theoreticists, new information that can be used to improve model usefulness. Their value lies in the fact they constitute a common language that translate information from a variety of sources into something tangible that can be edited, commented upon by experts in the field or theory.

It is not a waste of resources to go through the exercise of building a model that summarizes current knowledge, especially when that knowledge is incomplete, even if the resulting model has little predictive ability. It becomes a platform on which to build clear assumptions and hypotheses to move forward in full awareness of caveats and uncertainties.

Page 22. shortcoming of the peer review process - in a few words: subjectivity is inherent to human nature.

most reviewers do NOT have a conflict of interest - if they did they would not have been chosen as reviewers: a signed statement from reviewers attesting of their lack of conflict of interest is one of the 1st requirements in the existing process.

the qualification of reviewers is usually the first criterion to pick reviewers: one does not ask a brain surgeon how to build a house.

why should societal objectives be separate from science? Ecosystem services for ex. are clear goals in resource management.

preconceived opinions: it is called education or cultural background. Unless faith is involved different opinions make for lively scientific debates where all parties can learn from each other.

multidisciplinary projects: Why are multidisciplinary projects of particular interest (to who?) in contested areas of science? This seems out of place.

Page 23. the 2nd paragraph is redundant, a repeat from page 11.

similarly the 3rd paragraph repeats what has been said earlier in the manuscript.

Page 29. 2nd paragraph - quote from Moghissi and Anderson - This paragraph is entirely relevant to philosophy, not science, and is inadequate in this document.

Page 30. "so called" universal principles? Subjective statement.

the reproducible principle only applies to experimental results. It does not apply to theory development and future projections.

it is very strange to separate proven science from applied science. Moreover if applied science is defined here as applications to government, commerce and industry which is obviously

where the goal of Moghissi and ESIPRI diverge, or so it is said early in the document. Consequently this "definition" of applied science is inadequate here.

Page 31. what are "default" data (6th paragraph)?
This section is weak and some of the writing unclear. One talks abut hypotheses not hypothesized science.

the quote by Shepard is inappropriate. What is described here should be called expert opinion.

false information - The following statement is inappropriate in a scientific document: "We Believe" this category (false information) to be fairly large. What is this statement based on? There are no references of peer reviewed literature, no survey results, it is thus pure speculation.

Page 33. 1st paragraph. This section is more adapted to courts of law than the scientific process.

why is "peer review through standard /…/" judged "not as thorough or reliable as independent peer review"? What data are used as a basis for this judgment call? Again this is pure speculation as stated.

Page 34. Newton is quoted "accountability in reviews is a reasonable requirement" - accountability to the editor or program manager/panel convener is always a given in the existing peer review process.

aside from recriminations I would add retaliation

informal peer review is usually the 1st step of any review process and a requirement in most agencies.

Page 35. Grey literature is NOT about personal opinions: it is in general a document that contains more information, particularly about methods, than journal editors will accept in peer review papers. Scientific quality of the information is NOT unknown since the authors are clearly identified, thus their background checked and their published work available.

false information is NOT as frequent as this text would make the reader believe. "It has been observed" (by who? Cite the sources) "that this has seemingly been a preferred category of government agencies … to promote an idea or particular policy". This is 100% pure speculation. There are zero references to survey data or any credible source. This is pure personal opinion the way it is stated here.

last sentence: gray literature is gray literature. No need to split it into categories. It is certainly NOT least valued and I have based many of my research projects on grey literature that was never published in peer-reviewed journals. Many individuals who have worked hard to collect valuable data in the field have put together reports rather than articles that are valuable

sources of information, this include the fire records Bob Zybach came to show me a few weeks ago. Rather than discredit the source off-hand I value these sources and do my own research on the credibility of the source.

Page 36. Personal opinion should not be part of peer review process. Period. Expert opinion, when no data are available, is.

PLEASE CHECK THOSE SOURCES:

Science magazine: http://www.sciencemag.org/site/feature/contribinfo/review.xhtml

Good (if old) articles in nature on the subject: http://www.nature.com/nature/peerreview/debate/ in 2006

at NIH: http://enhancing-peer-review.nih.gov/ in 2011 and
http://grants1.nih.gov/grants/peer/ in 2012

at EPA: www.epa.gov/**peerreview**/pdfs/prhandbk.pdf

at NSF: http://www.nsf.gov/bfa/dias/policy/meritreview/

* EOS article: www.**agu**.org/pubs/crossref/2011/2011EO280001.shtml

among others . . .

Dominique M. Bachelet
Biographical Sketch

ACADEMIC TRAINING

Ph. D. 1983 Colorado State U., Fort Collins, USA. Botany and Plant Pathology.
DEA 1979 Université de Paris XI, Centre d'Orsay, France. Plant Ecology.
DEUG B 1976 Université des Sciences et Techniques, Lille I, France. Life Sciences.

PROFESSIONAL EXPERIENCE

2009-current senior Climate Change scientist, Conservation Biology Institute.
1998-current Associate Professor. senior research, Department of Biological and Ecological Engineering. Oregon State University, Corvallis, USA.
2007-2008 Director of Climate Change Science, the Nature Conservancy.
1989-1998 Assistant Professor. Department of Bioresource Engineering. Oregon State University, Corvallis, USA.
1988-1994 Quantitative Ecologist. ManTech Environmental Technology Inc., US-EPA Environmental Research Laboratory, Corvallis, USA.

PUBLICATIONS

Bachelet, D., B.R. Johnson, S.D. Bridgham, P.V. Dunn, H.E. Anderson, and B.M. Rogers. 2011. Climate Change Impacts on Western Pacific Northwest Prairies and Savannas. Northwest Science 85(2):411-429.

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Bachelet D. 1995. Rice paddy inventory in a few provinces of China using AVHRR data. Geocarto International 10:23-38.

Bachelet D., J. Kern, and M. Tölg. 1993. Modeling the rice carbon budget in China using GIS technology. pp 31-53, In: Huang Xuan, Liu Huigo, Zhou Chenghu, Chen Yufeng, Zhang.

Don Flora. PhD, University of Washington, Forestry and Economics. Program Manager, USDA Forest Service Pacific Northwest Research Station (ret.). Bainbridge Island, Washington.

ESIPRI PEER REVIEW QUESTIONS

PART I

IN WHICH I ASSUME THE MANUAL IS FOR INTERNAL USE

Looks good. I have no quarrel with the material. Moghissi seems to gild the lily a bit with his multiple classifications, but no harm done.

The paper would be easier read if the Introduction were revised as suggested below. However the Executive Summary may fill that need.

I have a personal problem with the role of the Peer Review Panel. I have no stomach for jury-like pressure toward consensus. My life is too short for that, and my opinions are strongly held. If that's true of others it seems to call for a presiding person who complies and presents the (perhaps disparate) views of the Panelists. Consider, for example, that Panelist #1 agrees with the reviewed paper's declaration that in some natural system factor A is strongly associated with factor B. Panelist #2 says factor C would undoubtedly override factor B if C were included in the analysis. Panelist #3 agrees with panelist #1 but points out that time lags and cumulative effects were not considered and should be. Now what?

That aside, I have no general problem with the process material on **pages 13-18**.

PART II

IN WHICH I ASSUME THE MANUAL IS FOR OUTSIDERS, MOSTLY POTENTIAL CLIENTS

The title misled me. I thought a 'manual' would be a how-to document, like a handbook. Such as, 'Here's how you can expect an ESIPRI review to be conducted, the questions that reviewers are expected to answer, the kinds of material they will and won't address, here's how to request a review, and perhaps some other procedural items. Some of those process items are to be found, but not until I get a long monologue about kinds of science and so on. Mostly from an obscure book whose reviews you may not have seen. The passages from Moghissi are all interesting but so numerous that one may wonder whether ESIPRI is a unit of Moghissi Enterprises. I would not refer prospects to a book (**page 3**) in order to understand the service that I offer.

What to do? I'd change the title, to just **ESIPRI Science Assessments** or something.

Then, in the introduction, I'd identify quickly the intended audience(s) of the document. Then, in one sentence, tell what this document is all about. Then what the ESIPRI process is all about, in about three sentences. Define environmental science, peer review. For this you might consider using Newton's second sentence, plus Brooks' first two, plus this from the text: "Independent

peer reviews are conducted by individuals who formerly declare . . .” Then, in a short paragraph, describe the three ‘applications’ of **p. 9 ff** that ESIPRI can provide. Then stop the introduction. Or maybe put this information into the (absent) Executive Summary.

In response to **Question 5**, I assume this is a sales brochure. If you increase the font to a size I can read comfortably it’ll be 50 pages long. I wouldn’t buy Ovaltine with that long an overture, even with pictures of sexy drinkers on a ‘clothing optional’ beach.

What to do?

I’d consider reducing the basal area by 40-50 percent. That’s for a crowd that messes with ‘apical meristems’. Here are some suggestions.

I’m not sure how **appendix B** pertains to ESIPRI assessments. Are reviewers supposed to discover whether the science being examined was developed in an ‘open-minded’ way? Or that the scientist was suitably ‘skeptical’?

Most of that appendix is given to putting science into pigeonholes involving 5 ‘principles’ and 3 ‘classes’ embracing 9 kinds of science. That seems to create 45 pigeonholes. How many of those are apt to be concerns to clients? Perhaps only those should be highlighted. Portray threats, not a classification system.

Yet another, two-tiered classification system starts at **page 33**. It’s interesting, but again, so what? Is ESIPRI proposing to provide the services implied by the peer-review items?

‘Personal opinion’ figures in the first paragraph of Category IV. I find this segment fuzzy; and again, so what?

However I may be missing the purpose of Appendix B. It may truly be extraneous and supplemental to the main document, included solely to illustrate the extent and variety of scientific endeavor and its evaluation. In any case I have no strong quarrel with Moghissi’s classifications.

Skip the discussion of regulatory sciences **{(pp 3-4)** and the first paragraph on environmental sciences **(p 4)}** ESIPRI is likely to be invited into both areas and the difference doesn’t seem important here. Similarly the segments on Fallacious Information through Professional Ethics seem superfluous **(pp 4-6**).

I couldn’t make out why the segment on Stakeholder Participation **(pp 7-8**) is needed. Attention to stakeholders is a tricky business and I think can be deferred to the instructions to peers and/or contract options with clients. Stakeholder involvement will presumably be appropriate in some situations, such as Independent Scientific Assessments; not in others.

Compress by deletions **pages 12-24**. By at least a third.

Parts of the intended paragraph on **page 12** seem acceptable albeit rather detailed for an external audience, as do **pages 13-18**, all involving Peer Reviews; **pages 19-22** on Scientific Assessments; and **pages 23-24** on Technical Reviews.

Do you really need the heavy burden of contrived nomenclature? For instance, the distinctions along model types (**p 21**) seem trivial. See also my indented mark above.

I like **pages 9-11**, Applications and fuller explanations of the three constructs presumably offered by ESIPRI. And I like **page 13**, dealing with the ESIPRI process.

Re **Questions 1 to 4**: If font size is the only beef I can make, the text is rather good! Subject to comments above.

Your **Question 7** asks whether the 'common metric' of Appendix B appears useful. I didn't find the common metric. Obviously I've missed something. Nor did I gain the 'interesting insights' of Question 8. Found interesting discussions but no new insights.

PERSONAL INSTANCES OF THE 'APPLICATIONS' (Question 6)

Twice during my research career I led and/or conducted analyses of a special nature for certain parts of government for which I had security clearance, unlisted phones, offices without addresses, and so on. Never published but needing confidential consultations with a few folks with particular enterprise. (To reduce the need for clearances the research and its results were usually segmented to obscure the whole.) Natural sciences and quantitative methods were involved. It would have been helpful to have ESIPRI-type access to people willing to be puzzled but helpful without any accompanying notoriety nor acknowledgement. (Cost was not a problem.) In short, research was done, by scholars, with scholarly review of segments of the work. I suspect that ESIPRI puts so many shoulders to the wheel that security concerns would have precluded the group's involvement.

Peer Reviews

For some years I was one of several technical editors for the *Journal of Forestry*. At that time *Forest Science* hadn't been started, so the Journal served both researchers and non-research professionals. I was free to use, and did use, blind reviews, no reviews, and even papers that I solicited. Always, more papers were offered than we could use, so winnowing submissions and juggling reviews was immensely time-consuming. (I [was] never offered compensation.)

In the past decade I've done 21 technical reviews of research papers and technical papers that had been presented as products of research. Here are some general comments that may be relevant to ESIPRI:

About half were solicited, mostly by people sending me a paper they had seen and asking what I thought. Rather informal. The others reflected simply my own curiosity. For none was I paid.

The subject matter varied but mostly was associated with county and city planning, and wetland and tidewater science related to that planning.

In three of the 21 papers I found things to compliment. I found glitches in every paper. I made few friends.

Most of the reviews were circulated on the internet; none was published formally. I'm aware of a few rejoinders placed on the internet (I'm not on e-mail).

I am surprised by what I perceive as a downward trend in the quality of scholarship in graduates of nearby programs in marine-related fields and quantitative science. There is a need for high-order help in planning and overseeing analytical work. ESIPRI might be a welcome source of scholarship in research planning in addition to its peer-review assessments of research products.

Scientific Assessments

Eons ago I rounded up almost every PhD forest economist in the country for a 3-month assessment of alternative federal timber policies. I offered no compensation, just the guarantee that all hands would have visible chapter authorships and that the report would be seen in high places. (This accounted for one of my two White House visits.) There was no review of the work outside the group: we had enlisted most of the relevant expertise. We exchanged chapters among ourselves but there was no pugnacity. Formally the venture was termed a policy analysis. Policy changes followed.

I was only on the fringes of another drop-everything chore, the 1992-93 FEMAT exercise in which forestry and wildlife experts were ordered to address spotted-owl habitat issues. That venture produced wide owl-protection spaces and, unexpectedly, created a vast network of buffers along all classes of forest streams. FEMAT was done swiftly, with some serious (in my view) technical twitches, some of which were adjusted the following year in the President's Forest Plan, leaving a residue of remarkable stream-protection requirements. Participants have argued for review of politics long precluded re-analyses. FEMAT, done in a rush, would clearly have benefited from ESIPRI-type external critiques. Another 'policy analysis' that led to profound policy changes.

Concurrently I was in research administration, looking after a dozen research fields at a half-dozen Northwest labs. An important, and most interesting, part of that job was doing Problem Selections and Problem Analyses. The former documented decisions about which of the broad forestry-science issues coming at us we would tackle. The latter comprised lists of studies seen as needed to resolve the larger issues. Both kinds were reviewed widely within the outfit and became public documents, though I don't recall requests from the public. Obviously I sought input from numerous researchers. Before committing years and millions of research dollars we wanted to be sure of the priorities and resource commitments required, and whether other research groups were already or potentially exploring the same issues. (No wrath equals that of a researcher being told to shift away from a life-long line of studies.) I can imagine using ESIPRI on segments of those chores, preliminary to making research decisions. Of course levels of

general funding plus intra- and inter-regional politics had much to do with what we actually studied. I can relate stories about that.

After retiring I was drawn into the Puget Sound fracases over wetland and tideland buffers, to which I gave a lot of effort, including library time. Then, puzzled by what I saw Batelle doing, I got interested in the tidewater littoral and its inhabitants, human or otherwise. All told I've done about a hundred writings intended not for journals but rather for shoreline planners. They've concluded a number of Science Assessments; that we used to call state-of-the-art papers. Many planners know me: most read what I write; few seem to respond policy-wise. The point of this paragraph is that ESIPRI could have done *all* of what I did, undoubtedly better, and without implicitly representing some point of view.

Kenn Brooks has been down this road; Norm MacLeod knows the route. I have valued their counsel.

Donald F. Flora
Biographical Sketch

Undergraduate work in geology and forestry.

PhD in forestry and economics, University of Washington, College of Forestry.

Former instructor at Yale in economics and biometrics.

Former affiliate professor at University of Washington.

Former director, Keep Washington Green Assn.

Former head, national forest danger rating research.

Former program manager and assistant director, Pacific Northwest Research Station, US Forest Service.

Formerly one of the several technical editors for the Society of American Foresters *Journal of Forestry.*

Former counselor to Cabinet Task Force on Timber Supply, President's Materials Policy Commission, and President's Advisory Panel on Timber and the Environment. Member, US-Japan Timber Committee.

Former project reviewer for EPA.

Former member, Oregon Governor's Council of Economic Advisors.

Family had a tidewater stump ranch, raised shellfish. I built a couple of boats, rowed to Alaska (what else do you do at 13 with video games and texting yet to be invented), had summer long logging jobs.

Don Flora

4 September 2012

Sharon Friedman. PhD, University of New Hampshire, Genetics. US Forest Service regional planner and NEPA (National Environmental Policy Act) specialist (ret.). Boulder, Colorado.

ESIPRI PEER REVIEW QUESTIONS

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

Yes, it is as valid as that others do; however for scientific information to be used in policy, I believe that higher standards should apply -- the Six Steps described below.

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

Yes, on **page 1**. "current guide to internal peer review processes."

3. Is the overall organization of the manual clear and effective? (Why or why not?)

I think it would have been clearer to focus on the products offered and then describe what you plan to do as a process for each product, with Appendices for more detailed information.

For example, "Here is what we think are scientific assessments. This is the situation in which a person might want one. Here is how we would do them. You would have choices to do it in one way or another way. We would involve stakeholders by…"

4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (Why or why not?)

I think it gets into too much background information. There is a whole body of literature around peer review, but you can't cite the breadth of literature in this paper, so I wouldn't begin to go there; just cite the studies that are directly applicable to the review process.

5. What portions of the manual should be expanded, condensed, or deleted? (And why?)

Don't think you need to describe regulatory sciences (I think that they are the same sciences, with the products being used for regulatory purposes, it's not like the scientific information is different), environmental sciences, fallacious information, outside the purview, religion and faith, societal goals and professional ethics. This whole part of the introduction can go.

Here's how I'd structure it:

I. Peer review is used for…

II. In the literature, peer review has been criticized for …. While others acknowledge "it's the only way".

III. Our organization seeks to offer this service so that there can be independence between the reviewers and the reviewees. We can also provide openness and transparent review by posting reviews and responses online, as well as opening up the review to others online.

IV. Then here are the different kinds of reviews we offer.

For each kind of review:

Here are the kind of problems we would expect this review to address.

Here's how we structure the review.

Here's how we involve stakeholders.

6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these three examples been (or were) improved with blind/anonymous review? (If yes, regarding the latter, why and how?)

Peer review . . .

When plans are being developed for management actions, you probably want some mix of people who understand the "science" but also people who have done the actions to know if your approach is feasible and practical, and how much it will cost, It's clear to me that "scientist" peer review might work for a study plan, or grant submissions, or even a report making scientific claims. I would use what you call "technical review" for reviewing plans for management actions.

Examples from my experience:

Technical Review -- Reviewing test plan for American Chestnut test sites. Not improved by blind review.

Peer review -- Reviewing proposals to be funded for Fund for Rural America (we used scientists and stakeholders on our funding panels); however, the director of the program got fired so perhaps that was too "outside the box" for the time. Not improved by blind review.

Scientific assessment -- Not sure that I have seen any examples of this. I have seen many examples of scientists being rounded up and giving their opinions on programs, etc., as "science reviews" but not the pure review of scientific information mentioned here. I guess only in literature reviews published in journals, but in reality some are fairly selective. I guess where scientific information is contradictory, I think open (to the public) discussion is best, rather than going off into a corner and coming up with "consensus."

In general, I think open reviews (knowing the reviewer) are better because then it can become a back and forth -- you learn more from an open discussion. Otherwise, it is done in secret with the editor making the judgment calls. Not good for research, most of which is funded with public funds, in my view.

So, for improvement, I would see a table like this, which helps us describe what we are looking for and who needs to weigh in for the different kinds of reviews:

What is to be Reviewed	Who Reviews	Scientists	Practitioners	Stakeholders	Statistics	QA/QC	Public internet review & data
Research Proposals		**X**	**X**	**X**			
Manuscript		**X**			**X**	**X**	**X**
Literature review/ scientific assessment		**X**	**X**	**X**	**X**	**X**	**X**
Program		**X**	**X**	**X**			
Technical review		**X**	**X**	**?**			**?**

Is a "scientific assessment" the same thing as a "literature review" if so then the review should include the QA/QC status of the key papers related to the topic, at least. If it's not the same thing, more explanations and examples might be helpful.

The key thing about ESIPRI doing the review is not that the reviewer would be independent, but that ESIPRI could select them, rather than the author or a journal editor. So they could pick a scientist who agrees with the person, one on the other side, and one who is more or less objective, if such an individual can be found. But most important (IMHO) would be posting the reviews so others can weigh in.

For the "independent scientific assessment" -- to me individual research studies are like patches and the reviewer links them into a quilt to tell a story. There is a great deal of judgment involved. I don't believe that the process "requires that consensus can be reached." I think that disagreements about the studies should be documented so that people understand what the issues are. Having to explain the concerns and evidence would help people understand more about the scientific process and give people more to go on when a "dueling scientist" situation develops. Practitioners should also be able to weigh in on the disagreements about the studies. It seems to me that if we don't do this, we are missing a great opportunity for science education -- when something is fairly complicated about something people care about.

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? (Why or why not?) (e.g., Would such measures be useful for considering projects or documents such as this one?)

I don't think it's very useful. People collect information based on scientific norms. They analyze it. They document what they conclude. That's where we need to keep the focus.

I also don't like the use of the term "science" when you mean "scientific information" or "research studies." In my view, it gives everything an aura of Newton and Einstein, when we may be talking about a paper with three interviews by a graduate student.

8. Does the manual include interesting insights into the peer review process? (Examples?)

I looked up the Dost citation and found this quote:

> *My emphasis in this discussion is common sense; the validity of analytical or statistical methods is not examined here. These papers fail in plausibility, context, background understanding and utility. Why evaluate a system at concentrations thousands of times greater than known maximum body burdens or environmental levels? Why study biochemical effects of chemical mixtures without knowing their constituents? Publications about pesticides all too frequently emerge from researchers who know nothing of the way the chemical they study is used, or the way it behaves in the environment or in the organisms that may absorb it. When reviewers have the same limitation, we find time and journal space wasted on work that tells nothing about possible risk, mechanism or other usable information. If the work makes no sense, the most elegant methodology cannot make it useful.*

I think our business suffers from this tendency to agenda-ize studies and for academics (often not affiliated with universities who are more knowledgeable in these areas) to not understand how the activities they discuss are done in practice. Research funding agencies use the "sounds plausible to a random bunch of scientists" standard and we're off to the races with extrapolations that don't make sense.

How to stop that from happening? A separate step of "practitioner review." Two questions: 1) "do you find this a useful study? Why or why not?" And 2) "have they made some claims in this paper that do not reflect reality as you experience it?"

9. What are the manual's two (or three) main strengths? (Why?)

First, I think that it is very useful to explore this territory, especially since "peer review" seems to be an expression that is slung around fairly broadly. Any contributions to a taxonomy of the different approaches and clarification and a common language to describe them will be immensely helpful.

10. What are the manual's two (or three) main weaknesses? (Why?)

First, I think that it is very useful to explore this territory, especially since "peer review" seems to be an expression that is slung around fairly broadly.

Peer review in science, is simply a review by (or expected to be) peers, or scientists in the same field. However, in my view, there is a difference in what you are looking for, and whom should be asked to review, depending on the objective of your peer review.

1. Proposals – who is going to get the money. Once I was managing a panel in which the idea was very good but it appeared to the member of that discipline on the panel that they were asking for too much money, so another proposal on a completely different topic, won. Often panels of scientists use the "it sounds plausible to us" criterion for whether the information will be useful. My favorite was genetically engineering red oak trees to produce pollen that doesn't provoke allergies. Or trees with reduced lignin to make paper. It really doesn't matter to anyone at this stage if these "applications" are likely, so the "it sounds plausible to a table of scientists" is probably good enough.

2. Publication -- Is it good enough to be published? This is the one with "no glaring errors." This is in fact a very low bar, since the reviewers don't have time to look at the data. This is simply a "we think that their methods are OK, and if we found what they found, we'd come to the same conclusions. Note: on the blog we've noticed folks who have generated conclusions way beyond what their data says. Is this the fault of peer reviewers or the editors? Not sure, but all I would depend on it for is that people in the same field thought their methods were OK. A fairly low bar. Now it is human nature for people in a field, and journal editors to want to publish "important" work . . . so the tendency to jump from "my study in South Dakota showed . . . so western fire management policies are flawed" is often not critically reviewed prior to publication. Another possibility is that journal editors are not familiar enough with the issues to question, and the peer reviewers don't care, or don't have time to do the edits, or don't want to question their buddies.

3. Studies used for management, regulations, or policy. Is it helpful? Has it been correctly done based on current scientific thinking? Are the facts found by the scientific methods clearly linked to conclusions drawn?

4. To my mind, if substantial amounts of money are coming out of taxpayers' pockets to do something, and if lives and property are at stake, we need reviews that are not the lowest bar. Here are the six key areas that must be examined in any kind of a critical review. Clearly "peers" are necessary but not sufficient. Each of the below steps ("Six Steps for Policy Fitness) should be documented.

Six Steps to Vet Scientific Information for Policy Fitness

1. Is the research structured to answer the policy question? Often the policy question is nuanced: say, "what should we do to protect homes in the WUI?" This is often where research goes off the rails. Say, historic vegetation ecologists study the past and claim that there was plenty of fire in the past -- but that information is actually not particularly relevant to the policy question. It seems obvious, but for scientific information to be policy relevant, policy folks have to structure the question. Most, if not all, research production systems do not have this step.

2. Did they choose the right disciplines and/or methods to answer the policy question? Clearly a variety of disciplines could have some useful contribution, as well as an inherent conflict of interest, if you rely on them to tell you if they are relevant or not.

3. Statistical review by a statistician. If you use statistics, this needs to be reviewed, not by a peer, but by a statistician. You can't depend on journals to do this. The Forest Service used to have station statisticians (and still does?) to review proposals so people worked out their differences in thinking and experimental design before the project was too far down the road.

4. The Quality Assurance /Quality Controls (QA/QC) procedures for the equipment used and data need to be documented (and also reviewed by others). For someone who is unfamiliar with QA/QC applications, you might start with the recent paper attached (Lockhart et al.), it has a number of citations, and also the implications of the Data Quality Act. What is odd is that the NAPAP program led the way for QA/QC, but it's not clear how that has been carried forward to today. It might be interesting to take the top-cited papers in forest management policy and review their QA/QC procedures.

5. Careful review of the logic path from facts found to conclusions drawn. It is natural for universities or other institutions to hype the importance of research findings. Since people will also use the findings to promote their own policy agenda, and it can be blown up and misused even if the scientist is careful (e.g. 4 Mile Fire), it is more important to be specific and careful about your interpretation and conclusions. It is also best that if the findings lead to conclusions that are outside those of the general consensus, that the authors forthrightly discuss different hypotheses for why that might be. An important part of this discussion for studies involving models should be "what checks did you have?" Did you use sensitivity analysis for your assumptions? Did you compare model projections to the real world? If not, why not? In fact, the relationship of empirical data to your work should be clearly described, since scientific information derives its legitimacy from its predictive value in the real world.

6. Post publication requirements: access by the public to data and open online review.

11. What specific recommendations do you make for the improvement of this manual?

Focus on the kinds of services you have to offer, clarify what kinds of folks will review what kinds of documents, and for what kinds of purposes, and then only provide background material and citations as needed.

Sharon Friedman
Biographical Sketch

Sharon Friedman is currently the Executive Director of C-3 (Common Ground, Common Interest, Common Sense). This organization works on filling gaps in informing the public on public lands issues through the New Century of Forest Planning blog, and does consulting work on understanding and resolving science/policy, scientific and scientist conflicts.

She is currently the Chair of the Forest Policy Committee at the Society of American Foresters. Sharon spent 32 years with the USDA, including 30 with the US Forest Service. Most recently, she was the Director of Strategic Planning for the Rocky Mountain Region of the Forest Service. Her work involved planning, NEPA, FOIA, litigation and appeals in the Region, which includes Colorado and parts of Wyoming, Kansas, Nebraska and South Dakota. She and her staff also coordinated climate change and sustainable operations activities in the Region, and cooperate with the State of Colorado on the Colorado Roadless Rule.

Previously, Dr. Friedman was the Assistant Director for NEPA in the Washington Office of the Forest Service. Prior to this position, she has had a long career in research administration, strategic planning and the interface between science, management and policy. She was a visiting scientist in the Genetics Department at North Carolina State University in 1985. At Forest Service Headquarters in Washington, DC, she has served as Research Coordinator for Forest Service-wide strategic planning. She also served as the National Program Leader for Forest Research with the USDA Cooperative State Research Education and Extension Service (now NIFA) and worked with the land grant universities in cooperative research. She was appointed a Commerce Department Science and Technology Fellow in 1996 and worked for a year as a legislative assistant to Congresswoman Carrie Meek of Florida. In 2000, she was the co-chair of the White House CEQ/OSTP-led interagency working group that conducted an assessment and evaluation of the manner in which the regulatory framework for biotechnology addresses the environmental release of genetically modified organisms. She was a Senior Executive Fellow at Harvard's Kennedy School of Government in 2005.

She was the Chair of the Science and Technology Board at the Society of American Foresters from 2001 to 2003 and is a Fellow of the Society. Before moving to Colorado, she taught a graduate-level course in Environmental Ethics at Virginia Tech. Her undergraduate degree is in Forestry from University of California at Berkeley, her masters' is in Forest Science from Yale University, and her Ph.D. is in Genetics from the University of New Hampshire.

Paul R. Houser. PhD, University of Arizona, Hydrology and Water Resources. Associate Professor, Department of Climate Dynamics, George Mason University. Fairfax, Virginia.

ESIPRI PEER REVIEW QUESTIONS

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

Peer review is a process to evaluate the scientific process and results produced by other people in the same field (peers) to maintain or enhance its quality. The concept is that a larger and more diverse group of people will more easily find weaknesses and errors that can then be identified and corrected. To obtain an unbiased or independent review, care must be taken to not choose reviewers who have conflicts of interest, such as close colleagues, relatives or friends of the author, or those that have a financial, political, academic or philosophical stake in the outcome of the reviewed work.

Peer review closely resembles a legal jury trial, where a judge oversees the proceedings, the defense and prosecution present and clarifies evidence using due process, and the jury deliberates to arrive at a final conclusion. Often an editor or a panel acts as judge to sort through conflicting opinions. Care must be taken to avoid the tendency of a jury or committee to gravitate towards a common dominator rather than taking minority concerns seriously.

Peer review is not perfect at identifying and correcting errors, weaknesses or scientific misconduct because the reviewers usually do not have the time or access to all of a project's data or to independently recreate the work. Peer review can also be slow and can have a build-in bias against highly original or creative work because reviewers are more tolerant of work in which they are familiar or have a vested interest in maintaining a status quo or agenda. There are many examples of important innovations that were originally rejected through peer review.

A lack of transparency in the peer review process also leads to a lack of confidence. Even when the process, review questions and answers, deliberations, author responses and conclusions have high integrity, lack of transparency can undermine the credibility of the process. Further, many entities will justify the validity of their work, saying that it has been peer reviewed, without acting to address issues identified by the review. New Internet innovations may help the peer review process by lowering their costs, increasing speed, and not only making the process transparent, but allowing the public and stakeholders to participate in the process.

The ESIPRI manual provides an excellent description of the peer review process, including defining roles, standards, expectations and process steps. The expectation for full transparency, independence from conflicts of interests, and proper oversight are particularly creditable. I believe that the ESIPRI peer review process, with its checks and balances, built-in flexibility and high standards will result in scientifically credible peer reviews. However, I am concerned that the ESIPRI peer review process, as it is now presented, does not explicitly embrace the concepts of due process, or correcting or enhancing the quality of the reviewed work. None-the-less, the development of this manual and the ESIPRI organization is setting an ambitious and much need goal for the pursuit of scientific integrity for use in critical environmental decision making.

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

The purpose of the ESIPRI manual is stated as follows:

The purpose of the Environmental Sciences Independent Peer Review Institute (ESIPRI) is to protect, promote, and restore the integrity of Environmental Sciences through our practice of open access and transparent review of relevant scientific documents, plans, and proposals, and by providing these services to elected officials, businesses, agencies, organizations, attorneys, individuals and other stakeholders concerned with the development of policies and actions based on credible science.

This manual serves as a current guide to our internal peer review process, the basis of our organizational functions, and will hopefully be a positive influence on the peer review process in general. We welcome its use by others.

This purpose is very clearly and concisely stated, and is consistent with the definitions, philosophy and process defined in the body of the manual. By basing the manual on well-established and tested peer review methods, providing the larger peer review context on which this manual is built, and defining clear peer review processes and expectations, there is high confidence that the manual will achieve its overall purpose.

However, as introduced in the previous section, I would encourage ESIPRI to consider expanding its peer review purpose to not only protecting, promoting and restoring the integrity of environmental sciences, but to also use the peer review process to actively improve and enhance the quality of the work it reviews. This would only require a slight change in the manual's purpose, as well as the addition of including the author in a due process and accountability phase in the process so as to actively improve the reviewed work. There is no doubt that the proposed purpose and process will result in valid peer reviews, but there is an opportunity to go beyond this for the peer review to actively improve the final scientific product.

3. Is the overall organization of the manual clear and effective? (Why or why not?)

In general, the overall organization of the manual is clear and effective. However, it would benefit from a few editorial changes:

1. The manual starts with a description of how it is arranged, rather than a concise overview of vision, purpose, process and expected outcomes. This synopsis may be intended to be part of the executive summary.

2. It may be useful to clearly state the desired end result of the ESIPRI peer review process. What is the end result you want your peer review to obtain?

To evaluate or validate science results?

To quality control scientific results? (reject science results below some threshold)

To improve science results? (implies some iteration and re-review process)

To mold science towards unbiased and trustworthy results? (also implies a multi-step process)

To fix science errors, or to eliminate bad science results? (requires a response from the scientists)

Offer clarity where scientific results or opinions differ?

Mold science programs toward broad agendas that consider all reasonable alternatives to address a problem and discount predetermined decisions?

3. It is sometimes difficult to understand the hierarchy of the writing, and how sections are related to each other. It may be useful to number the sections (1.2, 1.3, etc.) so that it is clear how the sections flow.

4. The definition of several terms is offered starting on page 2, and a glossary is also offered. What is the difference between these? It seems that the definition of terms section is actually offering an overall approach or philosophy; it may be better to rename this section as such. Also note that "peer review" is never actually defined in the definition of terms, but is defined in the glossary.

4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (Why or why not?)

Generally, the document is quite clear and concise. There are a few places where I question the importance of the information provided to the ESIPRI purpose and process. For example, some of the information provided in the "outside the purview of science" section, while insightful, may not be central, or could be said more concisely. I also find the section on "assessments of models and correlation" to be very philosophical and somewhat out of place. You may also need to make sure your use of language is extremely straightforward. For example, the use of the phrase "…becomes the round file…" may not communicate to all audiences.

Generally, the document is actually more concise than I expected for such an important topic. I would suggest actually providing more detail in the process section (starting on Page 12), making sure that the expectations and procedures are tightly defined. I would also recommend more content in the conflicts of interest section (page 16), perhaps even providing examples.

5. What portions of the manual should be expanded, condensed, or deleted? (And why?)

I think it may be useful to broaden the discussion of common issues with the current peer-review process in the introduction, to both serve as motivation for ESIPRI, and to show how the ESIPRI

procedures will avoid these pitfalls. Peer review standards are not well defined – without peer review standards, a peer review may constitute asking for a proofread by a secretary, or could be a full National Academy review.

Peer review is biased from the outset by how it is paid for – peer reviewers know that client wants a certain outcome.

Peer review is biased by what questions are asked – for example "Will removing dams benefit fisheries?" will give you a different answer than "What is the best way to improve fisheries?"

Current peer review practices are very private, not allowing the public to see/trust/respect/understand the process.

Peer reviewer conflicts of interest abound, and peer reviewers are often selected or screened by clients or the authors themselves.

Clients often are able to interact with the peer review process, giving them opportunity to tweak or guide the outcome.

Many critical decisions are made based on internal science and reports that are never peer reviewed.

Just because it's peer reviewed, does not mean the peer-review was favorable, or that the client made any attempt to improve the decision or science based on the peer review science. There may be a need for a peer review to outright reject the document.

6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these three examples been (or were) improved with blind/anonymous review? (If yes, regarding the latter, why and how?)

In my professional experience, I have seen both anonymous and open peer review, scientific assessments, and technical reviews used extensively to advantage. It is possible that anonymous reviews have the advantages that they allow the reviewer to be more candid in their assessments and potentially protect the reviewer from reprisal for controversial reviews. However, anonymous reviews also have the distinct disadvantages of hindering due process, and compromising conflict of interest disclosure. In general, I believe that review criticism is much more credible and useful if the reviewer discloses their identity and is readily available for follow-up clarification. In fact, harsh criticism from a reviewer who declares their scientific credentials is always more respected than an anonymous review.

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? (Why or why not?) (e.g., Would such measures be useful for considering projects or documents such as this one?)

I find the scientific information classification schemes offered in Appendix B to be generally useful, but also quite philosophical and a form of common sense for most experienced scientists. I would recommend that reviewers make themselves familiar with such classifications, as I believe it would enhance their reviews. However, I would not recommend that reviewers be asked to classify the reviewed work into one of these classes, because it will prove tedious and various aspects of the work will likely cross classes or fall into multiple different classes. Rather, I would ask reviewers to be aware that certain kinds of scientific information are unacceptable, and should be identified in a review (such as Fallacious information or personal opinions).
In terms of reviewing this document, it first must be determined if this document actually contains scientific information. This document does provide definitions, and processes, so it certainly contains knowledge. However, the knowledge it contains is not based on first principles, or physical laws. It may therefore be classified as applied science or reproducible evolving science, as it is based on much previous experience provided by experts in the field. Finally, in a sense, this document is a form of professional ethics, with a goal of preserving scientific integrity which may actually be a social objective outside the purview of science; if science was conducted perfectly by scientists than peer review would be unnecessary. However, I am not convinced that these classifications actually helps me to provide better or more insightful reviews of this document.

8. Does the manual include interesting insights into the peer review process? (Examples?)

The manual provides a number of interesting insights into the peer review process; a few that I found particularly insightful are:

1. Illustrating the distinctly different reviews and processes for peer review, scientific assessment, and technical review.

2. Offering measures for evaluating scientific information.

3. Defining areas that are outside the purview of science.

4. Identifying the importance of involving stakeholders.

9. What are the manual's two (or three) main strengths? (Why?)

The main strengths of the manual are:

1. **Independence:** The manual defines and stresses the importance of independent reviews, or those without conflicts of interest and that are signed. This concept is critical to assure high-quality reviews that the public and stakeholders can trust.

2. Transparency: The manual stresses full transparency so that Stakeholders can readily observe the process and obtain relevant information without jeopardizing confidentiality.

3. Formalized processes: The manual establishes written policies and processes that ensure that all parties involved in the process understand and follow the basic requirements of an independent peer review.

10. What are the manual's two (or three) main weaknesses? (Why?)

Process not specific enough: There is a lot more definitions and conceptual information in relation to actual directives and procedures. It seems a lot of the procedures are left undefined, and that they will be determined by the oversight committee. I suspect that much of the needed process detail will be added as ESIPRI gains experience and develops its best practices.

Improving work not emphasized: I encourage ESIPRI to consider expanding its peer review purpose to not only protecting, promoting and restoring the integrity of environmental sciences, but to also use the peer review process to actively improve and enhance the quality of the work it reviews. There is no doubt that the proposed purpose and process will result in valid peer reviews, but there is an opportunity to go beyond this for the peer review to actively improve the final scientific product.

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11. What specific recommendations do you make for the improvement of this manual?

Here are my top suggestions for improving the manual:

1. Include provisions for improving the reviewed work – this would include allowing for due process, allowing the author(s) to explain the work to the panel as needed, and not only allowing, but requiring the author(s) to respond to the peer review concerns in a transparent manner. Ideally, peer review is intended to find technical problems or unresolved issues in a draft work product, and that information can be then used to revise that draft so that the final product reflects sound information and analyses.

2. The ESIPRI peer review process calls for the Oversight Committee to "develop a series of questions and other review criteria" that will be addressed by the Peer Review Panel. The manual should advise that questions can be asked that can bias the peer review results.

Therefore, these questions must be phrased in a neutral, non-leading manner. The questions must be simple and easy to understand. I recommend that a standard set of example questions be provided to illustrate a generic unbiased approach. It is also important to sequence questions in a way that will not lead the panel to a particular conclusion. Here is an example of a poor sequence of questions that can lead to a biased result:

Q. Are you concerned about increased local noise pollution? Y/N

Q. Do you believe that jet aircraft contribute significantly to global warming? Y/N

Q. Will you support a third runway at Heathrow Airport? Y/N

3. The ESIPRI conflict of interest policy (**page 16**) is critical to the success of the review process. I recommend that this section be expanded to include practical examples of conflicts of interest, and consequences if a reviewer or committee member fails to recognize or disclose a conflict. Some practical examples of conflicts of interest are as follows:

a. Student/teacher and mentor/mentee relationships have lifetime conflicts of interests.

b. Colleagues from the same institution are conflicted, for a period of 5 years after departure.

c. Colleagues working on joint projects or publications are conflicted for a period of 5 years.

d. Etc.

Identification of conflicts of interests are generally the responsibility of the individual. What happens if a reviewer does not properly identify a conflict, either intentionally or unintentionally? Ideally, ESIPRI has the responsibility to report the conflict, and the review may need to be discarded and re-done. But what if that review was used to support a critical or expensive decision? Who is liable for damages or additional expenses caused by the faulty review? These are hard questions that should be addressed, and ESIPRI may want to include a statement or policy in the manual about potential inherent problems with peer review that will limit its liability.

Paul R. Houser
Biographical Sketch

Dr. Houser in an internationally recognized expert in local to global land surface-atmospheric remote sensing, in-situ observation and numerical simulation, development and application of hydrologic data assimilation methods, scientific integrity and policy, and global water and energy cycling.

He received his B.S. and Ph.D. degrees in Hydrology and Water Resources from the University of Arizona in 1992 and 1996 respectively.

Dr. Houser's previous experience includes internships at the U.S. Geological Survey and at Los Alamos National Laboratory.

Dr. Houser joined the NASA-GSFC Hydrological Sciences Branch and the Data Assimilation Office (DAO/GMAO) in 1997, served as manager of NASA's Land Surface Hydrology Program, and served as branch head of the Hydrological Science Branch.

In 2005, he joined the George Mason University Climate Dynamics Program and the Geography and Geoinformation Sciences Department as Professor of Global Hydrology, and formed CREW (the Center for Research for Environment and Water).

Dr. Houser has also teamed with groundwater development and exploration companies (EarthWater Global and Geovesi) and has served as Science Advisor to the U.S. Bureau of Reclamation.

Dr. Houser has led numerous scientific contributions, including the development of Land Data Assimilation Systems (LDAS), the Hydrospheric States Mission (Hydros/SMAP), the Land Information System (LIS), the NASA Energy and Water cycle Study (NEWS), and the Water Cycle Solutions Network (WaterNet).

Michael Newton. PhD, Oregon State University, Forest Ecology. Professor Emeritus, OSU College of Forestry, Department of Forest Sciences. Philomath, Oregon.

ESIPRI PEER REVIEW QUESTIONS

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

I think it will be once the Introduction makes it absolutely clear that this is a description of the process a company organized to provide review services is made very clear in its first paragraph. I got way into this before I figured out that this is a process a business would use to ensure quality.

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

See above.

3. Is the overall organization of the manual clear and effective? (Why or why not?)

It will be once some of the excess "process" is simplified. This was my primary criticism of the document, across the board. I believe that once the purpose is clarified, the process needs to be as simple as possible while maintaining the integrity of the focus.

4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (Why or why not?)

As stated above, it looks like a guide for a regulatory agency, in terms of detail. You already have my many comments on that subject.

5. What portions of the manual should be expanded, condensed, or deleted? (And why?)

See written comments on draft.

6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these three examples been (or were) improved with blind/anonymous review? (If yes, regarding the latter, why and how?)

In the controversy about whether Agent Orange, as applied in Vietnam, caused serious injury to servicemen who served there, Stellman and Stellman contracted with the Department of Veterans' Affairs to do an analysis of "exposure". They designed a model that provided a radius within which a person would be "exposed" if a single flight had applied Orange in Vietnam. The radius published was 5 km.

Stellman and Stellman published this document.

The Stellman and Stellman model needed all three types of review. It would have failed technical review because of a variety of aerial application technology studies already published by Yates et al, in the 1970s conducted to test whether extremely sensitive crops COULD be damaged within certain distances of aerial application of herbicides, including phenoxy herbicides.

Stellman and Stellman would have failed scientific review on evidence of movement of drops against gradients of atmospheric movement, and also evidence of a) dislodgeability of residues, and b) quantity of material present when troops would likely be in the vicinity. Troops were known to have been removed and not re-inserted for a matter of days before and after application as a part of coordination of action of several aircraft that had to be in the same place and same time; troops were in immediate contact with those organizing the spray missions. Troops were not in the area when sprayed. Residues were not dislodgeable when troops were re-inserted.

Stellman and Stellman may have had scientific review, but it appears unlikely that their selection of reviewers included people who had intimate knowledge of a) spray movement, b) dislodgeability of residues, and c) sensitivity of humans to the level of residue transfer that could have been dislodged by contact with foliage and ground where Orange had been applied after days of drying.

Yet the Department of Veterans Affairs is scheduled to pay some $40 billion to veterans who served almost anywhere in Vietnam during the years (1964-70) when Orange was applied somewhere in Vietnam. And a quarter million veterans (and the VA) are assuming that almost any serious illness manifesting itself 40 years later may have been caused by Agent Orange, potentially reducing their chances of obtaining remedies for the real cause of illness.

The VA and National Academy of Sciences Institute of Medicine have accepted this model. One is reminded that none of the IOM membership was qualified to evaluate the model, and the same statement is undoubtedly valid for the VA. And the media have gone nuts with such claims of poisoning in lambasting the use of pesticides, in general.

Not sure you need more examples than this! Failures of many claims of environmental damage by “green” organizations simply exemplify the degree to which our culture has increased the difficulty of establishing rigor in the environmental sciences. This is one reason I didn’t retire when I turned 65 15 years ago! It is also a reason why increasingly narrow programs are dominating doctoral educations today; universities are training the coming generation of scientists to be specialists who have no sense of how disciplines interact. We will not be able to fix that problem quickly.

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? (Why or why not?) (e.g., Would such measures be useful for considering projects or documents such as this one?)

I don‘t see how it can. Almost any scientific endeavor (or technical test of an invention) can be evaluated without a thoroughly vetted analysis of the basic question or task being dealt with, the technologies involved with materials and their adaptations, and the scientific interpretation of results obtained (perhaps among the least difficult of tasks for reviewers). Very few reviewers today less than 60 years old are generalists. That may be the biggest sticking point. It's hard to spot the flaws if you can't see the connections.

8. Does the manual include interesting insights into the peer review process? (Examples?)

I think you may find the answer to this above.

9. What are the manual's two (or three) main strengths? (Why?)

Maybe:

It may offer a screening of reviewers that will adapt strength of reviewers to the potential cost of weaknesses in the draft.

It may put incentive in the hands of ESPIRI to ensure that the product is worth investing in (a biggie), hence have a cadre of very competent reviewers with known qualifications.

Distinction between technical vs. scientific talent to review different types of document.

10. What are the manual's two (or three) main weaknesses? (Why?)

1. I don't think it is reasonable to assume ESPIRI can always find reviewers who are serious about the commitment implied in accepting a review assignment (a good review means the reviewer has invested a great deal of time and mental effort when pressure is on to write grants, manuscripts, advise research colleagues, etc.). Only older scientists are really qualified, and those are the ones who have the most responsibility for many other things.

2. There is no incentive in academia to review, and no accounting system for it. So why bother?

3. I have never heard a major professor insist that his students undertake technical/ scientific reviews under his supervision. This is a problem that will not go away. I myself am guilty.

11. What specific recommendations do you make for the improvement of this manual?

See comments in writing on draft, along with solving the sociological problems identified above!

Mike Newton: Handwritten Annotations on ESIPRI Peer Review Draft

Transcribed by Crys Stephens, NW Maps Co., Cottage Grove, Oregon
Rev. October 24, 2012: Selectively edited and excerpted, per Newton (2012: A-31 – A-33).

Page 1. *Paragraph two, under Purpose of This Manual, Sentence 1. The words 'of Environmental Sciences' are circled:* scientific reporting

Page 3. *Top of page, referring to top italicized paragraph:* This reference is interesting, but perhaps a bit off the mark. Juries are selected very carefully, and not without bias. Ideally, reviewers will be chosen for a combination of knowledge and integrity. Different processes.

Right side middle of the page notation: Not sure I see this the same way. I view peer reviews as ensuring that reports describe research that asks legitimate scientific questions with appropriate methods and analysis. Findings must include inconsistencies and unexplained variance in terms of uncertainty and context, and relation to current literature.

Notation at bottom of page referring to same paragraph: We differ in respect to correct practice. Regulatory science is clearly tied to political expedience. EPA and state Environmental Quality departments nearly always exaggerate estimations of risk so as to justify regulatory action. I can cite a litany of examples!

Notation above paragraph: Their confidence is undermined by uneven views and political pressure from top appointees. Not good.

Notation below paragraph: But typically, regulatory science is colored by political leadership, and may be very unreliable. Often written in secrecy. It is out of control.

Page 4. *Left hand side of page notation:* I think each of these topics can be substantially shortened. The quotes are both useful and potentially misleading, and I suggest very limited use of them. Fallacious information does not belong here at all. Validity of the quote must be assumed.

Notation underlining the words 'regulatory, legislative, and judicial decisions': This is the problem. Regulatory agencies are advocacy organizations that are distinctly not neutral in data interpretations. Science done by such agencies is notoriously unreliable. Especially EPA.

Page 5. *Left hand side of page:* To be detected by peer review – not really a part of science but definitely part of the context of applications.

Top of page: This page is entirely devoted to context. If this is to be included, its role must be identified as factors outside scientific disciplines that influence how we apply scientific findings, but not how we interpret them.

Right side of page notation referring to first paragraph: Yes, but this does not invoke science, but rather the context of how science is used. That's why "regulatory science" is only half science, and often fails peer judgment.

Page 7. *Left hand side notation, referring to first two paragraphs:* The stakeholder's role is in judging applications of science, not its quality.

Top of page notation, circling the words 'of stakeholders': Define. A problem society faces is that any person can claim to be a stakeholder if he has an opinion. I disagree with that definition. It is a bad problem except in judging a political decision not scientific.

Under the heading Personally Affected, end of sentence one, a notation circling the words 'proposed action': This is a use of science, rather than the scientific findings.

Page 8. *Top of page notation, paragraph one, underlining the words 'action resulting from the peer review process':* Again, this is not the science itself, but its applications. A major distinction that must be made in the introduction as part of the professional responsibility rather than the basic science.

Notation in the space after the heading Generally Self Concerned and Self-Identified: Peer review of professional analysis is very different from basic science, exactly because stakeholders are involved.

Notation referring to the paragraph under that heading: Delete. Not very useful.

Under the heading Communication with Stakeholders, circling the words 'Decision Makers and Facilitators': Presumably professionals. See above.

Left hand side notation referring to all four paragraphs under that heading: Not really part of peer review but is part of regulatory action.

Page 9. *Top of page:* Applications of Science involves professional judgment as well as some ability to critique underlying science. This needs to be explained in the introduction. Most particularly, with each removal from basic science, the role of professional judgment becomes more important in evaluating outcomes instead of basic science.

After heading Independent Peer Review: This should be part of Introduction.

Page 10. *Left side of page notation, referring to numbered **paragraphs1-4**:* Condense by including all those issuing edicts or affected by outcomes.

First sentence, notation circling the words 'Potential sponsors, clients, and': Meaning users of science or those affected by its applications?

Second paragraph, notation circling the words 'environmental restoration': Not a valid topic because it is not defined in practice. Omit.

Notation in the space after the heading Independent Scientific Assessments: Now we're back to science, where I had assumed this document was headed.

First paragraph, sentence four, under same heading -- circling the word 'consensus': consensus often isolates the careful scientist

Paragraph two, same heading: insert the words "consequences and/or" *between the words* 'implement the' and 'requirements.'

Page 11. *First sentence: take out the words* "more efficiently."

Notation: Must not assume that any proposal, from scientists or otherwise, has no agenda. Sometimes these are the worst! (Look at the stampede to global warming money!)

Page 12. *Top of page:* This topic was identified on the first page under "Need for this Manual!"

Notation after numbered paragraph 3, near bottom of page: Be careful about this. We are aware that there are no rewards for this. Reviews should be a major part of a senior scientist's responsibilities. Better to have one good review than three half-baked ones. JOURNAL editors need a good file of those who can do it right. Priority needs to focus on those reviews. Others are good, but . . . try to get 'em.

Page 13. *Notation, top of page:* Delete This Page.

After the first paragraph: That means they must be signed!

After third paragraph: No. Too many papers written, and who can afford to be serving in an intermediate step?

Page 14. *Notation at top of page:* Delete This Page.

Page 15. *Notation indicating to delete everything up to Required Qualifications.*

Page 16. *Top of page:* Let this be avoided by knowledgeable Department Head's, and by careful evaluation of reviewers by editors.

Left side of page, referring to everything before the heading Peer Review Panels: Condense. Important stuff. Everybody is aware of it.

Page 17. *Top of page:* The basic problem is pressure to publish and become narrower but deeper in what used to be broad fields. Generalists are essential to see where papers fit in the broader context.

Notation after the paragraph with the heading Project Proposals Review: These people need to be at the top of their field. How to recruit them will be a challenge especially if not academic.

Page 19. *Top of page:* One assumes that "Independent" means review by selected individuals, e.g., editors. Difference between this use of "peer review" and "scientific assessment" is in estimation of functional effectiveness and/or outcomes. The same rigor is involved, including validation of assumptions and relevant literature and its applications.

Left hand side of page: The difference is really splitting hairs.

Second paragraph, notation circling the words 'a topic': No, one cannot critique a topic!

In reference to the last paragraph: Back to Bureaucratic Form!

Page 20. *Under paragraph three:* Yet the mechanism for contact and transfer need not be entered into the models!

Notation after heading Strength: But no evidence of contact is required! Fatal!

After heading Dose-response: When there is evidence of contact.

After heading Coherence: Yes, but w/o evidence of contact. Association is really meaningless.

Page 21. *Left hand side of page, referring to all before heading Reliability of Peer reviewed Information:* Delete. The peer review process does not depend on classification of models.

Top of page, underlining the words 'based on Proven Science': Models are approximations. Each has unexplained variance. Modeling has taken on a life of its own, lending to models as substitutes for data, especially in regulatory agencies.

Notation after first paragraph: i.e., physical or chemical reactions driven by constants.

Bottom of page, circling the word consensus: Dependence on consensus is fraught with media-induced mis-information!!!

Page 22. *Paragraph one, underlining the words 'is not perfect':* Obvious.

Paragraph two: Start here.

Paragraph three, the words 'the subject is so specific that' and 'or most reviewers have a conflict of interest' are crossed out.

Notation: insert 'always' *between 'is' and 'limited.'*

Paragraph four, 'insufficiently' is underlined: It's not possible to be sure. Editors seldom know the reviewer in advance.

Paragraph five, 'separate societal objective' is circled: A good review will spot the need.

Paragraph six, 'Preconceived opinions of the reviewers' is underlined: Can't be avoided. So one looks for honesty.

Bottom of page: The size, lost & risk of failure drive the choices of reviewers and numbness of reviews per area of specialization. More an engineering problem than scientific.

Page 23. *Whole page indicated:* Reviews are reviews. I think all reviews can be lumped together – they all require integrity, focus, and knowledge, and willingness to take the time needed to make a dependable analysis, plan, invention, experiment, etc. No need to categorize.

Michael Newton
Biographical Sketch

Born Hartford, Connecticut in October 1932 of university-educated American citizens who built a rural private prep school in southern Vermont in 1937. Newton obtained primary, and secondary education with classics, math, sciences and hard physical labor involved in fueling the school with firewood and provision of vegetable, meat and milk products. Newton grew up as a mechanic, modern farmer, and woodsman. He entered the University of Vermont in Animal and Dairy Husbandry at age 16 and obtained his BS in 1954.

In 1955-56 Newton served as infantry officer and platoon leader in the U.S. Army in Kansas, Germany. He received his second BS and an MS in Forestry from Oregon State University 1960. Thesis and associated project research involved testing of forestry herbicides, physiology of action and product development protocols. Participated in considerable pre-registration research, and helped develop protocols for basic registration experimental data from the field.

In 1960 Newton was appointed Instructor at OSU, where he continued research on herbicides and reforestation. Led water quality research with 5-year Public Health Service grant on Biochemistry and Toxic Hazard of Forest Herbicides. Taught courses in forest measurements, watershed management, silviculture, forest ecology and forest protection. In 1964 he received his PhD and appointed Assistant Professor, with tenure; appointed Associate Professor in 1969; and Professor in 1975.

Expert witness in many lawsuits, including two in Canada, about ten in the US, nearly all dealing with potential environmental effects of herbicides, primarily phenoxys. Long-term role (continuing) in assisting Dow and Monsanto in studies of Agent Orange and a full array of potential outcomes, including transfer of residues to humans through various mechanisms. Retired officially, Nov. 30, 1999; remains as full-time volunteer or Expert. About 60 refereed publications since retirement, seven pending at time of writing.

National Academy of Sciences, Committee on Effects of Herbicides. Leader of field experimentation in Philippines and Vietnam with Agent Orange and Agent Blue residue behavior. Co-author of massive study of outcomes. Spent four months in Vietnam as civilian scientist during the war, 1972.

Society of American Foresters top award, 1999, Barrington-Moore Award for Excellence in Science. Many subsequent SAF awards, mostly regional.

Publications: About 350, over half in refereed literature, plus many technical reports to various cooperators. Three books, all dealing with forestry herbicides. Forestry Editor, Pacific Northwest Weed Handbook, about 1965-2011. Publications range in topics from herbicide efficacy, environmental fate, biochemistry and toxic hazard, behavior in water, changes in ecosystem structure, long-term outcomes of manipulating forest vegetation, herbicide behavior in temperate tropical and subarctic soils and climates. Much of the recent research deals with long-term effects, primarily indirect, of using herbicides and other management tools for manipulation of forest composition and wildlife habitat.

Edward W. (Ed) Shepard. MS, Washington State University, Forest Management. President, Public Lands Foundation. Newberg, Oregon.

ESIPRI PEER REVIEW QUESTIONS

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

The manual's described review processes is scientifically credible and valid. It follows peer review guidelines published by reputable and credible experts in peer review. The authors are qualified by years of experience in the field and by academic background. The authors cite other experts in the scientific community that are credible experts in their field. The manual also includes metrics for Best Available Science. The transparency and disclosure of reviewers' qualifications and non-conflict of interest requirements also adds credibility.

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

The purpose of the manual is clearly stated and addressed. It is clear that the intent is "…to protect, promote, and restore the integrity of Environmental Sciences…" through the processes described in the manual, and who the services will be provided to. It is also clearly stated that this manual is for the use of ESIPRI with the invitation of its use by others.

The need for the manual is clear, but could be elaborated on. There are several instances where federal agencies have been criticized or legally challenged under the various environmental laws that rely on accurate science, including the Data Quality Act (or Information Quality Act (P.L. 106-554)**.** Use of a structured, independent, transparent, and credible review would help in the defense of such legal challenge, or head off the challenge all together.

3. Is the overall organization of the manual clear and effective? (Why or why not?)

The manual is organized clearly and effectively. Each section is similarly organized and it is easy to follow from one section to the next and to compare the types of reviews presented in the manual.

4. Is the writing style sufficiently clear and concise and the document length appropriate in regard to content? (Why or why not?)

I found the manual to be clearly and concisely written. This version is an improvement over the previous version in eliminating redundancies. The use of cited quotes from well respected scientists adds to the readability and credibility of the manual. I did not find the manual to be too lengthy. I looked for ways that it could be shortened, but did not have any suggestions. As currently written, each section on the various approaches to reviews can stand on its own. Perhaps an editor could suggest ways to shorten the document (shorter is always better), but it should not be shortened at the expense of each review approach section being able to stand on its own.

5. What portions of the manual should be expanded, condensed, or deleted? (and why?)

At this point, I do not see any areas that should be condensed or deleted. After a period of implementing the manual, a review to see how it could be improved would be useful. As mentioned in my response to question 2, the need for the manual could be expanded upon to address some of the criticisms made against peer review processes.

6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these examples been (or were) improved with blind/anonymous review? (If yes, regarding the later, why and how?)

Throughout my professional experience I have seen each of these methods used, positively and negatively. Most scientifically-based federal agencies have moved toward some form of review of scientific information using internal, external, or a combination of internal and external expertise. Many agencies call these reviews "peer reviews", but in many cases they are closer to a scientific assessment or a technical review.

Most research agencies such as the Forest Service research stations or the U.S. Geological Survey use a formal peer review process of some kind. Many are purported to be blind or double-blind review, but, I have been told anecdotally by some researchers that there are so few people with the expertise in some areas that it is not difficult to figure out who the authors or reviewers are. Although this could be viewed as diluting the value of peer review, I still believe there is value in, at least attempting to do this type of review.

Another area where I have observed the problematic use of peer review is the review of regulation where the drafts are sent out to selected organizations that are known to have a bias toward a particular outcome. When the regulation does not meet provide all that the organization would like to achieve, the review often reflects that bias. I believe this to have happened, but even if it does not, the publicly known agenda of the organization leads to a perception that the review is biased.

One example where peer review, scientific assessment, and technical review where attempted in one major review was the Bureau of Land Management's review of the science used to revise its Western Oregon Resource Management Plans, released in 2008 (and later withdrawn by the Secretary of the Interior citing legal error). In this case, scientific information from many sources and many disciplines was used to develop a plan for the management of multiple uses on 2.5 million acres of BLM land consisting of a checkerboard ownership pattern on the Westside of Oregon from the Columbia River to the California border.

Resource professionals representing the many disciplines used scientific information that was developed, in many cases, by local scientists that the resource professionals knew. Predictive models where used to predict outcomes from different management regimes. In some cases the scientists had developed models that had already been peer reviewed and published. In other

cases, models did not exist and the resource professionals had to develop models using scientific information developed by others, much of which had been peer reviewed to one degree or another. Because of the controversy surrounding Northwest resource management and the conflicting use of science by various organization, the BLM decided to ask a team of scientists to review the work of the resource professionals. The review was not intended to be independent or anonymous, and was not considered by the BLM as a peer review.

Where models already existed, the scientists were asked to review the use of the model in the plans. Where the agency specialists developed the models themselves, the scientists were asked to review if the "new" model correctly used the scientific information and the assumptions used were valid. The scientists were asked a set of questions to consider in their review. The scientist developed a report that was placed on the BLM's website for transparency.

This review yielded mixed results. Some of the scientist deviated from the set questions and expanded their review into other disciplines, resulting in the resource professionals spending considerable time reconciling information. Overall, the review was useful and was used to improve the resource management plan.

However, the review was critical of some of the work done by BLM. This is the intent of a review or assessment. However, some stakeholders, members of the public, and politicians used the critical nature of the report to assert that BLM's plans "failed scientific peer review" and used the review to attack the plans without thoroughly reading the report or seeing how the BLM responded to the criticism.

Time permitting, the BLM would have benefitted from an independent peer review of models its own professionals developed. It may also have benefitted by using methods included in this manual to conduct an independent assessment.

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? (Why or why not?) (e.g., would such measures be useful be useful for considering projects or documents such as this one?)

I read Appendix B as more as a qualitative hierarchy of scientific rigor rather than a quantitative metric. (The text of the manual says "… having specifically to do with evaluating/measuring qualities of scientific information…", so the question may be in error. (?)) To me a quantitative metric would be somehow placing a numeric value on the science, such as defining a point system that could be applied to a particular project, and then assigning it to a category, such as 90-100 points would be Category I, 80-89 Category II, etc. I see value in assigning the science to a category using common criteria, as suggested in the appendix.

I am uncertain of the value of using such a measurement on a document such as this manual.

8. Does the manual include interesting insights into the peer review process? (Examples?)

The manual does include interesting insights into the peer review process. This is especially true for someone that does not routinely do peer review. Notably the discussion of how information of varying scientific rigor often makes its way into published report with little or no discussion of the value of the science used. This in effect, places low quality science, or even fallacious information on a par with rigorous peer reviewed science.

I found the use of quotes from well respected scientists, with considerable experience with the peer review processes added value and credibility to the manual.

9. What are the manual's two (or three) main strengths? (Why?)

The use of quotes as discussed in the response to question 8.

The section discussing the value and role of stakeholders added value to the manual.

Stakeholders represent differing levels of interest and this is well covered in the manual.

Stakeholders are interested in the outcome of the review, especially when it may result in a policy or regulation that affects them. Their involvement and defined role in the process is important.

Defining different types of scientific information and categorizing scientific information based on rigor also added value to the manual. A common definition for users of the manual, or observers of the review process, results in a common understanding going into a review. I found differentiating regulatory science from environmental science enlightening. Institutively I knew the difference, but did not think of it as being that different before reading the manual and reflecting on it.

10. What are the manual's two (or three) main weaknesses? (Why?)

The only weakness I would comment on is how this manual will be reviewed for updates as the methodology for peer reviews evolves and ESIPRI learns from implementing the manual.

ESIPRI has gone to great lengths to review this manual and be transparent with the review. A short statement in the introduction (possibly the second paragraph of the Purpose of This Manual) stating that the manual will be reviewed for possible updates and updates will be peer reviewed as appropriate would address this.

11. What specific recommendations do you make for the improvement of this manual?

Although I believe the authors did a good job of describing the types of review to do under different circumstance, the manual might be improved by adding some "frequently asked question" to assist clients and other users determine what type of review might best address their need. A flowchart or dichotomous key on the different approaches of review and when they are used inserted as an illustration might also be beneficial to users.

Edward W. (Ed) Shepard
Biographical Sketch

Edward W. (Ed) Shepard is the principal member of Shepard & Associates, LLC, a natural resource consulting company providing technical and policy advice to clients.

Ed retired as the Oregon/Washington State Director of the US Bureau of Land Management in 2012 after a 38-year career as a forester, fire manager, and executive with the agency.

Ed served the agency in several locations and at all levels of the organization, from field-level forester to assistant director at the National Headquarters in Washington, D.C. He also served two fellowships working for a Congressman and Senator on Capitol Hill.

Ed holds a B.S. degree in range and forest management from Colorado State University and an M.S. degree in forest management from Washington State University. He is a Fellow and Certified Forester with the Society of American Foresters.

APPENDIX C.

ESIPRI ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES:

RECONCILIATION WITH DRAFT REVIEWERS' COMMENTS,
WITH RECOMMENDATIONS

Prepared for ESIPRI Board of Directors and for
Reviewers of ESIPRI Peer Review Guidelines Drafts #1 and #2

By Bob Zybach, PhD.
November 28, 2012
(ver. June 18, 2013)

ESIPRI ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES: RECONCILIATION WITH DRAFT REVIEWERS' COMMENTS, WITH RECOMMENDATIONS

CONTENTS

Executive Summary

This report has been prepared for the purpose of reconciling peer review comments made by a select group of 19 senior scientists, knowledgeable resource managers, and technical writers with two separate drafts of ESIPRI's Peer Review Guidelines. The drafts' authors were Bob Zybach and Robert (Bob) Alverts, both members of the ESIPRI Board of Directors, with Zybach also serving as author of this report.

The intent of the peer reviews was to assess the quality of the proposed ESIPRI review process and to improve the finished Guidelines manual. This report presents the written reviews in their entirety (Appendices A and B) and makes specific recommendations, based on reconciling these reviews and reviewer comments, to improve the final Guidelines report.

Peer review of the drafts was performed in two stages: an initial working draft (Draft #1) of proposed ESIPRI Guidelines was distributed to a wide number of the authors' associates to gauge general interest, costs, and time needed to conduct a formal review, and to solicit suggestions for improving the existing draft (Appendix A); based on the response to this first step, formal agreements were made with seven select reviewers, who then responded to 11 specific questions ("criteria") in regards to quality and content of the improved "review draft" (Draft #2) of the Guidelines (Appendix B).

Ten final recommendations, based on a systematic consideration of review criteria, reviewer comments, and findings, are the focus and summary – or "true outcome" -- of this report:

1) The title of the finished report should be "ESIPRI Environmental Sciences Peer Review Guidelines";

2) The intended audiences for the Guidelines are ESIPRI directors, advisors, and reviewers, potential ESIPRI clients, students, and interested members of the general public;

3) The written style of the Guidelines should be in Plain English, concise, well-organized, with proper scientific referencing and minimal use of acronyms, abbreviations, and equations;

4) The "3 Questions"-type survey should be considered an optional strategic step in future ESIPRI peer reviews and should be included as such in the formal peer review process;

5) The "11 Questions" review findings and reviewer comments should be followed closely in constructing the finished ESIPRI Peer Review Guidelines;

6) All completed formal reviews and all referenced materials should be placed online and made publicly available as linked PDF files for purposes of transparency and review efficiency;

7) Reviewers should be required to sign formal conflict of interest statements, and should also provide ESIPRI with documentation of possible conflicts in instances where they may exist;

8) All final products, signed peer reviews, reconciliation reports, professional credentials, and formal review discussions should be placed online for public reference and consideration;

9) The finished Guidelines should include strong provisions and encouragement for student education, training, and participation in the scientific peer review process;

10) The majority of Moghissi quotations and peer review taxonomy in the main text should be moved to the Guideline's regulatory science appendix that already contains his work.

Introduction

The purpose of this report is to: 1) stratify and refine the use of existing peer reviews in helping to improve the draft ESIPRI Environmental Sciences Peer Review Guidelines; 2) demonstrate and test the peer review process as described in the draft Guidelines; 3) provide background information and a timeline as to how and why this report came to be.

This report represents the current iteration of the Environmental Sciences Independent Peer Review Institute (ESIPRI) purpose and strategy, as first envisioned and discussed in meetings of concerned scientists and resource managers near Port Townsend, Washington in the summer of 2009. ESIPRI (nee ESPRI) was formally established as a non-profit organization in the State of Washington on November 4, 2009. It expanded into a national organization following a May 15, 2010 meeting at the World Forestry Center in Portland, Oregon, and subsequent plans to make an application (as ESIPRI) to IRS, by filing for 501 c(3) nonprofit status.

During the December 10, 2010 ESIPRI Board meeting, also held at the World Forestry Center, and according to the minutes of the meeting:

> Bob Alverts noted that we have established a constructive relationship with Alan Moghissi, PhD, president of the Institute for Regulatory Science. Dr. Moghissi is an internationally-recognized expert on scientific peer review. Bob suggested that the materials he has developed may be helpful in developing our ESIPRI policies.

This marked the beginning point of this project: to develop a scientifically sound and economically viable peer review process that ESIPRI and its potential clients could use with good confidence.

In March 2011, ESIPRI began filing documents with IRS in order to achieve 501 c(3) status, which was anticipated to have a positive effect on planned fundraising strategies and operations.

On May 24, 2011, Moghissi provided the ESIPRI Board with a PDF file of his new "Independent Peer Review of Regulatory Science Information" paper, coauthored with Misti A. Anderson. On September 8, 2011 a published journal letter by Michael Newton regarding national peer review problems was distributed to the Board by email. On October 28, 2011, according to ESIPRI Board meeting minutes:

> Two documents related to peer-reviewed science were recently circulated to Board members. One is a paper titled *Peer review at a crossroads—a case study* by Frank N. Dost, the other is *The Endangered Species Act: Reviewing the Nexus of Science and Policy* by Jonathan H. Adler of Case Western Reserve. Bob Benze suggested that we establish an electronic library for such documents and make it available on the ESIPRI website. The Board agreed. Norm MacLeod will work with Bob Zybach to put this together.

On March 5, 2012, Moghissi sent a formal letter to Chairman Karl Duff and other members of the ESIPRI Board in which he offered:

> The first step should be to develop a M*anual* that describes the goal and the process of peer review. The *Manual* should rely upon legally mandated requirements and should include the details of how ESIPRI intends to perform peer review. I would be happy to cooperate and coauthor with one or more members of the leadership of ESIPRI to write the *Manual*. It would be desirable to set up a schedule for completion of the *Manual*. I suspect that it would take somewhere between 6-8 weeks to write the Manual and another 2-3 weeks to copyedit and format it. Once completed it would be placed on your website.

On April 9 Moghissi referred to the possibility of developing a "Peer Review Manual" in collaboration with ESIPRI Board members Alverts and Zybach; on May 4 Moghissi offered his own draft of a peer review manual, developed by his own organization, Institute of Regulatory Science (RSI), as a "point of departure"; on May 6 the direction was modified to "revise the document to be a joint RSI-ESIPRI document" (Moghissi: A-23). Zybach was subsequently provided with a number of digital versions of several of Moghissi's drafts and published writings and asked to develop them into a discussion outline for a single peer review document to be used by ESIPRI, with Moghissi as senior author. The resulting three-page outline was a key point of discussion between Alverts and Moghissi on June 4 in Washington, DC.

In the interim, on April 13, ESIPRI had been granted 501 c(3) status, and on May 18 learned that it had been awarded a significant "start-up" grant. These two circumstances resulted in an intensified effort on the part of ESIPRI to complete the proposed "Manual," but in terms of a greatly improved Internet presence. On June 7 Moghissi informed the ESIPRI Board (pg. A-23):

> The meeting with Bob Alverts was both enjoyable and constructive . . . Bob and I concluded that it would be more appropriate for ESIPRI to develop its own Peer Review Manual rather than coauthoring the manual with me and my student. You are welcome to quote from the manual you received from me.

At that time Zybach was tasked with assuming the senior author's position and developing the three-page outline of Moghissi's work into a completed manual that "clarified the differences between regulatory science and environmental sciences." Moghissi's files were combined with the work of Newton and Dost and the outline used as the basis for a 31-page working draft.

On June 25 through June 27, Zybach and Alverts distributed the resulting "Draft #1" by email to a number of their associates in order to get feedback on the quality of the draft itself, to identify potential reviewers, and to determine a cost and timeframe for performing a formal review. From that point in the process, the remainder of the project is described in the following pages.

Respondents to the late June emailing, and the dates and relevant content of their responses, are provided in Appendix A. Draft #2 was completed on July 31, 2012, formal agreement forms and criteria were developed in the following days, and on August 4, drafts, agreements, and criteria were distributed to seven reviewers who had agreed to perform reviews (Appendix B).

[From this point forward the narrative will be in first-person, and brackets will be used to separate my comments from those of reviewers that are being quoted. BZ]

Review Process

This report is a reconciliation of comments received during two-step peer review process based on successive drafts of formal peer review guidelines for ESIPRI. In many ways it is a test demonstration of the proposed draft Step 4: "The Peer Review Panel, under direction of the Oversight Committee, conducts a transparent review and creates a formal report of its findings, with recommendations."

In this instance, my coauthor and I also serve as the Review Panel and the remaining Board Members of ESIPRI serve as the Oversight Committee. We are assuming that the need for efficiently testing this process outweighs the potential for bias caused by this arrangement. The two step review of the successive drafts of ESIPRI Peer Review Guidelines were:

1) An initial working draft (#1) of the proposed Guidelines was distributed by email to a select number of the authors' associates, along with a three-question cover note intended to gauge interest, costs, and time needed to conduct a subsequent formal review, and to solicit general suggestions for improving the draft (Appendix A);

2) Based on the written and verbal responses to this first step, improvements were made to Draft #1 and formal agreements were made with seven reviewers, who then responded to 11 questions with regard to quality and content of the improved "review draft" (#2) of the Guidelines (Appendix B).

Draft copies of this report are being made available to ESIPRI Board ("oversight committee") and to previous reviewers of the draft Guidelines, to allow them an opportunity to consider these recommendations and to possibly reconsider, elaborate upon, and/or rephrase earlier comments before a final report is submitted.

At the time of completion and submission of the final Peer Review Reconciliation Report, it -- including Appendices A and B -- will be posted at www.ESIPRI.org and opened to public consideration and discussion. By that time it is possible that the finished Guidelines will also be online at the same address and available for public review.

Criteria and Findings

As described in the previous section, peer review for the ESIPRI Guidelines was conducted in two stages: a general "three question" email survey and discussion, and a subsequent "11 question" formal review. In each instance, the authors were responsible for developing review contacts, formal agreements, and questions ("criteria").

This section of the report has been arranged to: 1) repeat verbatim each of the review questions; 2) follow the question with a succinct answer ("finding") intended to reflect reviewers' generalized responses; 3) support the finding with representative quotes from the reviewers and/or general discussion(s) of their responses. All quotations are referenced by page numbers beginning with an A- or a B-, depending on the appendix in which they are located.

General "Three Questions" Email Survey and Discussion

The following three questions were included with many – but not all – emails sent to a relatively large number of potential reviewers, professional associates, and consultants, along with an attachment of Draft #1. Not all email contacts included these questions, and most included additional information and/or more general questions, depending on the recipient.

1. If you were asked to do a peer review of this document, or other similar document, what would you charge or believe to be a reasonable fee for those services?

Zabel (A-41): Unfortunately, one of your main selling points will need to be an answer to the reviewer question: what is in it for me? The reviewer has very limited available time and will want to know how they will benefit. The argument that this effort will lead to the overall betterment of our scientific knowledge and professional credibility will not sell.

Finding: Many scientists work for public agencies or universities that do not allow them to charge for peer reviews because it is part of their job description, so there is no fee. Most other responses were in the range of several hundred dollars to review the draft, or a document of similar length and content.

Discussion: Most responses to this question were verbal or confidential in nature. In general, fees in the range of $50 to $150 per hour were deemed "reasonable," including respondents already on salary or having other income sources, who did not account for full value of their time. Additionally, individuals with university or government backgrounds seemed to suggest far lower numbers than individuals with private business or consulting experience -- perhaps this is a result of differing concepts of overhead costs, base salaries, etc.

2. We believe such a review (at least for this document) could be done within a 4-12 hour time period, and completed with 30 days. Does that sound reasonable?

Finding: Yes.

Discussion: Most estimates concluded the 31-page draft could be reviewed in 4-12 hours over a one or two day period with little problem, "depending on the questions asked." It is worth noting that less than one-half of the reviewers were able to complete their review in the agreed upon time.

3. If you were willing to perform a full peer review of the final draft, would you be willing to have your comments and a brief professional bio available for review by others and openly posted on the ESIPRI website?

Finding: All responses were generally positive, although several respondents thought there should be conditional aspects to this question.

Bormann (A-5): I would, but you have the problem that you change the document presumably because of the reviewers comments, and the comments are for the previous version. I'd give the reviewer a chance to alter their review to match the final version. You also may need to publish the "reconciliation" which details the changes you made or not to each comment [Note: this report is a direct response to his suggestion]. If I was providing a review for someone I did not know well, I think I'd like to be able to approve the final version of my comments after seeing both the final version of the paper and the reconciliation.

Flora (B-14): Twice during my research career I led and/or conducted analyses of a special nature for certain parts of government for which I had security clearance, unlisted phones, offices without addresses, and so on. Never published but needing confidential consultations with a few folks with particular enterprise. (To reduce the need for clearances the research and its results were usually segmented to obscure the whole.) Natural sciences and quantitative methods were involved. It would have been helpful to have ESIPRI-type access to people willing to be puzzled but helpful without any accompanying notoriety nor acknowledgement. (Cost was not a problem.) In short, research was done, by scholars, with scholarly review of segments of the work. I suspect that ESIPRI puts so many shoulders to the wheel that security concerns would have precluded the group's involvement.

Houser (A-17): Absolutely – I am willing to be named and have my comments be public. Peer–reviews are often done with full disclosure. But it may be proper to give the reviewer the choice.

Shepard (A-36): Yes, I would be willing to have my comments on a final review posted on a web site. I don't think it would be appropriate to put comments on a review of a preliminary draft on a public web site.

Formal "11 Questions" Peer Review

Formal agreements were made with seven reviewers, who were each given a general outline of expectations and eleven open-ended questions to consider. General instructions and a list of formal reviewers is on page B-1 of Appendix B, and also includes Frank Dost (Appendix A: A-7 – A-11). Both Appendices A and B include complete reviewer responses and Appendix B also includes a brief biography for each reviewer. This was the opening paragraph of the formal review agreements (Appendix E: E-2):

> *Reviewers: Please answer the following eleven questions regarding your review of the ESIPRI Peer Review Manual Draft. Short sentences and brief answers are fine. It is important to remember that signed and finished reviews will be made public on the ESIPRI website following completion of the manual, and that reviewer's words may be referenced or cited in other media in relation to this project as well.*

The criteria for this review were determined by the report authors, which created a strong possibility for bias. This circumstance was a result of time and resource constraints, rather than design. However, the sincere efforts on the parts of both writers and reviewers to use the peer review process in order to help create a better and more useful product seemed to mostly resolve this conflict. In most instances, it would seemingly be a much better idea (some might say a necessity) to have review criteria established independent of the product's creators.

The criteria were focused on the scientific validity of the proposed review process, writing clarity, logical organization, and specific suggestions and recommendations for improving the final product. Several "case studies" of the perceived need for this project were also listed and discussed.

Question 1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

Finding: The proposed ESIPRI review process, as described, is both scientifically credible and valid.

Bachelet (B-2): To improve its credibility and validity, a thorough discussion of what process already exists and why it is flawed would have been useful.

Flora (B-12): Looks good. I have no quarrel with the material. Moghissi seems to gild the lily a bit with his multiple classifications, but no harm done.

Friedman (B-18): Yes, it is as valid as that others do; however for scientific information to be used in policy, I believe that higher standards should apply . . .

Houser (B-25): The ESIPRI manual provides an excellent description of the peer review process, including defining roles, standards, expectations and process steps. The expectation for

full transparency, independence from conflicts of interests, and proper oversight are particularly credible.

Newton (B-33): I think it will be once the Introduction makes it absolutely clear that this is a description of the process a company organized to provide review services is made very clear in its first paragraph. I got way into this before I figured out that this is a process a business would use to ensure quality.

Shepard (B-42): The manual's described review processes is scientifically credible and valid. It follows peer review guidelines published by reputable and credible experts in peer review. The authors are qualified by years of experience in the field and by academic background. The authors cite other experts in the scientific community that are credible experts in their field.

Question 2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

Finding: The purpose of the manual is clearly stated and addressed, but can be improved with suggested changes.

Bachelet (B-3): The overall purpose of the manual is stated as "to protect/promote/restore the integrity of Environmental Sciences." But it is based on and generously borrows much text from the writings of Alan Moghissi who focused specifically on *regulatory sciences* while this manual does not.

Flora (B-12): The title misled me. I thought a 'manual' would be a how-to document, like a handbook. Such as, 'Here's how you can expect an ESIPRI review to be conducted, the questions that reviewers are expected to answer, the kinds of material they will and won't address, here's how to request a review, and perhaps some other procedural items . . . The passages from Moghissi are all interesting but so numerous that one may wonder whether ESIPRI is a unit of Moghissi Enterprises.

Friedman (B-18): Yes, on page 1: "current guide to internal peer review processes."

Houser (B-26): This purpose is very clearly and concisely stated, and is consistent with the definitions, philosophy and process defined in the body of the manual. By basing the manual on well-established and tested peer review methods, providing the larger peer review context on which this manual is built, and defining clear peer review processes and expectations, there is high confidence that the manual will achieve its overall purpose.

Newton (B-33): See above.

Shepard (B-42): The purpose of the manual is clearly stated and addressed.

Question 3. Is the overall organization of the manual clear and effective? (Why or why not?)

Finding: The organization of the Guidelines is generally clear and effective, but can be improved in several ways.

Bachelet (B-3): I have found many redundancies throughout the manuscript that could be dealt with to streamline the text.

Friedman (B-18): I think it would have been clearer to focus on the products offered and then describe what you plan to do as a process for each product, with Appendices for more detailed information.

Houser (B-26): In general, the overall organization of the manual is clear and effective. However, it would benefit from a few editorial changes.

Newton (B-33): It will be once some of the excess "process" is simplified. This was my primary criticism of the document, across the board. I believe that once the purpose is clarified, the process needs to be as simple as possible while maintaining the integrity of the focus.

Shepard (B-42): The manual is organized clearly and effectively. Each section is similarly organized and it is easy to follow from one section to the next and to compare the types of reviews presented in the manual.

Question 4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (Why or why not?)

Finding: The writing style is mostly clear and concise, but the overall document length can be shortened significantly to positive effect.

Bachelet (B-3): Some sections of the document are stronger than others.

Flora (B-14): If font size is the only beef I can make, the text is rather good! Subject to comments above.

Friedman (B-18): I think it gets into too much background information. There is a whole body of literature around peer review, but you can't cite the breadth of literature in this paper, so I wouldn't begin to go there; just cite the studies that are directly applicable to the review process.

Houser (B-27): Generally, the document is quite clear and concise . . . Generally, the document is actually more concise than I expected for such an important topic.

Newton (B-33): As stated above, it looks like a guide for a regulatory agency, in terms of detail. You already have my many comments on that subject.

Shepard (B-42): I found the manual to be clearly and concisely written. This version is an improvement over the previous version in eliminating redundancies. The use of cited quotes from well respected scientists adds to the readability and credibility of the manual.

Question 5. What portions of the manual should be expanded, condensed, or deleted? (And why?)

Finding: Most of the references to regulatory science definitions and metrics can be removed and/or placed into an appendix; remaining redundancies can be reduced and explanatory sections can be abbreviated.

Bachelet (B-3): Add comments to document the existing process and particularly the improvements that have been discussed by Science editors, NSF program managers, IPCC review committees . . . Moghissi's quotes should be reduced and the essence of his writing condensed and interpreted to target the specific goals of this document.

Flora (B-13): In response to Question 5, I assume this is a sales brochure. If you increase the font to a size I can read comfortably it'll be 50 pages long. I wouldn't buy Ovaltine with that long an overture, even with pictures of sexy drinkers on a 'clothing optional' beach.

Friedman (B-18): Don't think you need to describe regulatory sciences (I think that they are the same sciences, with the products being used for regulatory purposes, it's not like the scientific information is different), environmental sciences, fallacious information, outside the purview, religion and faith, societal goals and professional ethics. This whole part of the introduction can go.

Houser (B-27): I think it may be useful to broaden the discussion of common issues with the current peer-review process in the introduction, to both serve as motivation for ESIPRI, and to show how the ESIPRI procedures will avoid these pitfalls.

Newton (B-33): See written comments on draft [see page B-36].

Shepard (B-43): At this point, I do not see any areas that should be condensed or deleted. After a period of implementing the manual, a review to see how it could be improved would be useful.

Question 6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these three examples been (or were) improved with blind/anonymous review? (If yes, regarding the latter, why and how?)

Finding: Several examples of "case studies" are provided by reviewers, which help serve both as illustration and as potential need for ESIPRI services.

Bachelet (B-2): Moreover while reading this manual, the impression that grew in my mind was that ESIPRI and its manual were in fact focusing mostly on controversial issues, the

so-mentioned "contested areas of sciences" more than anything else. This reduces the relevancy of some of the advice given. For example if Albert Einstein was to try and publish his famous equation, or Galileo a treaty about the shape of the planet, this manual would not be very helpful and would certainly squash any possibility of creative hypothetical science to be published or shared.

Discussion: This is an important point, but it must also be said that neither Einstein nor Galileo had to go through a peer review process to publish their findings and hypotheses. The principal purposes of a peer review, from ESIPRI's perspective, are to catch errors before they are reproduced and to otherwise help improve the finished product as a result of the review. It is not a substitute for creative thought, research methodology, or scientific findings – its value is in the enhancement of these processes and conclusions via systematic critical consideration by a number of other proven experts in the field.

The fact that Question 6 specifically asks for personal examples ("case studies") of peer review opportunities just about guarantees that "controversial issues" and situations would likely be among the first to come to mind for most people. And yes, as Bachelet suspects, it is precisely the "contested areas of science" that are of most interest to ESIPRI and its Board – and that formed a large part of the impetus in creating both the organization and this document.

Examples of such issues by reviewers include: the Agent Orange controversy (Newton: A-28; B-33), Puget Sound pollution issues (Flora: B-16), Klamath River dams removal (Menke: A-22), and spotted owls and old-growth (Flora: B-15; Shepard: A-34). Of key importance is that all of these controversies were discussed in terms of which projects had been improved – or could have been improved – via independent peer review.

Menke (A-22): I think such a case study as an appendix item in your manual would add immensely to its usability.

Bachelet (B-3): I have had a paper rejected because it contradicted the results of a famous scientist who reviewed my paper. I am certain that double blind reviews would have been beneficial to the review.

Flora (B-14): In the past decade I've done 21 technical reviews of research papers and technical papers that had been presented as products of research . . . I am surprised by what I perceive as a downward trend in the quality of scholarship in graduates of nearby programs in marine-related fields and quantitative science. There is a need for high-order help in planning and overseeing analytical work. ESIPRI might be a welcome source of scholarship in research planning in addition to its peer-review assessments of research products.

I was only on the fringes of another drop-everything chore, the 1992-93 FEMAT exercise in which forestry and wildlife experts were ordered to address spotted-owl habitat issues. That venture produced wide owl-protection spaces and, unexpectedly, created a vast network of buffers along all classes of forest streams . . . FEMAT, done in a rush, would clearly have benefited from ESIPRI-type external critiques.

After retiring I was drawn into the Puget Sound fracases over wetland and tideland buffers, to which I gave a lot of effort, including library time . . . The point of this paragraph is that ESIPRI could have done *all* of what I did, undoubtedly better, and without implicitly representing some point of view.

Friedman (B-19): Technical Review -- Reviewing test plan for American Chestnut test sites. Not improved by blind review.

Peer review -- Reviewing proposals to be funded for Fund for Rural America (we used scientists and stakeholders on our funding panels); however, the director of the program got fired so perhaps that was too "outside the box" for the time. Not improved by blind review.

Scientific assessment -- Not sure that I have seen any examples of this. I have seen many examples of scientists being rounded up and giving their opinions on programs, etc., as "science reviews" but not the pure review of scientific information mentioned here.

The key thing about ESIPRI doing the review is not that the reviewer would be independent, but that ESIPRI could select them, rather than the author or a journal editor. So they could pick a scientist who agrees with the person, one on the other side, and one who is more or less objective, if such an individual can be found. But most important (IMHO) ["in my humble opinion"] would be posting the reviews so others can weigh in.

Houser (B-26): In my professional experience, I have seen both anonymous and open peer review, scientific assessments, and technical reviews used extensively to advantage.

Newton (B-34): In the controversy about whether Agent Orange, as applied in Vietnam, caused serious injury to servicemen who served there, Stellman and Stellman contracted with the Department of Veterans' Affairs to do an analysis of "exposure."

The Stellman and Stellman model needed all three types of review. It would have failed technical review because of a variety of aerial application technology studies already published by Yates et al, in the 1970s conducted to test whether extremely sensitive crops COULD be damaged within certain distances of aerial application of herbicides, including phenoxy herbicides.

Stellman and Stellman would have failed scientific review on evidence of movement of drops against gradients of atmospheric movement, and also evidence of a) dislodgeability of residues, and b) quantity of material present when troops would likely be in the vicinity.

Stellman and Stellman may have had scientific review, but it appears unlikely that their selection of reviewers included people who had intimate knowledge of a) spray movement, b) dislodgeability of residues, and c) sensitivity of humans to the level of residue transfer that could have been dislodged by contact with foliage and ground where Orange had been applied after days of drying.

Yet the Department of Veterans Affairs is scheduled to pay some $40 billion to veterans who served almost anywhere in Vietnam during the years (1964-70) when Orange was applied somewhere in Vietnam. And a quarter million veterans (and the VA) are assuming that almost any serious illness manifesting itself 40 years later may have been caused by Agent Orange, potentially reducing their chances of obtaining remedies for the real cause of illness.

Shepard (B-43): One example where peer review, scientific assessment, and technical review where attempted in one major review was the Bureau of Land Management's review of the science used to revise its Western Oregon Resource Management Plans, released in 2008 (and later withdrawn by the Secretary of the Interior citing legal error).

Resource professionals representing the many disciplines used scientific information that was developed, in many cases, by local scientists that the resource professionals knew. Predictive models where used to predict outcomes from different management regimes. In some cases the scientists had developed models that had already been peer reviewed and published . . . The scientists were asked a set of questions to consider in their review. The scientist developed a report that was placed on the BLM's website for transparency.

Overall, the review was useful and was used to improve the resource management plan.

Question 7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? Why or why not? (e.g., Would such measures be useful for considering projects or documents such as this one?)

Finding: Moghissi's metrics and definitions are not particularly useful for the actual review process, but have apparent value for philosophical background consideration, public discussion, and student education.

Bachelet (B-3): One cannot use the same criteria to review a model as to review a dataset collected in the field or the description of a new theory or method.

Dost (A-9): I have two very general concerns about this document: First, it attempts to provide a pathway for virtually every situation that might arise in evaluating a proposal or process, implying that professional judgment may not be up to the task of crossing uncharted waters. The danger in this is that should an unaccounted-for rational factor appear, it may be rejected because there is no category for it.

Second, there is so much repetition that I suspect that the manual could be half its present size.

Flora (B-13): I'm not sure how **appendix B** pertains to ESIPRI assessments. Are reviewers supposed to discover whether the science being examined was developed in an 'open-minded' way? Or that the scientist was suitably 'skeptical.'?

Most of that appendix is given to putting science into pigeonholes involving 5 'principles' and 3 'classes' embracing 9 kinds of science. That seems to create 45 pigeonholes. How many of those

are apt to be concerns to clients? Perhaps only those should be highlighted. Portray threats, not a classification system . . .

However I may be missing the purpose of Appendix B. It may truly be extraneous and supplemental to the main document, included solely to illustrate the extent and variety of scientific endeavor and its evaluation. In any case I have no strong quarrel with Moghissi's classifications.

Friedman (B-20): I don't think it's very useful. People collect information based on scientific norms. They analyze it. They document what they conclude. That's where we need to keep the focus.

Houser (B-28): I find the scientific information classification schemes offered in Appendix B to be generally useful, but also quite philosophical and a form of common sense for most experienced scientists.

I would recommend that reviewers make themselves familiar with such classifications, as I believe it would enhance their reviews. However, I would not recommend that reviewers be asked to classify the reviewed work into one of these classes, because it will prove tedious and various aspects of the work will likely cross classes or fall into multiple different classes.

Newton (B-34): I don't see how it can.

Shepard (B-44): I read Appendix B as more of a qualitative hierarchy of scientific rigor rather than a quantitative metric . . . I see value in assigning the science to a category using common criteria, as suggested in the appendix . . . I am uncertain of the value of using such a measurement on a document such as this manual.

Question 8. Does the manual include interesting insights into the peer review process? (Examples?)

Finding: The draft Guidelines contained insights and ideas that were of different interest to different people, including use of Internet forums, Moghissi's metrics, and reviewer pay rates.

Bachelet (B-4): It was very interesting to read/peruse Moghissi's various papers and the constraints of regulatory science.

Flora (B-14): Your Question 7 asks whether the 'common metric' of Appendix B appears useful. I didn't find the common metric. Obviously I've missed something. Nor did I gain the 'interesting insights' of Question 8. Found interesting discussions but no new insights.

Friedman (B-21): Research funding agencies use the "sounds plausible to a random bunch of scientists" standard and we're off to the races with extrapolations that don't make sense. How to stop that from happening? A separate step of "practitioner review." Two questions: 1) "do you find this a useful study? Why or why not?" And 2) "have they made some claims in this paper that do not reflect reality as you experience it?"

Houser (B-29): The manual provides a number of interesting insights into the peer review process.

Newton (B-35): I think you may find the answer to this above.

Shepard (B-45): The manual does include interesting insights into the peer review process. This is especially true for someone that does not routinely do peer review.

Question 9. What are the manual's two (or three) main strengths? (Why?)

Finding: Principal strengths of this document include: documented need; method of production; proposed ESIPRI peer review process; selection of reviewers; and focus on public education and participation.

Bachelet (B-4): 1) The desire by its authors to produce a useful document; 2) Its existence and the review process it is going through to improve its quality.

Discussion: Bachelet has voiced two of the key strengths that have characterized the authors' intentions since the beginning stages of this project.

Friedman (B-21): Any contributions to a taxonomy of the different approaches and clarification and a common language to describe them will be immensely helpful.

Houser (B-29): The main strengths of the manual are: **1) Independence:** The manual defines and stresses the importance of independent reviews, or those without conflicts of interest and that are signed . . .; **2) Transparency:** The manual stresses full transparency so that Stakeholders can readily observe the process and obtain relevant information without jeopardizing confidentiality; 3) **Formalized processes:** The manual establishes written policies and processes that ensure that all parties involved in the process understand and follow the basic requirements of an independent peer review.

Newton (B-35): Maybe: a) It may offer a screening of reviewers that will adapt strength of reviewers to the potential cost of weaknesses in the draft; b) It may put incentive in the hands of ESPIRI to ensure that the product is worth investing in (a biggie), hence have a cadre of very competent reviewers with known qualifications; c) Distinction between technical vs. scientific talent to review different types of document.

Discussion: Newton has also keyed on one of the authors' principal intents in beginning this project: to assemble "a cadre of very competent reviewers with known qualifications." We believe that this process is well underway with the current group of quality reviewers for this manual. It is also worth noting that related actions of "screening of reviewers" and distinguishing between "technical vs. scientific talent" during this process have directly addressed Newton's remaining two "maybe" points.

Shepard (B-45): The use of quotes as discussed in the response to question 8 . . . The section discussing the value and role of stakeholders added value to the manual.

Defining different types of scientific information and categorizing scientific information based on rigor also added value to the manual. A common definition for users of the manual, or observers of the review process, results in a common understanding going into a review. I found differentiating regulatory science from environmental science enlightening. Intuitively I knew the difference, but did not think of it as being that different before reading the manual and reflecting on it.

Question 10. What are the manual's two (or three) main weaknesses? (Why?)

Finding: Principal weaknesses of this document include: over-use of Moghissi quotes and taxonomy; lack of certain details regarding peer review process; and need for field testing.

Bachelet (B-4): 1) Obvious and accepted plagiarism; 2) Lack of in-depth review . . . of other review process guidelines from agencies, journals, science groups (a table would have been appropriate); 3) Lack of original idea to improve the existing review process beyond what already exists.

Friedman (B-21): First, I think that it is very useful to explore this territory, especially since "peer review" seems to be an expression that is slung around fairly broadly. Peer review in science, is simply a review by (or expected to be) peers, or scientists in the same field. However, in my view, there is a difference in what you are looking for, and whom should be asked to review, depending on the objective of your peer review.

Houser (B-30): Process not specific enough: There is a lot more definitions and conceptual information in relation to actual directives and procedures. It seems a lot of the procedures are left undefined, and that they will be determined by the oversight committee. I suspect that much of the needed process detail will be added as ESIPRI gains experience and develops its best practices.

Newton (B-35): 1) I don't think it is reasonable to assume ESPIRI can always find reviewers who are serious about the commitment implied in accepting a review assignment. Only older scientists are really qualified, and those are the ones who have the most responsibility for many other things; 2) There is no incentive in academia to review, and no accounting system for it. So why bother?; 3) I have never heard a major professor insist that his students undertake technical/ scientific reviews under his supervision. This is a problem that will not go away. I myself am guilty.

Shepard (B-45): The only weakness I would comment on is how this manual will be reviewed for updates as the methodology for peer reviews evolves and ESIPRI learns from implementing the manual. ESIPRI has gone to great lengths to review this manual and be transparent with the review. A short statement in the introduction . . . stating that the manual will be reviewed for possible updates and updates will be peer reviewed as appropriate would address this.

Question 11. What specific recommendations do you make for the improvement of this manual?

Finding: Reviewer recommendations principally involved repeating their earlier suggestions of increased literature review, improved peer review method, use of tables, etc.

Bachelet (B-4): 1) Use more than one source of information to describe review and conduct a thorough review of what works and what does not in the existing review guidelines; 2) Focus objectively on science issues rather than controversial issues that have economic or regulatory implications. Objectivity should be the main principle behind any science activity.

Discussion: By distributing drafts of the proposed Guidelines we feel we have drawn on the combined expertise of several key scientists and resource managers; most of who have extensive experience and familiarity with peer review literature and processes. It is their combined experience – and not the current literature – that we have chosen to determine "what works and what does not." As stated earlier, it is ESIPRI's intent to focus objectively on the quality of environmental sciences – and particularly that which might have important economic, policy, and regulatory implications. Those of us with a cultural anthropology background might also argue whether "objectivity should be the main principle behind any science activity," or if such a condition is even possible.

Friedman (B-23): Focus on the kinds of services you have to offer, clarify what kinds of folks will review what kinds of documents, and for what kinds of purposes, and then only provide background material and citations as needed.

Houser (B-30): Here are my top suggestions for improving the manual: 1) Include provisions for improving the reviewed work – this would include . . . requiring the author(s) to respond to the peer review concerns in a transparent manner; 2) The questions must be simple and easy to understand. I recommend that a standard set of example questions be provided to illustrate a generic unbiased approach. It is also important to sequence questions in a way that will not lead the panel to a particular conclusion; 3) The ESIPRI conflict of interest policy is critical to the success of the review process.

Newton (B-35): See comments in writing on draft [B-36], along with solving the sociological problems identified above!

Shepard (B-45): Although I believe the authors did a good job of describing the types of review to do under different circumstance, the manual might be improved by adding some "frequently asked question" to assist clients and other users determine what type of review might best address their need. A flowchart or dichotomous key on the different approaches of review and when they are used inserted as an illustration might also be beneficial to users.

Summary of "11 Questions" Findings

1. Finding: The proposed ESIPRI review process, as described, is both scientifically credible and valid.

2. Finding: The purpose of the Guidlines is clearly stated and addressed, but can be improved with suggested changes.

3. Finding: The organization of the Guidelines is generally clear and effective, but can be improved in several ways.

4. Finding: The writing style is mostly clear and concise, but the overall document length can be shortened significantly to positive effect.

5. Finding: Most of the references to regulatory science definitions and metrics can be removed and/or placed into an appendix; remaining redundancies can be reduced and explanatory sections can be abbreviated.

6. Finding: Several examples of "case studies" are provided by reviewers, which help serve both as illustration and as potential need for ESIPRI services.

7. Finding: Regulatory science metrics and definitions are not particularly useful for the actual ESIPRI review process, but have apparent value for philosophical background consideration, public discussion, and student education.

8. Finding: The draft Guidelines contained insights and ideas that were of different interest to different people, including use of Internet forums, Moghissi's taxonomy, and reviewer pay rates.

9. Finding: Principal strengths of this document include: documented need; method of production; proposed ESIPRI peer review process; selection of reviewers; and focus on public education and participation.

10. Finding: Principal weaknesses of this document include: over-use of Moghissi quotes and taxonomy; lack of certain details regarding peer review process; and need for field testing.

11. Finding: Reviewer recommendations principally involved following their earlier suggestions of increased literature review, improved peer review method, use of tables, etc.

Recommendations

The following recommendations are derived from the findings listed in the preceding section of this report and/or as suggested by reviewers in Appendices A and B. Each recommendation is followed by a listing of relevant review comments, and a relatively detailed rationale as to how the recommended text was – or was not – altered in response to reviewer's suggestions. Liberal use of the word "should" in the following pages should be read in context of being a desired future condition on the part of the writer.

#1. Title. The title of the finished report should be "ESIPRI Environmental Sciences Peer Review Guidelines."

Dost (A-7): I am concerned about the use of "peer review" in the title . . . I worry that purists who see each peer review as a new independent exercise, will feel that it is a cookbook.

Flora (B-12): The title misled me. I thought a 'manual' would be a how-to document, like a handbook. Such as, 'Here's how you can expect an ESIPRI review to be conducted, the questions that reviewers are expected to answer, the kinds of material they will and won't address, here's how to request a review, and perhaps some other procedural items. Some of those process items are to be found, but not until I get a long monologue about kinds of science and so on . . . What to do? I'd change the title, to just **ESIPRI Science Assessments** or something.

Discussion: The recommended title is significantly different from the July 31 Draft #2 of the Guidelines: "Independent Peer Review and Scientific Assessment Manual." Due to reviewer comments, the recommended title contains three basic changes from the Review Draft: 1) "ESIPRI" has been formally added to the title, 2) the phrase "Independent Peer Review and Scientific Assessment" has been shortened and changed to "Environmental Sciences Peer Review," and 3) the word "Manual" has been changed to "Guidelines." Although the phrase "peer review" remains in the title, the addition of "ESIPRI" distinguishes this specific process from the more general uses of that phrase that some reviewers questioned.

#2. Audience(s). The ESIPRI Guidelines should clearly state its intended audiences at the outset: 1) ESIPRI directors, advisors, and reviewers; 2) current and potential ESIPRI clients; 3) students and teachers; and 4) interested members of the general public.

Flora (B-12): IN WHICH I ASSUME THE MANUAL IS FOR INTERNAL USE: Looks good. I have no quarrel with the material. Moghissi seems to gild the lily a bit with his multiple classifications, but no harm done.

IN WHICH I ASSUME THE MANUAL IS FOR OUTSIDERS, MOSTLY POTENTIAL CLIENTS: Then, in the introduction, I'd identify quickly the intended audience(s) of the document. Then, in one sentence, tell what this document is all about. Then what the ESIPRI process is all about, in about three sentences.

Discussion. Flora makes the point that the draft did not clearly identify an intended audience. As one result, other reviewers have also made comments that are specific to audiences they may have assumed to be intended – and which have varied from possible journal editors to ESIPRI peer reviewers to university professors and students. The key is that these reviews and resulting products are clearly intended, at some point, to be made available for public consideration and comment via the ESIPRI website -- and, as one result, the intended audiences for the Guidelines should be clearly stated at the outset (as Flora suggests) for people first learning about ESIPRI via the Internet. The four listed groupings – ESIPRI internal use, clients, students, and public – are derived from ESIPRI Board discussions and draft reviewer comments.

#3. General Format & Style. The written style of the Guidelines should be in Plain English, concise, well-organized, with proper scientific referencing and minimal use of acronyms, abbreviations, and mathematical equations.

Ivy (A-18): I read the peer review manual [Draft #1]. Painful, but very readable and understandable for a lay audience. And helpful to those like me who have to read reports.

Shepard (A-37): Thanks for the opportunity to review the manual. As we discussed before, I think this is really needed. It is becoming more so as science gets "used" more and more by politicians and others to push their agenda. An objective, transparent process is needed. I found this version of the manual very readable and feel it should serve as a good tool as ESIPRI works toward its mission.

Straka (B-39): This is a very interesting manual. I glanced at it and did note a couple of things . . . I read it quickly and found it informative and well-written.

Discussion. The document's format and writing style were directly addressed to reviewers by Questions 3 and 4 of the "11 Questions," and the subsequent Findings directly support this recommendation. "Plain English," for purposes of ESIPRI, can be defined as a general term for written and spoken communications in English that emphasize clarity, brevity, and a general avoidance of technical language. The goal is to write or speak in a way that is easily understood by the intended audience: clear and straightforward, appropriate to their technical reading skills and knowledge, and free as possible of wordiness, cliches, and jargon. This approach includes all four of the intended ESIPRI audiences, and helps resolve conflicts in Environmental Sciences communications caused by differing definitions, methods, and terminology that exist between the multiple scientific disciplines comprising this field.

Proper scientific referencing to sources of information draws directly from comments by Straka (A-39), who provides a useful example that is easy to use and includes most scientific disciplines. Straka's comments only refer to published literature, however, and other acceptable formats will need to be identified for spoken communications, correspondence, Internet websites, etc. The conversion of mathematical equations to words is also an important step in maintaining scientific integrity, while opening methods and conclusions to the widest possible audience for

consideration and review.

#4 "3 Questions" Survey. Future ESIPRI reviews should strongly consider using this preliminary survey step of soliciting and recruiting a wide range of potential reviewers, while using the opportunity to discuss some basic issues with a working draft or detailed outline.

Atzet (A-3): Also liked what your paper says: there are many papers that talk about the increasing abuse and misuse of science, including bastardizing the peer review process. Politics is an obvious culprit, but merchandising is not far behind. I think your paper will help put some structure on the organization and use [of peer review].

Johnson (A-19): I have read the ESIPRI document carefully and find it to be very good.

Menke (A-22): Your mission is outstanding and such a manual and service is needed.

Smith (A-37): Impressive and needed. An invaluable contribution to science.

Zabel (A-41): It will be imperative that ESIPRI maintains a neutral reputation in the scientific community. Once ESIPRI is branded one way or another, reviewers will hesitate to be associated with it due to some perceived reputation."

Discussion: There were three principal reasons for distributing Draft #1 with (usually) the "Three Questions" survey: 1) to see what interest, if any, might exist in formally reviewing such a document; 2) learn what the time and costs might be for such a review; and 3) learn what improvements could be made to the existing draft in order to better prepare it for a formal review. The quotations listed above demonstrate how well the initial draft was received, indicates the perceived need for such a document, and is also representative of the willingness of our various respondents to perform a formal review. The beginning portion of the Criteria and Findings section in this report discusses points 2) and 3) in greater detail and with additional quotations.

The current Guidelines draft has no formal provision for a preliminary survey of this nature, but it is discussed to some degree in the section on "informal peer reviews." This recommendation could be used as a strong suggestion in Step 3 of the current Guidelines Peer Review Process, which lists the Oversight Committee's obligation to select a peer review panel and provide them with an initial set of possible review questions.

#5 "11 Questions" Review. Findings and reviewer comments should be followed closely in constructing the finished ESIPRI Peer Review Guidelines.

Discussion. Reviewer comments and subsequent findings are considered in some detail in the previous section of this report. In addition to these specific findings, many reviewers also included important observations regarding ESIPRI purpose, the importance of scientific credibility and validity in conducting reviews, and other critical aspects of ESIPRI's ability to

function in a positive and successful manner. Some reviewers (Bachelet: B-4; Dost: A-7; Flora: B-13; Lapham: A-20; Newton: B-36; Straka: A-40) also included detailed page-by-page commentary that varied from correcting small typos to challenging key portions of the draft. The combination of these materials provide a number of detailed suggestions for making significant improvements on both the finished ESIPRI Guidelines report and the proposed formal ESIPRI peer review process.

#6. Literature Review. All completed formal reviews and all referenced materials, wherever possible, should be placed online and made publicly available as linked PDF files for purposes of transparency and efficiency.

Bachelet (B-2): In fact the review process has been described and written about by many organizations such as the Ecological Society of America, the American Geophysical Union, the Society of American Foresters, and many others, all the scientific journals that request peer-reviews, and all agencies (NSF, NASA, USDA, NIH: see end of this review for sources) delivering funding for scientific research . . . I did not read one quotation from any of those sources in this manual and I think that is an important missing part of a "review" such as this that intends to extract the best principles of the review process.

Discussion: It was not the authors' intent to specifically describe or write about – and definitely not to "review" – the peer review process; nor were we attempting to "extract the best principles of the review process." Rather, our continuing effort is to assemble a written guideline for ESIPRI: to hopefully use for the purpose of conducting peer reviews in an efficient and scientifically credible manner, and for the purpose of Internet applications, including public discussion and review, and as student resources.

Bachelet makes some excellent points regarding the quality of available literature that exists on the topic and practice of peer reviews, and provides a number of useful links to such sources (pg. B-10). It is the intent of the authors to make all references to such literature that appear in the Guidelines and its appendices (including all of Bachelet's links and suggestions) readily available as PDF files on the ESIPRI website: www.ESIPRI.org/Library

#7. Conflict of Interest Issues. Reviewers should sign formal conflict of interest statements, and also provide ESIPRI with documentation of possible conflicts in instances where they may exist.

Bachelet (B-7): Conflicts of interest should also include friends, students, and competitors.

Houser (A-15): I like the idea of forms (in an appendix) – you include a conflict of interest form. I might also suggest a standard form for each type of review, with extremely general peer-review questions about the merit, justification, methods, and validity of the scientific results.

Conflict of interest: May want to add a lifetime COI for student/teacher relationships, and

colleagues having done joint work within last 5 years; Also expertise may be relevant, but biased – for example, there is an obvious conflict of interest when an engineer who specializes in dam removal is asked to review a dam removal plan; What are the consequences if a reviewer or committee member lies or forgets about a COI?

Houser (B-30): The ESIPRI conflict of interest policy is critical to the success of the review process.

Moghissi (A-25): Conflict Of Interest: There are well-established processes for determining the lack of conflict of interest. These include financial, personal, institutional and others. The fundamental principle is: *Those who have a stake in the outcome of the review may not act as a reviewer or participant in the selection of the reviewers.*

#8. Full Disclosure & Transparency. Final products, signed peer reviews, reconciliation reports, professional credentials, and formal review discussions should be placed online for public reference and consideration.

Houser (A-15): Many new electronic science journals are adopting a new, almost blog-based public peer review process. This involves the paper being publically posted, then for some fixed period of time (2-4 weeks), the paper can be commented on by the public at large. At the same time, a regular panel of peer-reviewers is tasked with preparing professional reviews, which are also publically posted. After the review period is over, the authors are asked to publically respond to each review, which can be iterated with the reviewer. In the end, an editor or committee publically assesses the peer review process and issues a final acceptability of the work. This can all be very easily facilitated using automated software that would systematically make the process publically transparent, and predictable.

Shepard (A-37): I would be willing to have my comments on a final review posted on a web site. I don't think it would be appropriate to put comments on a review of a preliminary draft on a public web site.

Discussion: This is a significantly different suggested use of the Internet than Recommendation #6, which is intended to build a comprehensive reference library of PDF files: including many of the items listed in this recommendation. Key differences are intended use and format. This recommendation is not restricted to PDF formats, and is intended to encourage public use and access -- including discussions -- of ESIPRI scientific reviews, findings, and finished products.

#9. Public Education & Student Training. **The finished Guidelines should include strong provisions and encouragement for student education, training, and participation in the scientific peer review process.**

Flora (B-15): I am surprised by what I perceive as a downward trend in the quality of scholarship in graduates of nearby programs in marine-related fields and quantitative science. There is a need for high-order help in planning and overseeing analytical work. ESIPRI might be

a welcome source of scholarship in research planning in addition to its peer-review assessments of research products.

Menke: A-22): Your mission is outstanding and such a manual and service is needed. However, I do not think your manual will displace existing quality journal peer review, but learning in Paul's statement about blog-based transparent review is totally new to me and appears at first assessment on my part to be outstanding.

Newton (B-35). I have never heard a major professor insist that his students undertake technical/ scientific reviews under his supervision. This is a problem that will not go away. I myself am guilty.

#10. Glossary & Metrics: Moghissi Taxonomy. The majority of quotations and peer review taxonomy in the main text attributed to Moghissi should be moved to the existing regulatory science appendix that already contains his work.

Discussion. As described in the Introduction, the initial outline and draft of this document was derived to a very large degree from the writings of Alan Moghissi. The influence and pervasiveness of his work throughout the ESIPRI drafts was apparent to most reviewers and was directly addressed by Question 7 and its findings. Some seemed disturbed by this near-constant presence; while others thought it was appropriate, and/or even useful for ESIPRI's purposes. A few reviewers (most notably Newton, Flora, and Dost) thought that much of this work should be eliminated outright from the manual, mostly because of its close association with Regulatory Science processes; others thought the information helpful and relevant (e.g., Houser and Shepard). The recommendation is to remove those portions of the Guidelines' main body that contain the less essential Moghissi contributions to an "Appendix D" (nee Appendix B) that has already been created – and reviewed – in order to accommodate informative Regulatory Science information related to ESIPRI's mission and purpose. In this way, key portions of Moghissi's work remain in the main body and processes of the Guidelines, while a majority of his more philosophical ideas and taxonomy is made available as an important reference source organized specifically for the use of ESIPRI members and reviewers -- and of science students with an interest in peer review methods.

Bachelet (B-2): I am also surprised at the amount of material copy/collated verbatim from Moghissi et al. Despite permission from the authors I would consider this manual as mostly an exercise in undisguised plagiarism. Another problem with this is that Moghissi is clear in explaining that his goal is to address the peer review process specifically for **regulatory sciences** (Zybach and Alverts are well aware of this since they mention it clearly on page 3). But the manual by Zybach and Alverts does not make this claim and aims to encompass all sciences. Consequently the quotes from Moghissi are somewhat taken out of context since conditions for reviewing non-regulatory sciences can be quite different.

Friedman (B-21): Any contributions to a taxonomy of the different approaches and clarification and a common language to describe them will be immensely helpful.

References

Friedman (B-18): I think it gets into too much background information. There is a whole body of literature around peer review, but you can't cite the breadth of literature in this paper, so I wouldn't begin to go there; just cite the studies that are directly applicable to the review process.

Discussion. All of the references, quotations, and citations in this report (Appendix C) are, by design, specific to the authors and to their documents that have been reproduced -- with standardized pagination -- in Appendices A and B.

The Reference section in the Guidelines contains published references for the main body of the report, while Appendices D and E each have their own list of cited references. In addition to discrete reference lists, all three documents also contain quotes and citations of draft reviewers' comments in Appendices A and B.

ESIPRI
ENVIRONMENTAL SCIENCES PEER REVIEW GUIDELINES

APPENDIX D. GLOSSARY & REGULATORY SCIENCE TAXONOMY

There has been much discussion and some major disagreements as to what constitutes peer review and scientific assessment, the implications of independency and transparency, and the differences between independent peer review and peer review: including how these words and phrases (and their associated terms) are defined and used in practice and in policy. This appendix provides common definitions of such terms and phrases routinely used throughout this document and generally accepted by members of the scientific community. Several of the following terms are defined almost precisely as given in Moghissi et al. (2010: 94-96) and are used in a similar manner in the Guidelines. Additions and modifications to this list have been provided by other reviewers of this document (Appendices A and B) or the authors.

GLOSSARY

Accepted Science: Science that has demonstrated its reliability by consistent replication by many others and/or by direct application.

Applied Science: Use of scientific information demonstrated by reproducible evidence and systematic employment.

Assessment: Critical evaluation of a subject or product.

Assessment Panel: A group of individuals chosen to perform scientific assessments.

Blind Peer Review: A relatively recent type of formal peer review, in which either the writer(s) and/or peer review panelists purposefully remain anonymous. When both writers and panel members are kept anonymous from one another, it is called a "double-blind" peer review.

Conflict of Interest: A circumstance that would lead an individual having to choose between scientific judgment and other interests, including personal interests.

Consensus Panel: A group of individuals chosen to reconcile conflicting information.

Consensus Process: A formal process that attempts to reconcile inconsistent or contradictory scientific information.

Criteria: Formal questions addressed during a peer review or scientific assessment.

Decision Makers: Individuals in a position of authority that can authorize actions to be taken based on available information.

Discipline: Specialized divisions of the major fields of scientific study.

Environmental Sciences: A multi-disciplinary science consisting of those disciplines that study interrelationships between the living and non-living components of our planet.

Evolving Science: A classification of scientific information than spans the entire spectrum of science from Speculation to Accepted Science.

Facilitators: Individuals in a position of authority with the responsibility of implementing actions desired by Decision Makers.

Fallacious Information: Information that is presented as scientific, but is shown to be either false, or not science at all.

Full Disclosure: Refers directly to the public availability of findings, reviews, and other data related to a scientific undertaking and final products. This includes the revelation of all known information that may support or conflict with the findings of a scientific report and/or the revelation of all known or perceived conflicts of interests and/or biases of a reviewer.

Gray Literature: Information of unknown quality that has not been peer reviewed.

Independence: Lack of conflict of interest.

Independent Consensus Process: A formal process that attempts to reconcile inconsistent or contradictory scientific information using independent peers.

Independent Peer Review: Critical evaluation of a project or product by independent peers.

Independent Scientific Assessment: Critical evaluation of a scientific subject by independent peers.

Knowledge: Combination of academic training and actual experience in a scientific field.

Open Access: Complete access to reports, reviews, formal discussions, and other data generated by a peer review or scientific assessment process. Similar to Full Disclosure.

Open Mindeness: A key principle in the undertaking of a scientific review or assessment.

Opinion: A personal belief.

Oversight Committee: A committee formed to oversee the formal peer review process and/or associated scientific assessment of a particular product, project or subject.

Peer: Individuals who are capable of participating in the review process through experience, training, and access to pertinent information.

Peer Review: A critical evaluation of a project or product by qualified peers.

Plain English: A clear, concise, well-organized writing style, for general audiences, with proper scientific citation and limited acronyms, abbreviations, and mathematical equations.

Product: A result of a project that is being planned, is in progress, or has been completed. Typically includes reports, constructions, curricula, and other forms of using scientific information for a desired result.

Project: A study, program, report, article, activity, or any other technical product that is planned, is in progress, or has been completed.

Regulatory Sciences: Consist of those disciplines that constitute the scientific foundation of regulatory, legislative, and judicial decisions.

Review Panel: A group of at least three individuals chosen to perform peer review.

Reproducibility: Scientific processes or experiments that can be readily reproduced by others, and by using the same (or similar) methods.

Scientific Assessment: A critical evaluation of a scientific subject or product that results in a formal report.

Skepticism: A basic scientific principle requiring those who make a scientific claim to provide sufficient evidence supporting their claim.

Speculation: The beginning point of scientific research and investigation.

Stakeholder: An individual, group, business, agency, or organization directly affected by, or with an outside interest in, the outcome of a peer review or scientific assessment.

Subject: A basic area of thought or discussion.

Technical Assessment: Evaluation of a scientific subject by individuals who are not necessarily peers or independent.

Technical Review: Virtually the same as Technical Assessment, consisting of a review of a project by individuals who are not necessarily peers or independent.

Transparency: Conducting peer review or scientific assessment in which all formal documents and related decisions are made freely available to all Stakeholders.

REGULATORY SCIENCES TAXONOMY

> *Although regulatory science is a distinct scientific discipline, it encompasses numerous areas of study, as do other scientific disciplines such as physics, chemistry, or biology. Consequently it is often collectively referred to as "regulatory sciences" to include the various regulatory agencies that deal with regulatory toxicology, regulatory pharmacology, regulatory ecology, regulatory atmospheric sciences, regulatory engineering, etc. to mention a few. The most recent definition of regulatory sciences is as follows: "Regulatory Sciences consist of those scientific disciplines that constitute the scientific foundation of regulatory, legislative, and judicial decisions."*
>
> -- Moghissi and Anderson (2011: 3)

This appendix is principally based on the ideas, terms, definitions and organization contained in several publications by Dr. A. Alan Moghissi: most notably his book, *Best Available Science (BAS): Fundamental Metrics for Evaluation of Scientific Claims* (Moghissi et al. 2010); his paper, *Independent Peer Review of Regulatory Science* (Moghissi and Anderson 2011); and, as synthesized and organized in his Congressional testimony of November 30, 2011, *The Need for Regulatory Science Transparency at the EPA* (Moghissi 2011). The first two titles are published by the Institute of Regulatory Science in Alexandria, Virginia, where Dr. Moghissi has served as President since its founding in 1985.

The various principles and categories listed in the following pages have been modified to some degree in organization and definition from their original sources. This is for two primary reasons: first, Moghissi's own work often varies in these attributes from source to source, as his work has been refined through time and varies in focus; and second, most of the following has gone through two peer reviews (see Appendix C) where the attempt had been made to modify Moghissi's writings to better serve the subtle differences in scientific focus and representative disciplines between Regulatory Sciences and Environmental Sciences – a principal difference being Environmental Sciences focus on scientific information that drives policy, while Regulatory Sciences focus on the policies driven by scientific information.

Table of Contents and Index

1. Fundamental Scientific Principles

The following principles form "the basis" for evaluating scientific information -- and thus, "help guide credible scientific reviews and assessments" (Moghissi and Anderson 2011: 15-16):

Open Mindedness Principle. This principle implies the willingness to accept new information and scientific claims: e.g., each claim of a discovery; identification of a new principle; development of a new drug; description of an environmental risk; and numerous other examples requires a willingness to carefully evaluate the claim.

Skepticism Principle. This principle requires that those who make a scientific claim must provide sufficient evidence supporting their claim. This principle appears to contradict the Open-mindedness Principle. How can one be open-minded and yet skeptical? A key ingredient in reaching this balance is the obligation of those who make a claim to provide sufficient evidence to satisfy not only members of their discipline but also the scientific community outside their discipline, that their claim is credible.

Dost (2012: A-10) claims these Principles are not necessarily exclusive of one another:

> *Perhaps my problem here is that I am an idealist; I can't imagine a good scientist who is not both open-minded and skeptical. An open mind allows one to examine that which is accepted wisdom and 'fact' with the sense that it is real and established, but perhaps there is something further that no one has thought of. The two ideas are not incompatible.*

Transparency Principle. Those who make a scientific claim have an intellectual and ethical obligation to identify the "level of maturity of each segment of their claim," including: areas that meet the Reproducibility Principle; inclusion of assumptions, judgments, or default date; and consideration of societal and other areas "outside the purview of science."

Reproducibility Principle. Reproducibility is the true proof of the validity of a scientific claim. It clearly separates undisputed areas of science from those that include assumptions, interpretations, and/or the inclusion of ideological and societal objectives in a scientific assertion. This principle implies that any investigator who has the necessary skills, proper equipment, and the appropriate facilities will be able to reproduce the claim.

Universal Scientific Principles. All scientific disciplines use certain methods, processes, and techniques in pursuit of their professional activities. The "Universal Scientific Principles" implies that there are certain principles applicable to virtually all scientific disciplines. "This principle is valid regardless of the nature of the discipline. It is valid in physics, geology, biology, climatology, and anthropology, to mention a few."

Dost (2012: A-10) makes the point that: "Universal principles as shown here is a generalization with no specifics," and shouldn't be considered a separate principle.

2. Outside the Purview of Science

Scientific information is used to help inform decision making and suggest the potential consequences of various choices. Decisions are always made with incomplete information, and science information is just one of several factors in the decision process. Also important to this process are social and economic values, stakeholders, politics, and time. Moghissi takes care to identify areas that are "outside the purview of science" (Moghissi, et al. 2010: 32-34; Moghissi and Anderson 2011: 19-20). Such areas include religious faith, societal decisions, and numerous other social and economic values of a society. This concept does not imply that the scientific community or individual scientists have no role in areas that are outside the purview of science: instead, it implies that "the role of the scientific community or the individual scientist is similar to the roles of members of any other profession."

Religion and Faith. This category could also be labeled as Belief Systems or Traditional Values. It is based on personal confidence in the truth of an idea and largely consists of personal beliefs that science cannot address. One of the key characteristics of faith is the inability of science to prove or disprove these various assertions of faith, either now or in the foreseeable future. A large percentage of beliefs, much like faith, cannot be proven or rejected by science.

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Societal Goals. Throughout history societies have demonstrated how difficult it is to maintain long-term goals and objectives. Societies tend to change over time, and with those changes, values and belief systems also change. Historical evidence ranging from the "intrusion of church doctrine in the claims by Galileo, to intrusion of the world politics framing ideology in the case of Einstein, to Soviet promotion of Lysenkoism," are recognized examples of the consequences of intrusion of societal objectives in science. There is evidence indicating the intrusion of societal values and goals in the scientific process can jeopardize objectivity and the acceptance of information. Depending on prevalent values and belief systems some science information on a given subject may be adopted, while other related information is rejected.

Professional Ethics. Many professions have developed ethical guidelines addressing the practice of members within the respective profession. While some ethical guidelines are derived from legal requirements, others represent the views of members of the profession. It is important to recognize that as critical ethical guidelines may be, they are derived from societal objectives and thus remain outside the purview of science.

Dost (2012: A-8) observes:

> *Societal objectives may decide why a project may be initiated, or where it is located, or what part of the community may have to be displaced. They have nothing to do with the quality of the work and materials, the competence of employed staff, or integrity of design. If a project is likely to cause physical or social damage, an ethical professional would refuse it. Ethical behavior may be outside the purview of science only in the sense that it should characterize the entire spectrum of human activity, including science.*

3. Classification of Scientific Information

It is well established that science evolves and that new discoveries, the advancement of scientific knowledge, and numerous technologies result from the evolution of science. Therefore, it is useful to classify scientific information in terms of its level of quality and reliability. The following classification system constitutes one of the "Three Pillars" in the Best Available Science (BAS) metric system (Moghissi et al. 2011: 16-18). Classification titles and organization have been somewhat modified in response to suggestions by Dost (2012: A-10) and others.

Class I – Accepted Science

This class consists of scientific laws (or principles) and their application. These concepts are predictable and reliable.

This classification is the equivalent to scientific laws in the classical "hypothesis-theory-law" process. The cornerstone of this class is compliance with the Reproducibility Principle, implying that any investigator who has the proper equipment and the necessary skills can reproduce it. Therefore, this class of scientific information does not require assumptions or any other conditions for its validity. Moghissi and Anderson (2011: 16) provide these examples:

> *For example, the validity of the law of gravity has been well established, including the fact that it does not apply to the inside of an atom. Similarly, the speed of light is known and the differences in results of its measurement are within the generally-accepted accuracy.*

Dost (2012: 10) offers this caveat:

> *In toxicology we are constantly confronted with demands that safety must be "proven." It is thereby a prediction of the future, a philosophical impossibility. Where we use the word "safe" so casually really means that the probability of harm is so small that it cannot be distinguished from zero. The law of gravity is a useful example. If I drop something, I can assure you with great certainty that it will fall, but I cannot "prove" it until after it hits the ground.*

Class II – Evolving Science

Accepted Science consists of scientific information that is uncontested and is principally reproducible by anyone with relevant training and appropriate equipment. Evolving Science constitutes that area of science where the overwhelming majority of scientific advancements are made: from initial speculation to reproducible findings.

1. Speculation. This class is based almost entirely on the opinion and intuition of an individual. Often the objective of speculation is to initiate a research project or stimulate a scientific discussion.

2. Hypothesis. This class consists of an organized response to an observation, an idea, or any other initiating thought process. Information in this class is not necessarily based on Accepted or Reproducible Science. The historical record shows that, although many great scientific discoveries started with this class, there is also a long list of hypothesized information that have proven to be either wrong or not worth pursuing.

3. Reproducibility. Reliable information dealing with a subject that is not completely understood constitutes the core of this class. The key factor in placing information into this category is reproducibility. Although the observations that are the foundation of this class may not necessarily have general applicability, they are clearly and unambiguously reproducible by those with appropriate skills and equipment. The scientific foundation of information in this class is often either unknown or the knowledge is incomplete.

Class III – Decision Driven Science

> *It seems too, that a category of "Decision-driven Science" or some such theme should include Rationalized Science, Correlation-Based Science, and Scientific Judgment. Decisions in the social arena are almost always based on what we know as of this moment, and rational prediction. We can't wait until knowledge is complete, which will come just after the end of the world.*
>
> -- Frank Dost (2012: A-10)

1. Rationalized Science. This class includes certain segments of regulatory sciences information that includes predictive models. Although it builds upon Accepted or Reproducible Science, it typically uses assumptions, extrapolations, and default data to derive its results. An important characteristic of this class is its level of reproducibility: the choice of assumptions, mathematical processes, default data, and numerous other prerequisites are inherently arbitrary and thus are not necessarily reproducible.

2. Correlation Based Science. This class attempts to correlate systematic observations to an effect. There is an extensive literature covering this class including a large segment of epidemiology. Experience shows that correlation or association does not necessarily imply causation and some associations have correctly identified their cause but others have proven to be unrelated.

3. Scientific Judgment. Information is often provided to society that lacks scientific foundation. Management decisions often must be made without having needed information, including basic principles, necessary data, and other scientific requirements. The methodology for expert judgment is reasonably well developed and consists of asking a number of presumably knowledgeable individuals to provide answers to specific questions and statistically assess the results. However, this class is "often tantamount to a collection of educated opinions" (Shepard: 2012: A-36).

Class IV – Fallacious Information

As suggested by Brooks (2012: A-6), a key purpose of peer review is to: "point out glaring errors that disqualify the work for further consideration." The most "glaring errors" revealed by any review are data presented to be factual that turn out to be entirely (or mostly) false; i.e., "fallacious information." Class IV information therefore becomes the fool's gold of faulty scientific claims – and which determination can be a very positive result of independent peer review by eliminating the need (and cost) of further examination for such discredited claims.

Moghissi et al. (2010: 29-30) make this observation regarding fallacious information:

> *Originally, this class was considered to be the fourth class in the scientific classification system. However, during the peer review, it was brought to our attention that fallacious information is not science and therefore, does not qualify to be considered to be a class in the science category . . . Those who desire to promote specific political, ideological, or other goals disseminate some of the information in this class. Their opponents often call this information "pseudo science," "junk science," or "agenda-based science."*

For current purposes of ESIPRI, there is value in having a category to file information that – prior to review – had claims of a higher classification. It is the authors' informed opinion that this category of information is fairly well represented in a number of products of the various disciplines that comprise Environmental Sciences, and similarly influential so far as federal and state resource management policies are concerned.

4. Reliability of Scientific Information

> *The value of peer review and similar processes in assessing the validity of scientific assertions has been known for at least two centuries. Mandel (1996) describes the evolution of peer review emphasizing the medical research. Kronick (1991) suggests that peer review has been known since the late 18th century. It is not surprising that peer review was developed in England and substantially expanded in the U.S. The Anglo-American judicial system, requiring conviction by a jury of peers, appears to have been the impetus and model for the development of the peer review process. There are significant similarities between the judicial system using jury of peers and the scientific process using peer reviewers. A careful observer will also notice that many European countries with the scientific status comparable to the Anglo-American competencies started to use the peer review process much later than it was common in the Anglo-American systems.*
>
> -- Moghissi and Anderson (2011: 18-19)

The reliability of scientific information can be considered in seven separate categories, as described by Best Available Science (BAS) precepts (Moghissi and Anderson 2011: 19), and as slightly modified and reordered for current purposes of ESIPRI (e.g., Dost 2012: A-11).

Category I – Science Validated by Reproducibility

By far the most reliable peer review is confirmation by attempting to reproduce the experiment or other claims. In past centuries confirmation by independent peers was the method of choice in evaluating various claims. The confirmation process continues today as the most reliable form of peer review, and is routinely practiced in many science and engineering areas. If someone claims to have developed a new and more efficient process and suggests it be used, it is the common practice to verify the claim prior to adoption.

Category II – Independent Peer Reviewed Science

This category consists entirely of scientific information that has been subjected to peer review, but has limited capacity to be reproduced; often due to impracticality. In some disciplines such as physics, chemistry, biological applications, and engineering, certain studies can be reproduced but there is no interest to do so. In other cases, such an effort is either determined to be too costly or inherently impossible. In all of these cases, independent peer review is the most reliable mechanism to assess the validity of a scientific claim.

Category III -- Blind Peer Reviewed Science

Peer review through standard agency procedures, journal publication, or grant determinations are typically conducted by processes unique to individual agencies, publications, or foundations. Although such reviews are not as thorough or reliable as independent peer review, scientific information acquired via this means forms the foundation of significant scientific advancement

over the past 70 years. A typical feature of these reviews are that they are (theoretically) conducted "blind." That is to say, in a "single-blind" review, the authors are typically supposed to have no idea whom their reviewers might be or were; in a "double-blind" review, both the authors and the reviewers are intended to be unknown to one another. Often, it is not difficult to figure out or clearly know the true identities of these participants.

Category IV – Consensus Processed Science

This category consists of information resulting from a process used to resolve scientific disputes, particularly those in contested areas of science. The prerequisite for this process is the formation of a group of individuals to reach a consensus on a specific scientific subject. Members of this group must meet the qualifications and independency criteria described for peer review. Furthermore, they should must be overseen by an organization that is uniquely qualified to do so; i.e., an Oversight Committee. Professional societies that include member scientists, managers or engineers are the primary candidates for this activity. In the consensus process an expert panel, convened in a manner similar to that described for Peer Review Panels (pp. 9-16), evaluates the proposed information. It is not unusual or surprising that contradictory information can be found in peer reviewed literature covering a specific subject. In such cases, the consensus process increases the likelihood that its outcome would be consistent with the information that will result from relevant future studies.

Newton (2012: B-38) cautions that: "consensus often isolates the careful scientist." Depending on how the word "careful" and "often" are defined, this could be interpreted to mean that consensus has the potential to regularly exclude creative thought and innovative solutions based on individual detailed studies.

Category V – Informal Peer Review

This is the type of peer review most commonly practiced by scientists and other knowledgeable individuals during the general course of research and documentation -- or of generating reports of strictly proprietary interest, such as: the location of an ancient burial ground or observations of rare or endangered plants and animals. Scientists frequently consult with one another, review a colleague's paper, or hold meetings -- both formal and informal -- to discuss the quality and validity of their findings. Feedback from these types of communications between peers can be a very important aspect of the scientific process; though without the certainty or common acceptance of more formally reviewed products, projects, and ideas.

Category VI – Other Scientific Literature

Written information prepared by government agencies, advocacy groups, and others that has not been subjected to peer review is included in this category, which often seems to consist of an organized and written form of personal opinions. Ideally, this category should be most often be accepted as Speculation and used to initiate a study. Experience shows that the scientific quality of information included in this category is unknown, and ranges from reproducible science to fallacious information. It has been suggested that this has seemingly been an oft-preferred

category of government agencies, advocacy groups, and individuals who want to promote an idea or a particular policy.

Scientific Technical Assessment. Information developed via this methodology may have legitimate and valuable application, but potential unreliability of the data and other factors limit its functionality in more generalized settings.

Literature Review. Literature reviews are a typical first step in the performance of many types of environmental sciences research as well as being an early step in the completion of Scientific Assessments. If a review has been performed by a credible source, it may have excellent research value, while still not meeting the requirements of peer reviewed science.

Gray Literature. Distinctions between gray literature, scientific gray literature, and peer reviewed gray literature often form the basis for developing systematic research approaches to a variety of Environmental Sciences disciplines. The definition of "gray literature" in the fields of engineering or geology is going to vary significantly from the definitions given in anthropology or conservation biology. In all fields it is the least valued form of information for almost all types of research -- depending on how it is defined and used.

Category VII -- Personal Opinions

Expression of views by individuals regardless of their training, experience, and social agenda, are included in this group, and are seldom shown to be reliable. At best, this category can be used as Speculation to initiate a study covering a scientific thought, area, or idea.

Knowledgeable and Informed. Scientists and professional resource managers of long-standing and recognized expertise are often worth listening to when discussing topics of mutual interest. Their personal opinions are not the same thing as their scientific findings.

Personally Affected. Long time residents or local businesses directly impacted by science based decisions can typically provide the types of insights and perspectives that are "outside the purview of science," yet can often provide direct access to reliable documentary materials that might otherwise remain unknown or unavailable to researchers and instructors.

Other Sources. Further definition is possible, but probably unproductive. "Everybody has an opinion" is probably a fact, but the scientific value of this source is virtually nonexistent.

5. Assessments of Models and Correlations

Models are summaries of current knowledge that can pinpoint holes in understanding and foster more research/monitoring/data collection. They are constantly evolving as more knowledge is constantly acquired by field scientists as well as theoreticists, new information that can be used to improve model usefulness. Their value lies in the fact they constitute a common language that translate information from a variety of sources into something tangible that can be edited, commented upon by experts in the field or theory.

It is not a waste of resources to go through the exercise of building a model that summarizes current knowledge, especially when that knowledge is incomplete, even if the resulting model has little predictive ability. It becomes a platform on which to build clear assumptions and hypotheses to move forward in full awareness of caveats and uncertainties.

-- Dominique Bachelet (2012: B-8)

Models are approximations. Each has unexplained variance. Modeling has taken on a life of its own, lending to models as substitutes for data, especially in regulatory agencies.

-- Mike Newton (2012: B-39)

Correlation vs. Causation

Despite enormous efforts to correlate a statistical association with causation, the confusion continues as demonstrated by repeated allegations that an adverse effect was caused by an event, a chemical, or an activity. Note that the issues related to correlation vs. causation are, in fact, a subset of computer models that predict the occurrence of an event, including adverse effects. Consequently, it is reasonable to discuss them in the context of predictive models.

In 1965, Sir Austin Bradford Hill, and epidemiologist, developed a series of nine criteria for more specifically addressing the question of correlation and causation. In recent years, Hill's criteria have been "optimized" as follows (Moghissi et al. 2010: 49-51):

Temporality. The exposure ("cause") must precede the effect.

Strength. There must be a reasonably strong statistical association and evidence of contact is required (Newton 2012: B-39).

Dose-response. The cause-effect relationship must be consistent with the observed association, when there is evidence of contact (Newton 2012: B-39).

Consistency. There must be repeated observations by different investigators, in different places, different circumstances, and different times.

Coherence. Cause and effect relationship must be congruent with current knowledge of the science relating to the subject, but without evidence of contact, such association is meaningless (Newton 2012: B-39).

Predictive Models

A large number of policy decisions dealing with budgets, economics, environment, safety, transportation, human health, ecology, and several other areas are based on predictive models. Given the large economic consequences of application of models, it is "surprising that in many cases uncertain or speculative models seem to receive nearly the same acceptance as highly reliable and reproducible models" (Moghissi et al. 2010: 51-53):

> *The reliability of predictive models is often insufficiently considered. While prediction by certain models is highly reliable, others provide no more than an educated guess.*

Predictions Based on Accepted Science. Models that are entirely based on Accepted Science are, by definition, a form of Applied Science. For example, models that predict the fall of an item on the surface of the earth are normally based on the law of gravity. Consequently, they are precisely predictable and the time required for the item to fall can be accurately computed. Virtually the entire fields of engineering, medical instrumentation, space science, and numerous other parts of industrial production use models that are based on Accepted Science.

Predictions Based on Reproducible Science. These models rely entirely upon Reproducible Science. They are the types of models successfully used in the biological sciences, e.g., forestry growth and yield models and crop and animal science models. The distinction between these models is that their scientific foundation is not completely understood.

Primary Predictive Models. Although a large number of models used in Environmental Sciences are based on Accepted Science or Reproducible Science, they also use assumptions that fall into neither class. Therefore, their predictions include inherent uncertainties. Consequently, Primary Predictive Models are classified as Rationalized Science. It is imperative to recognize inherent uncertainties associated with these models. Often, for a number of reasons, society has no other choice but to use these models in making decisions.

Secondary Predictive Models. These models use Primary Models as their foundation, including those that rely upon Rationalized Science. The predictive ability of these models is significantly lower than those of Primary Models. A large number of models attempting to correlate two parameters without considering Hill's revised criteria fall into this group. Whereas Open Mindeness dictates that these models be considered for further study, "a society that bases its decisions on these models must accept the notion that it may waste its resources."

Lesser Predictive Models: These models use secondary models as their foundation. The predictive ability of these models, is at best, speculative. "A society that bases its decisions on these models must accept the notion that it is wasting its resources."

6. Stakeholders: Identification and Participation

> *Science is one of several factors used in decision making. Economics, politics, social values, personal belief systems, and other factors also weigh heavily in the decision making process. The role of the scientist and science information is to help inform decision making and the consequences of choice or selection of various options, not to actually make the decisions -- those are ideally left to the elected officials and hired managers selected to make them.*
>
> -- A. Alan Moghissi

According to Moghissi and Anderson (2011: 10), there is "ample evidence suggesting that participation of stakeholders enhances the appreciation of the decision process." The participation of stakeholders in peer reviews and scientific assessments: "increases the probability of their acceptance of solutions resulting from the peer review. The review or assessment criteria are the technical issues of concern to the stakeholders. Consequently, these criteria should consider stakeholder concerns" (ibid.: 12-13).

The following categories and definitions of stakeholders are also based on Moghissi and Anderson (2011: 10-13). According to the authors, experience has demonstrated that comments by stakeholders are taken seriously by panel members and provide a powerful incentive for stakeholder participation. Further, the "impact of comments by the stakeholders is a major reason for their acceptance of the results of review or assessment."

Identification of Stakeholders

Stakeholder participation is important to the integrity of the decision making process. In order to ensure adequate participation, members of each stakeholder category should be identified and notified so that they might become engaged in the process. The identification and notification of each group should be consistent with the manner in which they will be directly impacted or otherwise affected by the action under consideration.

Decision Makers and Facilitators. Decision Makers encompass the people or the organizations that initiate a proposed change (e.g., executives of a corporation or government officials responsible for a proposed action). Other examples might include a manager of an agency proposing new regulations or an individual or company proposing construction of a new facility. As the initiators of a proposed action, these individuals have a clear stake in the outcome of the peer review process. Facilitators are the individuals or organizations that are responsible for implementing the actions of the Decision Makers. This might include company or regulatory agency employees, or any other individuals with a key role in facilitating the process under review.

Personally Affected. Personally Affected stakeholders are people who are directly affected by the outcome of a proposed action. The impact may be in regard to personal health, financial gain or loss, alteration of property value, or notable changes in other aspects of life that may cause discomfort or inconvenience such as noises, smell, etc. Since members of this group

typically live or work near an existing or proposed facility or project in question, they may be identified either by physical address or through local professional organizations that would keep lists of those directly involved.

Administratively Affected. These stakeholders are the elected, appointed, or employed individuals that will ultimately be responsible for implementing an action resulting from the peer review or scientific assessment process. Elected officials may represent groups of Personally Affected Stakeholders while employees of governmental regulatory agencies or of private industries may be primarily responsible for preparing and issuing permits, licenses, and enforcing regulations that support the proposed action.

Generally Concerned and Self Identified. The Generally Concerned stakeholders are not personally impacted by the outcome of a decision, but they hold an interest in the outcome nonetheless. Advocacy organizations or citizen groups typically represent these interests. These individuals seek to ensure that all categories of stakeholders are engaged and heard, that the science used in decision making is evaluated and determined to be the Best Available Science (Moghissi et al 2010), and that no single group of stakeholders is given undue influence over the process. Members of these groups are usually either affiliated with advocacy groups or other organizations, or are simply concerned individuals.

Communication with Stakeholders

Both Decision Makers and Facilitators can be identified based on their employment or affiliation with a company, organization, or agency and therefore notified in writing or verbally on that basis.

Through experience, it is clear that Personally Affected stakeholders are often reluctant to participate in the process unless they perceive the impact of the proposed action to be particularly imminent. As a result, an "affirmative outreach approach" is typically required to encourage their participation. Such an approach may include mailing invitations, contacting individuals by phone, going door to door to speak with those potentially affected, or conducting open meetings and listening sessions.

In common with Decision Makers and Facilitators, Administratively Affected stakeholders can typically be identified through the institution or organization for which they work; or elected officials can be easily identified through their constituency. Once identified, they can be notified either in writing or by phone.

Whether an otherwise-unaffected individual or a group is Generally Concerned about an issue -- and wants to participate or be kept informed of a process -- they must also be Self-Identified as there is no other means by which to find them. Once this has occurred, large-scale notification can be accomplished through electronic media or printed information.

References

> *[We] required nearly three decades of efforts to develop a process that is applicable to various scientific disciplines. The concept attempts to provide metrics for evaluation of scientific claims by answering the age-old question of what is science; what is the level of its maturity and its validity; and what is outside the purview of science. We had to struggle with the original definition of science meaning knowledge. Obviously, knowing writings of Shakespeare, Molière, or Schiller would constitute knowledge. Similarly, familiarity with the Music of Beethoven, Mozart, and Verdi would constitute knowledge. Would these be considered to be science?*
>
> -- A. Allen Moghissi

Moghissi, A. Alan 2011. *The Need for Regulatory Science Transparency at the EPA*. Statement before the Subcommittee on Energy and Environment, Committee on Science, Space, and Technology, US House of Representatives, November 30, 2011, Washington, DC: 9 pp.

Moghissi, A. Alan, Michael Swetnam, Betty R. Love and Sorin R. Straja 2010. *Best Available Science (BAS): Fundamental Metrics for Evaluation of Scientific Claims*. Potomac Institute Press, Alexandria, Virginia: 108 pp.

Moghissi, A. Alan and Misti A. Anderson 2011. *Independent Peer Review of Regulatory Science Information*. Institute for Regulatory Science, Alexandria, Virginia: 22 pp.

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APPENDIX E. SAMPLE FORMS

> *I like the idea of forms (in an appendix) – you include a conflict of interest form. I might also suggest a standard form for each type of review, with extremely general peer-review questions about the merit, justification, methods, and validity of the scientific results.*
>
> -- Paul Houser (2012: A-15)

A good selection of sample forms used by the US Environmental Protection Agency for purposes of peer review is provided by Dearfield and Flaak (2000: F-1 – F-14). Several of these forms, with appropriate modification, would seemingly serve as good base models for use by ESIPRI. These forms include: a Conflict of Interest Inquiry Form; a Checklist for Conducting Peer Review; and a Checklist for Determining Whether Peer Review is Needed.

Of more practical and/or pressing need for ESIPRI are the specific forms for securing peer reviewer and oversight committee agreement for their services, as well as signed formal statements on the parts of these individuals regarding conflict of interests. Business arrangements with ESIPRI Reviewers and other contractors are typically private agreements in which terms and conditions remain discrete. For that reason, there is no particular need at this time, in the authors' opinion, to develop any particular forms of this nature for public display or consideration. This Appendix could be readily expanded for future revisions of these Guidelines, but it is probably more useful and efficient to begin accumulating standard forms as needed and developed on the ESIPRI website: **www.ESIPRI.org/Guidelines/Forms/index.html**

Form 1. Conflict of Interests Statement

Title: "DECLARATION REGARDING CONFLICT OF INTEREST FOR MEMBERS OF THE ESIPRI PEER REVIEW PANEL"

I certify that I am unaware of any matter which may reduce my ability to participate in an unbiased and professional manner as a member of the Peer Review Panel for the project listed below. In making this certification, I have considered all my financial interests and employment arrangements and those of my immediate family (Moghissi and Anderson 2011: 21).

Program, Project, or Topic: _____

Name: _____ Date: _____

Signature: _____

Form 2. Peer Review Criteria

The following sample form was the one used for the formal review of these Guidelines (see Appendices B and C). Once the formal criteria for a project have been adopted, it is important that all reviewers – including the public, if the process is to be transparent – be given access to the same information and in the same format:

Reviewers: *Please answer the following eleven questions regarding your review of the ESIPRI Peer Review Manual Draft. Short sentences and brief answers are fine. It is important to remember that signed and finished reviews will be made public on the ESIPRI website following completion of the manual, and that reviewer's words may be referenced or cited in other media in relation to this project as well.*

Answers can be made in any common Word text, and presented in either Word or PDF format.

****

1. Is the manual's described review process scientifically credible and valid? (Why or why not?)

2. Is the overall purpose of the manual clearly stated and addressed? (Why or why not?)

3. Is the overall organization of the manual clear and effective? (Why or why not?)

4. Is the writing style sufficiently clear and concise and the document length appropriate in regards to content? (Why or why not?)

5. What portions of the manual should be expanded, condensed, or deleted? (And why?)

6. In your professional experience, can you provide an example in which each of the three described Applications (peer review, scientific assessment, and technical review) was – or could have been – used to advantage? Could any of these three examples been (or were) improved with blind/anonymous review? (If yes, regarding the latter, why and how?)

7. Does inclusion of a common metric for quantifying scientific information (Appendix B) provide a useful basis for considering the value of a document or project? (Why or why not?) (e.g., Would such measures be useful for considering projects or documents such as this one?)

8. Does the manual include interesting insights into the peer review process? (Examples?)

9. What are the manual's two (or three) main strengths? (Why?)

10. What are the manual's two (or three) main weaknesses? (Why?)

****

11. What specific recommendations do you make for the improvement of this manual?

Form 3. Peer Review Agreement

This is the form that includes the contractual arrangement between ESIPRI and a project peer reviewer and outlines the terms of payment and performance for work to be performed on a specific project. The Conflict of Interests Statement (Form 1) should be appended to this document, as well as other forms and agreements specific to that project. The formal questions and other criteria determined for a particular project (e.g., Form 2), would not necessarily need to be included with this document – primarily because it is expected to be public information and be made readily available at some point during the review process. The most important aspects of this form are the dates and signatures of the parties making the agreement, and their common understanding of the written terms they have agreed upon, including deadlines and payment schedules.

References

Dearfield, Kerry L. and A. Robert Flaak 2000. *U.S. Environmental Protection Agency Peer Review Handbook* (2nd Edition). EPA 100-B-00-001. Science Policy Council, U.S. Environmental Protection Agency, Washington, DC: 82 pp. w/seven appendices.

Moghissi, A. Alan and Misti A. Anderson 2011. *Independent Peer Review of Regulatory Science Information*. Institute for Regulatory Science, Alexandria, Virginia: 22 pp.