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Good Science in the Public Interest: A Neutral Source of Friendly Facts?

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By Lynn E. Dwyer◔

I. Introduction: Calling for Good Science

> *Given the necessity of acting in the face of enormous uncertainty, it is more important than ever that our scientific analysis be rigorous and the quality of data high.*[1]

Public officials, agency managers, environmental organizations, industry and the public are frustrated. Debates over natural resources are a common feature of the policy landscape and the problems are increasing. Decision-making related to California's environment is now more difficult because of the increasing complexity of the relationships between that environment and the economic and social well-being of humans.

All too often, however, public officials, and ultimately the public, lack a neutral source of friendly facts to inform any stage of their decision-making. Public officials regularly encounter politically motivated distortions of science by interest groups to promote or undermine programs or projects. "It's no help to get answers from one camp or the other. It's balance I'm looking for," remarked one agency manager.[2] Agencies face challenges to the legitimacy of their decisions. These continuous, contentious challenges are major impediments to decision-making. "We're frustrated," commented a senior official from a state regulatory agency, "we get the same questions

◔ At the time this article was prepared, Senior Project Manager, Sustainable Conservation, San Francisco, California. Currently, California Private Lands Coordinator, Environmental Defense, Oakland, California. This article is based, in part, on "An Evaluation of Selected Science Advisory Programs in the United States" prepared by the author for the California Environmental Dialogue (CED), San Francisco, California (February 19, 1999). The David and Lucile Packard Foundation provided the initial funding for this study. The opinions stated in the article are those of the author and do not represent the positions of CED, The David and Lucile Packard Foundation, Sustainable Conservation, or Environmental Defense. The author expresses deepest appreciation for review of the manuscript, ideas and the enduring confidence of Mr. Richard Morrison, Bank of America (retired) and Dr. Eugene Mancini, Atlantic Richfield Company (retired), now E.R. Mancini & Associates, Camarillo, California. The author appreciates the thoughtful feedback provided by Dr. Dennis Murphy, University of Nevada, Reno.

1. William D. Ruckleshaus, *Science, Risk and Public Policy*, 221 SCIENCE 1026 (1983).

2. Survey by Author of 40 respondents from the government, environment and business communities (Sept. 1998-Jan. 1999) (information on file with the author) (hereinafter "Survey").

again and again and we are forced to make decisions in a vacuum because we cannot get any scientific answers."[3]

The same officials must increasingly make decisions that embrace economic prosperity, and preservation and restoration of vital natural systems—one compatible with the other. The decisions often carry a high risk of lasting harm to environmental quality, nature and the economy.[4]

II. Where Science Can Provide Value

There are many practical advantages to developing an enhanced scientific advisory capacity. It provides a relatively low cost and timely way for public officials to access the most current, recognized and credible sources of scientific information. It is a mechanism to ensure that the palate of available options offered to the public official are consistent with the best available scientific information. It can enrich the strong general expertise available in public agencies.

Many natural resources issues now being dealt with are complex problems that span multiple spatial and temporal scales. A representative from a federal management agency commented, "we are moving from dealing with water quality along a stream to water quality in a watershed; and forest management less from the standpoint of timber production and more from the perspective of how to manage forest resources to provide a range of goods and services the public wants."[5]

An enhanced science advisory capacity can result in decisions that are more scientifically and legally defensible. In 1998, Supreme Court Justice Stephen Breyer requested more scientific information to help judges sort through evidence. In response, the American Association for the Advancement of Science is now seeking funding to supply courts with that expertise.[6]

The legislative branch sees no less a need for enhanced technical and scientific capacity to assist their decision-making, as evidenced by the plethora of such bodies from New York to Hawaii.[7] A California legislator remarked that questions of the environment are terribly relevant and the need for objective analysis is crucial.[8]

Because authority is highly decentralized in the legislative, judicial and executive branches, examining science and technology issues in a single science advisory process can help bridge mandates and responsibilities.

III. Challenges to the Effective Use of Science

A. Boundaries for the Use of Science

The desire for good science strikes a resonant chord in key institutions and among decision-makers. The note often sours when the specific role science will play is discussed. It is likely impossible to maintain a "bright line" standard between the scientist as advisor and the scientist as decision-maker in the current environment. This situation presents a serious dilemma for scientists and public officials.

Scientists interviewed for this article complain public officials ask them for advice and the next question is "can't you change that a little?"[9] Public officials are equally frustrated because there are policies and procedures for taking action on advice provided by the scientific panels. The public officials interviewed remarked that the scientists have no idea how the law works.[10]

Nobody can reasonably expect to eliminate public debate about issues by simply providing advice. These issues are hardly ever purely technical disagreements, but reflect real and profound differences in societal values and priorities. A scientist who has led science advisory panels bluntly stated that the mistake being made is that somehow science will provide

3. *Id.*

4. *See* G. Meffee et al., *Independent Scientific Review in Natural Resources Management*, CONSERVATION BIOLOGY, Apr. 1998, at 269.

5. Survey, *supra* note 2.

6. *See* Constance Holden, *Supreme Court Clarifies Junk Science Stance*, 279 SCIENCE 35 (1998).

7. *See* MEGAN JONES ET AL., INFORMED LEGISLATURES: COPING WITH SCIENCE IN DEMOCRACY (1996).

8. Survey, *supra* note 2.

9. *Id.*

10. *Id.*

answers to problems or make choices clear. "The choice is not really whether science will tell us if we do take this action, we will destroy the universe or if we don't take the action, we won't; the choice is whether we really give a damn. That's not science, that's people's values."[11]

A public official further clarified the boundaries for the use of science in decision-making, noting, "It's our job to make decisions based on all the factors that need to be brought to bear, scientific, economic and social. What we want to know is if we are operating in a zone of reasonableness, that is, the realm of credible science? Scientific knowledge and wisdom are needed to frame questions to be posed, provide assessments about current conditions and evaluate the consequences of different policy or management options."[12]

B. Finding a Balance Between Effectiveness and Independence

One of the greatest challenges to science review is to strike a balance between independence and effectiveness. There is no agreement as to what constitutes "good science." A majority of the respondents interviewed for this article commented, in one way or another, that people say they want good science, but what they really mean is they want their science.[13] The models presented in this article are unswerving in their definition of good science, which is that it be independent. That said, independent science review is difficult for many to accept because the outcomes of that review become less predictable.

In order to be most effective, the science panels also should understand the context of their decision-making. Bruce Smith believes, for example, that the Science Advisory Board (SAB) at the United States Environmental Protection Agency (EPA) only became a truly useful body to the agency after developing an expertise in regulatory science.[14] A 1993 Carnegie Commission report noted that analytical processes such as scientific advisory panels should complement and not supersede the capabilities in departments and agencies.[15]

C. Not All Science Is Created Equal

A closely related challenge to the disagreement over what defines good science is that all science is not created equal. Many organizations conducting "science-based" research expect their findings to be accorded the same weight as peer-reviewed research. To be truly credible, science work must be peer-reviewed. There is a large amount of pseudoscience presented to the public or to decision-makers. This taints the process of review.

D. Selection

Selection of scientists is another example of the difficulty of drawing that bright line. Where selection is based too strongly on organizational affiliation, the selection process has been criticized because those involved do not always take a fresh look at the scientific issues.[16] However, there is an accepted practice of interest group balancing that occurs in many of the institutions that select scientific panels that may surprise readers. An appropriate selection process is the centerpiece of any scientific advisory process.

IV. Science Advisory Panels and the Science of the Panels Defined

A. How Does Scientific Review Work?

The actual scientific advisory process is given different names in the literature, including risk assessment,[17] independent scientific

11. *Id.*

12. *Id.*

13. *Id.*

14. *See* BRUCE SMITH, BROOKINGS INST., THE ADVISORS: SCIENTISTS IN THE POLICY PROCESS 69 (1992); *see generally* SHEILA JASANOFF, THE FIFTH BRANCH: SCIENCE ADVISORS AS POLICY MAKERS (1990).

15. *See* CARNEGIE COMM'N ON SCI., TECH. & GOV'T, RISK AND THE ENVIRONMENT: IMPROVING REGULATORY DECISION MAKING 12 (1993).

16. Donald Boesch & Swantje Macke, *Bridging the Gap: What Natural Scientists and Policy Makers and Implementers Need to Know about Each Other, in* IMPROVING INTERACTIONS BETWEEN COASTAL SCIENCE AND POLICY: PROCEEDINGS OF THE CALIFORNIA SYMPOSIUM 38 (1995).

17. *See generally* NAT'L RES. COUNCIL, NAT'L ACAD. OF SCI., RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS (1983).

review[18] and peer review.[19] It can be described as a process of identifying and quantifying potential risks and of making decisions about how to deal with those risks by comparing various options and potential outcomes. Qualified scientists trained in the scientific method conduct this process by using accepted scientific standards to evaluate the quality of the data under review. Whatever the name, the processes are designed to add to the credibility of the information being applied in policy-making and contribute to the legitimacy of the overall decision-making process.[20]

B. Defining...Science?

The term "science" in this report is used in its broadest form to include the physical, natural, life and social sciences, mathematics and engineering. Natural resources are attributes that constitute ecosystems and ecosystem function. Environmental media are air, water, soil and biota.[21]

V. Methodology

The research methodology used in this article involved a literature review of permanent and ad hoc science advisory programs and panels. This article looks at seven permanent models of scientific review and two ad hoc science advisory models.

Formal and informal discussions and interviews were also conducted with more than 40 respondents who are producers or consumers of scientific advice that represent science, government, industry and environmental organizations. Several themes were addressed in the interviews, including:

1. The Role of the Science Advisor.
2. Building a Credible Science Advisory Process.
3. Housing the Institution.
4. Funding the Institution.

18. *See generally* Meffee, *supra* note 4.

19. *See generally id.*

20. *See* Terry Yosie & Timothy Herbst, The Soc'y for Risk Analysis, Using Stakeholder Processes in Environmental Decision Making: An Evaluation of Lessons Learned, Key Issues and Future Challenges 14 (1998); Staff on House Comm. on Sci., 105th Cong., Unlock Our Future: Toward a New National Science Policy (Comm. Print 1998).

A. Permanent Models of Science Advice

There are many institutional science advisory models both permanent and ad hoc. The permanent models tend to provide advice to decision-makers on families of scientific issues and create ad hoc review or assessment panels to address specific scientific questions. The examples selected and described below are generally considered to be credible and independent sources of scientific advice. The permanent models were explored based on similarities and differences in mission, location, funding and criteria for selection of scientists.

1. The Science Advisory Board of the United States Environmental Protection Agency (EPA) and the National Research Council (NRC) are examples of federal scientific advisory programs. These two institutions are interesting because the agencies have strong mechanisms to help develop appropriately scientific questions and selection criteria.
   a. The Science Advisory Board (SAB) is housed in and administered by the United States Environmental Protection Agency. Its mission is to "provide[] expert and independent advice to the [EPA] on the scientific and technical issues facing the Agency."[22] It also functions as a technical peer review panel for the agency. The Environmental Research Development and Demonstration Authorization Act chartered the SAB in 1978.[23] The SAB is comprised of 97 non-federal scientists, economists and engineers, and 300 consultants who support the work of the executive committee and the 10 standing committees. The SAB is led by a staff director and a deputy staff director. Both are scientists. The average annual budget for the SAB for 1993-1997 was $2.1

21. Eugene Mancini, Ph.D., Atlantic Richfield Company, Los Angeles, CA (retired), now Mancini and Associates, Camarillo, CA, offered the working definition of science for this article.

22. 40 C.F.R. § 1.25(c) (1999).

23. 42 U.S.C. § 4365 (1994).

million. The agenda of the SAB is developed based on requests from Congress, the EPA Administrator, and the regions, program offices and departments of the agency. Ideas also come from the membership of the SAB. Questions addressed by the SAB are formulated in concert with the EPA.[24]

The bases for selection of scientists to serve on SAB committees are education, training, experience and credibility. However, the SAB is charged by the Federal Advisory Committee Act (FACA)[25] to achieve a balanced panel. FACA defines an advisory committee as a group or committee that is created by a federal agency for advice or recommendations and whose members include one or more individuals who are not full-time federal employees. Balance is defined as seeking "a range of legitimate, technical opinion." The SAB also attempts to balance its committees on the basis of geography, ethnicity, gender and academic/private sector representation. No member of the SAB can be a full-time federal employee. A conscious effort is made by the SAB to avoid recommending members from the extremes of scientific positions or who take frequent public stands on issues because these factors can undermine objectivity.[26] The intent of the selection process is to assure that problems are dealt with in a way that "transcends federal agency or other organizational boundaries."[27]

b. The National Research Council (NRC) is a non-profit organization chartered by an executive order issued by President Woodrow Wilson to address the increased need for scientific and technical resources resulting from World War I.[28] The NRC is the primary operating agency of the National Academy of Sciences and the National Academy of Engineering (the Academies).[29] The Academies are concerned with the use of science, technology and engineering for the public welfare and each serves as an advisor to the federal government on those issues.[30] The mission of the NRC is to provide advice on important public policy questions for those entities. Its most public and familiar role is to convene committees and then publish studies. The NRC staff works with the Academies and with the individuals initiating the review to reformulate questions to be appropriately scientific. [31]

Because the work of the Academies and the NRC is so varied and their budgets are combined in many key reference materials, it is difficult to calculate the individual annual budget of the NRC. Review of the 1996-97 combined budgets of the three institutions reveals the nature of their revenue stream may help preserve their highly valued independence. The revenue stream is from multiple federal, private and non-federal sources, including grants, contracts and contributions. The single largest source of funding is from the federal government. Total federal sources in 1996-97 equaled $144 million. Grants and contracts from private and non-federal sources including foundations, corporations and the states were $24 million. Contributions

24. *See* SCI. ADVISORY BD., U.S. ENVTL. PROT. AGENCY, PUB. NO. EPA-SAB-98-002, ANN. STAFF REP. FY 1997, at 19 (1998).

25. 42 U.S.C. § 4365(a) (1994).

26. *See* SCI. ADVISORY BD., *supra* note 24, at B-2. B-5, B-11 to B-20, 2.

27. JASANOFF, *supra* note 14, at 88.

28. Exec. Order No. 2859 (May 11, 1918), *reprinted as amended in* 58 Fed. Reg. 5905 (1993).

29. NAT'L RES. COUNCIL, FREQUENTLY ASKED QUESTIONS, *at* http://www.nas.edu/about/faq3.html (last visited Oct. 17, 2000).

30. NAT'L ACAD. OF SCIS., ORGANIZATION OF THE ACADEMIES – FREQUENTLY ASKED QUESTIONS, *at* http://www.nationalacademies.org/about/faq.html (last visited Oct. 17, 2000).

31. NAT'L RES. COUNCIL, *at* http://www.nas.edu/about/faq3.html, *supra* note 29; Survey, *supra* note 2.

from private and non-federal sources only totaled $3.2 million.[32]

The Academies operate approximately 600 committees to advise the government on technical issues ranging from arms control to pest control. The Academies and the NRC place a great emphasis on professional competence in relevant fields when developing their peer review panels. The NRC uses selection factors that include scientific expertise, reputation among peers, ability to work in groups, and writing skills. The NRC staff actively solicits suggestions for candidates from the committee members of the Academies. Both NRC and the SAB also use informal networking and administrative discretion to achieve a diversity of backgrounds and interests on the panels and committees.[33] A number of scientists closely involved with these committees have observed that there seems to be a conscious effort by NRC to have many points of view represented.[34]

2. The Chesapeake Bay Program's Science and Technical Advisory Council and the Michigan Environmental Science Board are examples of scientific and technical guidance in a multi-jurisdictional setting and for a single state, respectively. A major difference between these and the federal programs is that elected or appointed leaders make the scientific appointments.

   a. The Chesapeake Bay Program (CBP) is a regional partnership of Maryland, Pennsylvania, Virginia, the District of Columbia and the Environmental Protection Agency.[35] The CBP's mission is to direct and conduct restoration of the living resources of the Chesapeake Bay. The Chesapeake Bay Agreement chartered the organization in 1983.[36] Staffing and funding for the CBP comes from the National Estuary Program. One major component of the CBP is the Science and Technical Advisory Council (STAC). For the past five years, the average operating budget for STAC has been $215,000. Approximately $30,000 is also spent annually for workshops to address scientific and technical issues. Requests for scientific advice come from the Executive Council that is comprised of all key members of the regional partnership. The Executive Council generates many questions addressed by STAC. The questions are also generated as a result of public and media attention, or by coalitions of interest groups. A variety of subcommittees comprise the STAC. The subcommittees deal with specific scientific issues affecting the Chesapeake Bay such as Nutrients, Toxics, Monitoring, Modeling and Living Resources. The STAC Workgroups address the scientific and technical questions. The Workgroups use technical conferences and workshops, technical reports and position papers, literature synthesis and reviews to assist them in their work.[37]

   The STAC has approximately 60 members and alternates from academic institutions, research institutions, state and federal agencies and private industry. Members are selected to represent a cross section of individuals with diverse scientific backgrounds. Senior scientists are appointed by the

32. Nat'l Acad. of Scis., Report of the Treasurer to the Council of the National Academy of Sciences 1996-97, at 39-51 (1999); Survey, *supra* note 2.

33. *See* Jasanoff, *supra* note 14.

34. Survey, *supra* note 2.

35. Chesapeake Bay Program, Overview of Bay Program, *available at* http://www.chesapeakebay.net/overview.htm (last modified Feb. 1, 2000).

36. Chesapeake Bay Agreement (1983) (on file with West-Northwest).

37. *See* Chesapeake Bay Program, *available at* http://www.chesapeakebay.net/overview.htm, *supra* note 35; Sci. & Technical Advisory Comm., Chesapeake Bay Program, Bylaws - Organizational Structure and Mechanisms (1998); Survey, *supra* note 2.

Executive Council. There is a strong emphasis on selecting scientists that represent important institutions in the region.[38]

b. The Michigan Environmental Science Board (MESB) is an interesting example of a state-chartered science board with a permanent structure, but with an ad hoc and very lean form of operating. The MESB is an independent, autonomous state entity established to provide sound scientific advice to the Governor of Michigan and to state departments "on matters affecting the protection and management of Michigan's environment and natural resources."[39] It was chartered by an Executive Order of the Governor.[40] Although it has no full-time staff, the MESB is housed within and uses employees on an as-needed basis from the Department of Environmental Quality, Office of Special Environmental Projects, an executive agency of the State of Michigan. The small annual operating budget of $70,000 does not reflect staff salaries. This budget is paid by the Environmental Response Fund which is comprised of money resulting from penalties and fines levied by the state. The MESB convenes only at the request of the Governor to review a particular issue. The executive agencies must route requests for scientific review through the Governor's office. The MESB membership is mandated to have expertise in one or more of the following areas: science, economics, chemistry, physics, toxicology and biological sciences, human medicine, statistics, risk assessment and geology. The Governor appoints all MESB members. The ad hoc panels are selected based upon relevant expertise. Once the evaluation is prepared and a recommendation is delivered to the Governor, the work of the MESB is complete.[41]

3. The Health Effects Institute (HEI) and the University of California, Davis, Centers for Water and Wildland Resources (CWWR), are two models of "external" scientific advice. One institution is an independent research institute and the other is university-based. The HEI is an interesting model because of its strict selection standards for panels. Scientists are only drawn from academia or research institutes to preserve the independence of the institution. The CWWR is noteworthy from a funding perspective. It receives only a portion of its budget from university sources. As a result, it also accepts outside contracts. Formulation of the initial scientific question is not always in the hands of the scientists. As a result, the process of science review may be more agency-driven.

a. The Health Effects Institute is an independent, non-profit institute sponsored by the Environmental Protection Agency and the automobile industry to deal with the conflicts between government and industry regarding the health effects of mobile source emissions by serving as both a research broker and reviewer. Its mission is to provide "private and public decision makers with independent, unbiased, timely, and high quality science on the health effects of emissions from motor vehicles, fuels, and other sources of environmental pollution." The projects focus on pending regulatory

38. *See* SCI. & TECHNICAL ADVISORY COMM, *supra* note 37; Survey, *supra* note 2.

39. MICH. ENVTL. SCI. BD., MESB MISSION, *available at* http://www.mesb.org/mission.html#mission (last visited Oct. 17, 2000).

40. Mich. Exec. Order No. 1992-19, Michigan Environmental Science Board (Aug. 6, 1992), *available at* http://www.mesb.org/mission.html#execor (last visited Oct. 17, 2000).

41. MICH. ENVTL. SCI. BD., OPERATING PROCEDURES FOR IMPLEMENTING EXECUTIVE ORDERS 1992-19 & 1997-3, *available at* http://www.mesb.org/mission.html#proceed (last visited Oct. 17, 2000); MICH. ENVTL. SCI. BD. & MICH. OFFICE OF SPECIAL ENVTL. PROJECTS, FY1999 BUDGETS (1999) (hereinafter "FY1999 BUDGETS"); MICH. DEP'T OF ENVTL. QUALITY, FY 1999-2000 RESOURCE GUIDE 89-90 (1999).

changes or anticipate emerging questions affecting the field.[42] The EPA and automobile industry jointly and equally fund the $6.8 million annual budget. Approximately $1.5 million of the total budget is dedicated to reviews of HEI-funded research, and special reviews and projects. It costs an average of $200,000-$400,000 to administer these single purpose peer reviews.[43] Special reviews and projects are initiated by a variety of sources including the HEI board of directors, during the HEI strategic planning process, by the sponsoring organizations and the community. Expert committees are selected based upon recommendations of two independent committees of scientists that oversee the work of the HEI. The Health Research Committee selects, guides and funds the research, and the Health Review Committee provides evaluations of every HEI study.[44] The HEI does not try to balance the committees either by broad affiliation or by relevant points of view. It consciously avoids developing its committees on that basis. As discussed, scientists are drawn from academia and research institutes. The founders of HEI did not want individuals with predisposed environmental or industry agendas participating in the programs.[45]

b. The University of California (UC), Davis, Centers for Water and Wildland Resources (CWWR) were formed, in part, to create technical panels in order to address statewide issues concerning research needs, and resource conservation and management of water and wildlands. These institutions were authorized by the California legislature and established by the University of California Regents or by action of a UC President. The CWWR is comprised of system-wide, multi-campus research units. The average annual budget of the CWWR is $2 to $6 million depending upon the number of research projects and contracts it undertakes each year. It receives operating and program funding from multiple sources. The University of California provides the basic operating budget of $1.3 million from annual state appropriations. It covers salaries for permanent staff and administration. Project and research funds for the CWWR come from a combination of state, federal and private sources. The Centers have oversight boards comprised of University of California academic representatives that meet periodically to review the policies, program activities and finances of the Centers and are liaisons to the University of California campuses. Scientists are selected from a broad range of affiliations and include academic researchers, non-academic/private scientists and public agency scientists. The final composition of the scientific teams depends upon the nature of the project and the type of question being considered for review.[46]

4. There is increasing interest in improving the integration of accurate and credible scientific information from professional scientific societies into environmental policy and management decisions.[47] For example, at the request of Washington State, the

42. HEALTH EFFECTS INST., HEI STRATEGIC PLAN 2000-2005, at 1 (2000).

43. *Id.* at 2; *see generally* Thomas Grumbly, *The Health Effects Institute*, *in* HARNESSING SCIENCE FOR ENVIRONMENTAL REGULATION (John D. Graham, ed., 1991).

44. HEALTH EFFECTS INST., HEI RESEARCH & REVIEW PROCESSES, *at* http://www.healtheffects.org/researchprocess.htm (last visited Oct. 17, 2000).

45. Grumbly, *supra* note 43.

46. WILDLAND RESOURCES CTR., UNIV. OF CAL., REP. NO. 45, ANN. REP. 1996-97 (1998); WATER RESOURCES CTR., UNIV. OF CAL., REP. NO. 94, ANN. REP. 1996-97 (1998); Survey, *supra* note 2.

47. *See, e.g.*, UNION OF CONCERNED SCIENTISTS, SOUND SCIENCE INITIATIVE, *available at* http://www.ucsusa.org/resources/ssi.html (last visited Oct. 18, 2000) (detailing USC initiative to disseminate credible scientific information to policymakers and media and "to counter misinformation on environmental science"); *see also* Jane Lubchenco, *Entering the Century of the Environment*: A *New Social Contract for Science*, 279 SCIENCE 491 (1998).

American Fisheries Society recently helped in the selection of scientists for a statewide salmon plan.[48] The Society of Environmental Toxicology and Chemistry has also developed a peer review program for public and private initiatives.[49]

The American Institute of Biological Sciences (AIBS) appears to be one of the most active of the professional scientific societies in peer review. Its mission is to advance research and education in the biological, medical, environmental and agricultural sciences. The AIBS, a federally chartered non-profit scientific institution, acts as an umbrella society for many of the primary interest societies such as the Ecological Society of America. The AIBS Scientific Peer Advisory and Review Services (SPARS) division conducts independent and confidential peer reviews in biological, environmental and biomedical sciences. The SPARS activities are kept independent of the other work of the AIBS.[50]

The annual budget for SPARS averages $2 million. Contracts and cooperative agreements fund peer reviews. It costs in the range of $100,000-$200,000 to administer single purpose peer reviews. The majority of the projects involve reviews of research proposals submitted to federal agencies, although SPARS also provides program monitoring and reviews draft agency scientific documents and projects. SPARS has a database of more than 8,000 scientists from which it recruits panel members. SPARS staff selects the scientists in concert with its consultants based on given expertise in the topic area. Senior retired scientists are consultants to the organization and prepare reviews of the final reports. There is an effort to maintain a balance in the background of the individuals selected to serve. The panels may include scientists from industry, academia, government agencies and non-governmental organizations.[51]

B. Similarities and Differences in the Permanent Models of Scientific Advice

While there is no "one size fits all" approach to developing a scientific advisory program, there are more similarities than differences in the models examined in this article. The programs take precautions to avoid stepping into the regulatory realm, either by carefully formulating the questions to be clearly scientific or by weighing in early in the process before regulatory standard-setting occurs. Most programs have multiple sources of funding from public and private sources. There are frequently standing committees associated with the permanent programs that serve as "gatekeepers" for the institution. These gatekeeper committees are a source of institutional memory and process, help select and formulate the questions, chose scientists for the ad hoc panels and review final reports. Two of the most significant differences are who charters the institution and where the science advisory programs are housed. They range from federally chartered and housed entities to university-based enterprises.

Scientists are selected first and foremost based on their expertise to answer the question. A majority of the programs included in this article attempt to balance committee representation to a certain degree based on interest groups, although scientists are expected to deal with the questions using the scientific method and expertise. Several models discussed in this article exclude government or non-academic scientists, but these are exceptions rather than the rule.

C. Ad Hoc Models of Scientific Advice

Ad hoc panels are stand-alone committees that are generally created to address a discrete suite of scientific questions associated with a

48. Interview with Curt Smitch, Special Assistant to the Governor for Natural Resources, Executive Policy Office, Office of the Governor, State of Washington (Oct. 1999).

49. Soc'y for Envtl. Toxicology & Chemistry, SETAC Standard Operating Procedure for Peer Review, *available at* http://setac.org/peerreview.html (last modified Apr. 20, 2000); Charles Pittenger, Summary of Conference Call on Peer Review, Pensacola, Fla. (Mar. 9, 1998); Rodney Parrish, Soc'y for Envtl. Toxicology & Chemistry, The Pellston Workshop Series (1998).

50. Sci. Peer Advisory & Rev. Servs. Div., Am. Inst. for Biological Scis., Resume, *available at* http://www.aibs.org/spars/sparsresume.html (last visited Oct. 18, 2000).

51. *Id.*; Survey, *supra* note 2.

specific natural resource or technical problem. Models described in this article include the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl and the Scientific Review Panel for Natural Community Conservation Planning.

1. Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl

One of the early ad hoc science advisory panels was the Interagency Scientific Committee (ISC). The ISC was appointed by interagency agreement and then chartered under public law by Congress. The ISC charge developed by the agencies was to create a reserve system and management plan capable of sustaining populations of the Northern spotted owl. [52]

The ISC was funded by four federal agencies—Forest Service, Bureau of Land Management, Fish and Wildlife Service and National Park Service. The ISC had unlimited access to data, staff and equipment from the public agencies. The ISC was a very interesting panel. It had a very central role in defining the questions. Perhaps because it was among the first panels and the power of this tool had not yet been realized, its recommendations are considered among the most scientifically pure of the ad hoc panels. It had unrestricted access to public agency resources. The scientists were selected, in part, because of their specific background in conservation planning or with the species and because they represented key public and private interests. The ISC had a core team of six agency scientists, with three additional scientists participating from each of the affected states—California, Oregon and Washington. One scientist from the timber industry, a scientist from the environmental community and a scientist from academia completed the team. The scientists representing industry and the environmental community were invited to observe the deliberations of the core team.[53]

2. Scientific Review Panel for Natural Community Conservation Planning

The Scientific Review Panel (SRP) for Natural Community Conservation Planning (NCCP) was created to ensure that the ecosystem-based planning and management goals of the program to preserve the relic coastal-sage scrub natural community and associated target species, particularly the threatened and federally listed California gnatcatcher, were scientifically justified.[54] The SRP refined the assessment to several key technical questions, including how to define the overall and subregional management planning areas and the appropriate conservation framework for reserve design.[55] California's Secretary for Resources appointed a scientist to lead the panel. A list of potential scientists was then developed based on expertise. The environmental and development communities were also able to suggest candidates.[56] The California Department of Fish and Game was the agency responsible for the SRP and funded the review. The budget was $125,000.[57]

52. Department of Interior and Related Agencies Appropriations Act, Pub. L. No. 101-121, 103 Stat. 701 (1990); Interview with Dr. Dennis Murphy, University of Nevada, Reno (Oct. 1998).

53. Interview with Dr. Jack Ward Thomas, University of Montana, Missoula (Oct. 1998); J.W. Thomas et al., Interagency Sci. Comm. to Address the Conservation of the Northern Spotted Owl, A Conservation Strategy for the Northern Spotted Owl (1990); B.R. Noon & D.D. Murphy, *Management of the Spotted Owl: The Interaction of Science, Policy, Politics & Litigation, in* Principles of Conservation Biology 432-41 (G.K. Meffe & C.R. Carroll, eds., 2d ed. 1997).

54. Dennis Murphy, Natural Cmty. Conservation Planning, Cal. Dep't of Fish & Game, The California Coastal Sage Scrub Scientific Review Panel: Its Purpose and Approach (1992).

55. P.F. Brussard & D.D. Murphy, *Subregionalization for Natural Communities Conservation Planning, in* Cal. Dep't of Fish & Game, Southern California Coastal Sage Scrub Natural Communities Conservation Plan: Scientific Review Panel Conservation Guidelines & Documentation § 5 (1992).

56. Interview with Dr. Dennis Murphy, NCCP Scientific Review Panel Chair, Stanford University, Cal. (Jan. 1995).

57. Memorandum of Understanding by and between the California Department of Fish and Game and the United States Fish and Wildlife Service Regarding Coastal Sage Scrub Natural Community Conservation Planning in Southern California (1991); Cal. Dep't of Fish & Game, Natural Community Conservation Planning Quarterly Reports to the Legislature (1992) (hereinafter "1992 Quarterly Reports"); Cal. Dep't of Fish & Game, Natural Community Conservation Planning Quarterly Reports to the Legislature (1991) (hereinafter "1991 Quarterly Reports").

3. Similarities and Differences in the Permanent and Ad Hoc Models of Science Advice

There are many similarities between the two types of models. Comparable to permanent panels, ad hoc requests generally come from agencies or public officials. Scientists are also selected based on expertise and knowledge, with an attempt to balance the panels to represent all relevant points of view. However, in contrast with permanent models, ad hoc panels are most often funded by exclusively public sources. Additionally, stakeholders can have a stronger direct role in problem formulation and selection of scientists in the ad hoc models.

VI. Ideas for Making a Science Advisory Program More or Less Effective

A. Ideas for Building a Credible Science Advisory Process.

1. Participants on Science Panels Must Do More than Provide Cosmetic Balance.

As discussed previously, institutional representation does not always equal contribution.[58] While many working models of science review, including some described in this article, strike a delicate balance of expertise and affiliation, it is expertise and the ability to contribute meaningfully to the final product that must dominate in selection. To effectively meet this objective, many science advisory programs, including the Environmental Protection Agency's Science Advisory Board and the National Research Council, engage in an interdisciplinary selection process that directly involves the scientific community. Consumers of science advice use both institutions regularly, and consider their reports and recommendations to carry great weight. For example, the Administrator's report to the Science Advisory Board indicates that the agency has acted affirmatively on a majority of the SAB's recommendations.[59]

2. A Recommendation Is a Recommendation Is a Recommendation.

Challenges to agency science are a common feature of the administrative landscape in California. This is not surprising. Agencies operate in a very complex and constrained environment. Legal mandates, legal defensibility, and the existing regulatory record drive their decision-making. Where the stakes are high it is hard to deliver a product that is satisfactory to any interest group. Bureaucracies are not places that encourage that risk-taking, creativity or "give and take" atmosphere that are the hallmarks of the external science review process.[60] The flip side of this coin is that the agencies sometimes attempt to change recommendations. Participants in two advisory panels in the western United States described situations where public agencies tried to modify their draft recommendations. This caused an outcry among the science panel participants.[61] Moreover, this problem is not restricted to California. In the early 1980s, the EPA Administrator challenged the independence of the Health Effects Institute. At that time, the Administrator tried to influence the agenda and priorities of the HEI.[62] Sheila Jasanoff also describes manipulation of scientific data to suit predetermined policy aims in chemical regulation.[63] Recommendations must not be subject to change by the staff if the credibility of the scientific enterprise is to be maintained.

3. Use Panels Sparingly.

The job of science advisor is very specialized. It is important to have scientists on the panels with an interdisciplinary bent who understand administrative process. Several scientific respondents indicated that they have many more invitations to participate on panels then they can reasonably accept.[64] For this reason,

58. *See* Boesch & Macke, *supra* note 16.

59. *See* Sci. Advisory Bd., *supra* note 24.

60. James Q. Wilson, Bureaucracy: What Government Agencies Do and Why They Do It, chs. 6, 7, 12, 18 (1st ed. 1989).

61. Survey, *supra* note 2.

62. *See* Grumbly, *supra* note 43.

63. *See generally* Jasanoff, *supra* note 14.

64. Survey, *supra* note 2.

scholars recommend that scientific panels be used sparingly (and only for the most important issues) to avoid draining scientific resources or creating another layer of bureaucracy that delays decisions.[65]

4. Use Panels Well.

All the models described in this report consciously try to avoid any effort to get them to define regulatory goals, set regulatory standards or manage regulatory risk. This is the job of the agencies. It is neither reasonable nor possible to answer every question asked.

To streamline the process and avoid irregularities, question development should follow several guidelines. First, questions should be asked at the earliest stage of a problem to allow scientists to offer guidance well in advance of actual decision-making. Second, questions should be dealt with when there is sufficient information to evaluate the technical merits of an issue based on standards of scientific proof. Third, questions should be addressed of the utmost importance to the agency such as when a decision carries a high risk of lasting harm to environmental quality, nature, the economy and communities. Fourth, questions should be asked when science is controversial, in dispute or inadequate. Finally, the actual format of the questions is significant. Questions should be formulated in small sets of very focused scientific questions that are answerable in a reasonable time-frame.

B. Defining the Role of the Science Advisor.

1. Bridge the Gap Between Scientists and Public Officials.

Peter Douglas, Executive Director of the California Coastal Commission, a California regulatory body, identifies six variables that any policy-maker needs to use science effectively in his or her decision-making. These variables are: 1) timely information; 2) credible information; 3) an understanding of the limitations of the science; 4) identification of the additional questions to be answered; 5) a clear explanation of conclusions drawn; and 6) the resources required to provide the additional information.[66]

The different models described in this article show that a lack of understanding between the scientist and the public officials can be bridged if there is early discussion about the scope of the review and a clear statement of the problem. While this would seem to be a given, it was astounding how many respondents commented that everyone had to work harder to clarify exactly those issues in order to develop a relevant product.[67]

2. Define the Advisory Function Clearly.

Many scientific respondents remarked that when public officials and agencies did not like their recommendations the advice was ignored or that it had a small role in the final decision-making. Respondents from public agencies were universal in their view that science panels can only provide guidance and direction. It is up to the policy-maker to make the final call. The Science Advisory Board at the Environmental Protection Agency has a unique approach to solving this problem. While the SAB can only offer non-binding recommendations, the EPA Administrator has to respond to all reviews. The majority of the responses from the Administrator indicate that the agency has acted positively on the advice provided by the SAB.[68] This seems to be a very effective approach for providing feedback to the scientists.

3. Formalize the Program in the Agencies.

Government, often with the involvement of key interest groups or public officials, formally chartered all the institutions and panels described in this article. Formal, individual administrative agreements defining the terms

65. *See* Meffee, *supra* note 4.

66. Peter Douglas, *What Do Policymakers and Policy-Implementers Need from Scientists?*, *in* IMPROVING INTERACTIONS BETWEEN COASTAL SCIENCE AND POLICY: PROCEEDINGS OF THE CALIFORNIA SYMPOSIUM, *supra* note 16, at 30-32.

67. Survey, *supra* note 2.

68. *See* SCI. ADVISORY BD., *supra* note 24.

for triggering scientific review should be created with relevant state and federal regulatory and management agencies in the key natural resources areas. The agreements should spell out the mission, anticipated role, broad areas of inquiry and mechanisms for initiating the committees by the agency. The agreement should also stipulate that the recommendations are to be delivered to the highest appropriate level in the agency.

C. House the Institution Where It Can Capitalize on Existing Scientific Resources.

There are different forms of permanent scientific advice located inside and outside of government. The desired home for this enterprise is in an existing and credible institution with established links to the scientific research establishment. This will allow the institution to capitalize on those relationships and to make it more cost-effective.

D. Provide a Committed Source of Government Funding.

Because a science advisory institution is a public good, it should reasonably receive a majority of its funding from government. From the small subset of models examined, government funding largely supports the work of science advisory panels.[69] Without this funding, the institution may become too reliant upon single sources and contracts. Fundraising takes time away from the primary work of scientific assessment. Question formulation becomes driven by contracts. The credibility of the institution can be compromised. To avoid these problems, government should commit to at least two-thirds of the operating budget and the institutional endowment. A third of the budget could be sought from multiple sources including private foundations, the National Science Foundation, individual public agencies and consortiums of affected industries.

69. *See id.*; CHESAPEAKE BAY PROGRAM, *available at* http://www.chesapeakebay.net/overview.htm, *supra* note 35; FY1999 BUDGETS, *supra* note 41; Interview with Dr. Jack Ward Thomas, *supra* note 53; 1992 QUARTERLY REPORTS, *supra* note 57; 1991 QUARTERLY REPORTS, *supra* note 57.

This article makes no claim to have all the answers or to identify all the steps necessary to provide more policy relevant scientific information. Instead, it lays out in broad strokes some of the challenges to achieving that vision. Going forward and building this new community of scientists for California will require a commitment of time and resources in many areas.

Appendix: Communications

Dr. Donald Barnes, Staff Director
Science Advisory Board, United States Environmental Protection Agency, Washington, DC

Loretta Barsamian, Executive Director
Regional Water Quality Control Board, Oakland, CA

Dr. Donald Boesch, President
Center for Environmental Science, University of Maryland, Cambridge, MD

Peter Douglas, Executive Director
California Coastal Commission, San Francisco

Noel Eldridge, Director
Scientific Peer Advisory and Review Service, American Institute of Biological Sciences, Washington, DC

Neil Ewald, Manager
Simpson Timber Company, Korbel, CA

Brooks Firestone, Retired Assemblyman
California State Legislature, Sacramento (Currently Firestone Vineyard, Los Olivos, CA)

Monica Florian, Senior Vice President, Corporate Affairs
The Irvine Company, Newport Beach, CA

Dr. James Gaither, Program Manager
The Nature Conservancy, San Francisco, CA

Dr. Donald Greenbaum, President
Health Effects Institute, Cambridge, MA