Linking Science to Environmental Policy and Decision Making in Israel

A report prepared for Yad Hanadiv (the Rothschild Foundation) and the Israel Society of Ecology and Environmental Sciences (ISEES) by an International Advisory Committee consisting of:

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EXECUTIVE SUMMARY

In May 2009, Yad Hanadiv (the Rothschild Foundation) and the Israel Society of Ecology and Environmental Sciences (ISEES) hosted an International Advisory Committee consisting of experts in environmental sciences and policy. The Advisory Committee was asked to make recommendations as to what actions Yad Hanadiv and ISEES might take to improve the scientific basis of environmental policy and natural resources management in Israel.

The Advisory Committee spent the week of May 9-16 in Israel. During this period, the committee met with over 50 representatives of academic institutions, non-governmental organizations, and government ministries, and heard a wide range of opinions about the current status of environmental science and policy in Israel. The committee also toured several sites to become familiar with specific examples of environmental issues in Israel, attended the annual meeting of the ISEES, and met with representatives of Yad Hanadiv and ISEES.

The committee found both strengths and weaknesses in the linkages between science and environmental policy and decision making in Israel. Overall, the committee concluded that basic environmental science is strong in Israel but that the link between science and environmental policy is weak. Among the major strengths are a highly educated populace, a strong capability in basic environmental science, and effective non-governmental environmental and conservation organizations. Among the major weaknesses found by the committee are a lack of communication between the science and policy communities, few opportunities for training professionals in problem-oriented environmental science, and a general lack of established institutional arrangements to synthesize scientific information and link science to environmental policy.

The Advisory Committee learned as much as it could about how environmental decisions are made in Israel and compared the Israeli process to models committee members are familiar with in other countries. The committee used the Issue-Attention Cycle (section 2.2.1) to help frame its analysis of how environmental issues emerge and how environmental policy is developed, implemented, and evaluated. The committee also utilized the concept of the Information Value-Added Chain (section 2.2.2) to identify gaps in the linkages between science and policy and to identify opportunities for adding additional value to scientific information by synthesizing and communicating it in a form more useful to decision makers.

In the opinion of the Advisory Committee, the greatest opportunities for improving the linkages between science and environmental policy in Israel are 1) providing better mechanisms for integration and synthesis of scientific information and 2) training a new generation of environmental professionals skilled in interpreting and communicating scientific information in a policy and decision making context. Accordingly, our recommendations focus on strengthening the human and institutional resources necessary to better integrate and synthesize environmental information and communicate scientific opinion in a policy relevant manner.

Throughout the report, the Advisory Committee has identified many steps to improve the linkages between science and policy in Israel. Here we focus on our six highest priority recommendations designed to increase the value of scientific input into environmental policy formulation and decision-making.

An important first step in improving the link between science and environmental policy is to have more scientists and science-policy professionals who understand the role of science in environmental decision-making and policy and who know how to communicate relevant scientific information to decision makers. The Advisory Committee has the following three recommendations to develop human resources needed to further this goal:

- **Development of new professional MS Degree Programs to train students to work at the science-policy interface**. Such programs differ from traditional M.S. degree programs by emphasizing interdisciplinary coursework, practical internship experience, and the option of a project-based degree as opposed to traditional thesis-based research degree. There are many examples of these programs including some in countries around the Mediterranean, such as France and Spain.

- **Development of Environmental Internship and Fellowship Programs to provide graduate students and scientists with practical experience at the interface between science, resource management, and policy.** A highly successful model for this program is the AAAS Science and Technology Fellows Program in the US that provides fellowships for PhDs to serve as scientific and science-policy staff in the legislative and executive branches of government.

- **Development of an Environmental Leadership Program to train mid-career and senior scientists to participate more effectively in the policy process.** The Aldo Leopold Leadership Program managed by Stanford University's Woods Institute for the Environment is an excellent example of an existing program of this type. Australia and New Zealand operate fellowship programs in the public service, which allow a staff member to spend (usually) a year in another country's government service.

The link between science and policy can be significantly strengthened by integrating, synthesizing, and communicating research results early in the Issue-Attention Cycle (see section 2.2.1). Accordingly, we propose among our highest priority recommendations:

- **Creation of a National Environmental Synthesis Center to assess environmental knowledge, synthesize existing information, and provide a forum for developing scientific consensus.** Such a center could combine some of the functions of the National Research Council (NRC) and the National Center for Ecological Analysis and Synthesis (NCEAS) in the US. In Australia, the Prime Minister's Science Council provides a forum for such synthesis.

- **Strengthening the capacities of the Chief Science Advisors in the ministries in order to improve science input into management decisions and policy formulation**. To be more effective the Chief Scientist needs a more substantial budget, a standing Science Advisory Committee, and the authority and resources to convene standing or ad hoc advisory committees.

Having a corps of scientists trained at the science-policy interface and having the integrated and synthesized scientific information needed by decision makers are both necessary but not sufficient conditions to link science and environmental policy. Recognizing that it is also necessary to have a culture that demands science input in policy formulation and environmental decision-making, we further recommend:

- **Establishment of a government-sanctioned commission to design and oversee the implementation of a "State of the Environment" report that summarizes environmental conditions, trends, and projections in Israel.** We also recommend that the need for such information be articulated in a National Environmental Policy which requires that environmental trends be monitored and provides a legal basis for using environmental assessments in policy formulation.

Each of these recommendations stands on its own in as much as each has the potential of improving the linkage between science and environmental decision making in Israel regardless of whether or not the other recommendations are adopted. However, taken as a whole, they fit together and reinforce one another. For example, the creation of an environmental synthesis center will provide scientists a mechanism for integrating and synthesizing scientific data in a policy-relevant format, but this information will have a far greater impact if there is a new generation of professionals with the combination of scientific expertise and communication skills needed to integrate scientific information into policy formulation and decision making.

If acted upon, the recommendations for new professional MS degree programs to train students to work at the science-policy interface, the new internship and fellowship programs to provide practical experience, and the environmental leadership program to train mid-career and senior scientists to participate more effectively in the policy process, will ensure that there is the human capacity to fully utilize the scientific information available to decision makers. The State of the Environment Report will help inform policy makers and the public about environmental issues and help create the demand for using scientific information in environmental decision-making. Strengthening the role of the Chief Scientists in the ministries will help ensure that science informs environmental decisions at the highest levels of government.

Although the Advisory Committee found problems with the current paucity of linkages between science and environmental policy in Israel, the committee completes its task with considerable optimism for the future. Adoption of any of the recommendations listed above would substantially improve on the current situation, and adoption of the complete package of recommendations would transform Israel into a world leader in incorporating science into environmental decision making and policy and, as such, a model for other nations.

2

INTRODUCTION AND FRAMING

2.1 The Charge to the Advisory Committee

This report represents the findings of an International Advisory Committee on Linking Science to Environmental Policy and Decision Making in Israel. The Advisory Committee was invited by Yad Hanadiv (the Rothschild Foundation) and the Israel Society of Ecology and Environmental Sciences (ISEES). The 'Terms of Reference' provided to the committee by our hosts provides the following rationale for its work:

"In light of the desire to improve the scientific basis of environmental policy and natural resources management in Israel, the Israel Society of Ecology and Environmental Sciences and Yad Hanadiv (the Rothschild Foundation) are collaborating in forming an international advisory group made up of individuals familiar with models of interaction between science and policy. The group will spend a week in Israel with a schedule encompassing workshops, lectures, interviews, tours, and the ISEES conference after which the group will prepare a report with recommendations."

The Terms of Reference also provided the Advisory Committee with the following questions to guide their deliberations:

Discipline and Expertise: What areas of scientific expertise are required as a basis for evidence-based environmental policy in Israel? What is the current status of the relevant environmental and ecological expertise in Israel? What inhibits its development?

Specific Research Agenda: What kinds of research are essential? To what extent is interdisciplinary research necessary, and where/what is necessary to be encouraged? What funding mechanisms best support desirable research?

Data: What is the role and importance of data and information (monitoring)? How are they best made available in order to support informed decisions on natural resource management? What organizations or institutions should be responsible for data collection and dissemination? What mechanisms should exist to synchronize and disseminate results? In what format should data be collected and stored?

Policy: What capacities and infrastructure - that pertain to policymakers - should be developed or enhanced? What should the science and research community do to support these developments and contribute to their success?

Framework: What is missing at the interface of science and environmental policy? Should it be provided by existing institutions and organizations? Is there a need for new frameworks or institutions? What models exist outside Israel?

Moving Forward: What actions or role would you recommend for the Foundation? For ISEES?

Although the Advisory Committee deliberated on all of the questions listed above, we focused special attention on questions 4 (Policy), 5 (Framework), and 6 (Moving Forward). Accordingly, much of this report focuses on addressing questions related to what, in the opinion of the Advisory Committee, is missing in the institutional framework linking science to environmental policy and decisions in Israel. Most of the committee's detailed recommendations concerning ISEES (question 6) were given in a separate statement sent directly to that organization (see Appendix 3).

The Advisory Committee consisted of the following five individuals (institutional affiliations are given for background purposes only; the opinions expressed in this report are made entirely on behalf of the individuals below and do not represent the opinions of the institutions mentioned):

- Dr. H. Ronald Pulliam, Advisory Committee Chair; University of Georgia, U.S.A.
- Dr. David Blockstein; Senior Scientists National Council for Science and Environment, U.S.A.
- Dr. Peter Bridgewater; Chairman, UK and international nature conservation advisory organization Joint Nature Conservation Committee, U.K.
- Dr. Peter Frumhoff, Director of Science & Policy, Union of Concerned Scientists, U.S.A.
- Dr. Barry D. Gold, Initiative Lead, The Gordon and Betty Moore Foundation, U.S.A.

The Advisory Committee spent the week of May 9-16, 2009, in Israel. During this period, the committee met with over 50 representatives of academic institutions, non-governmental organizations, and government ministries (see list in Appendix). The committee toured several sites to become familiar with specific examples of environmental issues in Israel that illustrated the current status, challenges, and opportunities to strengthen links between environmental science and decision making. Among the sites visited were the following:

Azekah and the Valley of Elah in the Judean Hills - the location of the biblical site where David is said to have defeated Goliath - to gain some historical perspective and to explore Mediterranean biodiversity and the relationships between agriculture and nature conservation;

Ein Gedi on the west coast of the Dead Sea to discuss the issues associated with over-mining and the decreased in-flow of water resulting in lower sea level and the appearance of sinkholes;

Yatir Forest between the southern edge of Mount Hebron and the north-east tip of the Negev desert to discuss afforestation projects in Israel and to learn about long-term ecological and meterological studies on the site;

The Taninim Nature Reserve near kibbutz Ma'agan Michael, the location of a large freshwater aquaculture project, to discuss conflicts arising between aquaculture and the conservation of migrating birds;

Mount Meron Nature Reserve to learn of biodiversity and other land-use and conservation management issues associated the Druze village within the park boundary, fires, and tourism in one of Israel's largest nature reserves.

The committee also attended the annual meeting of the Israel Society of Ecology and Environmental Sciences, gave lectures, held discussions in an open workshop with the society members, and met with officers of ISEES, graduate students, and representatives of Yad Hanadiv.

The Advisory Committee recognizes that in such a short period of time an outside group can achieve only limited knowledge and perspective on such a complex subject as the linkages between science and environmental policy. Nonetheless, the committee members drew upon their experiences with this set of issues in other countries and attempted to offer a fresh perspective and recommendations for consideration.

2.2 Problem Definition Advisory Committee

Environmental policy covers a wide spectrum of concerns, ranging from brown (air and water pollution, control of hazardous waste, and toxic chemicals) to green (natural resources, forestry, agriculture and food production) to blue (water quality and quantity and ocean health). At an even more fundamental level, environmental policy must address the protection of vital local, regional, and global ecological and biogeochemical systems. Increasingly, environmental policy must address both short-term and local as well as long-term and global risks to health and the environment.

The development, implementation, and enforcement of environmental policy can be complex, involving many actors and actions. Beyond laws, regulations, and court rulings, environmental policy is influenced by the officials who are responsible for developing, implementing, and enforcing environmental laws. Their decisions, in turn, are influenced by political, economic, and social forces, including the policy beliefs of elected officials, the health of the economy, anticipated costs and benefits of laws and regulations, public opinion, media coverage, and efforts by corporations, environmental groups, and scientists to influence environmental policy.

There have been times when environmental issues received much public attention (e.g). the 1972 United Nations Conference on the Human Environment in Stockholm which gave rise to UNEP; its 20-year follow-on in Rio de Janeiro where the environmental conventions on biological diversity, combating desertification, and climate change were conceived; the publication of the Brundtland Commission Report in 1987; and the UN General Assembly Declaration in 2008 which produced the Millennium Development Goals). Yet, for the most part, environmental policy has been a second tier public policy issue for most countries, including Israel, taking a back seat to issues of economic growth and development, national security, health care, etc. Nonetheless, world leaders and the general public are coming to see that national security is inextricably linked with food security, water security, and environmental security generally. Thus to achieve national security fully, enhanced attention must be given to environmental security.
Increasingly in many countries, environmental issues are being seen as critical to national security and economic well-being, with a growing recognition that demands for ecosystem goods and services[1] can only be provided by the natural capital sustained by healthy ecosystems and that many of these ecosystem services are not replaceable, or not cost-effectively replaceable, by physical capital[2]

2.2.1 The Issue-Attention Cycle

One framework for analyzing the development and implementation of environmental policy is the issue-attention cycle proposed by Downs[3] The issue-attention cycle is divided into four phases, the Pre-emergent (i.e., problem definition and problem analysis), Emergent (i.e., problem re-analysis and policy development), Action (i.e., strategy and implementation), and Post-Emergent phase (i.e., enforcement and evaluation). In each phase, different actors play different roles.

The pre-emergent phase is when an issue is the concern of a relatively small group of specialists and institutions and where it has not made its way onto the public policy agenda. This is often where scientists, engineers, and others are first becoming aware of an issue and begin to develop basic knowledge of it.

The emergent phase is when the issue, for some reason, first emerges onto the public political agendas. This is when policy- and decision-makers become involved and it is generally accompanied by increases in media coverage and the number and kinds of groups trying to influence the policy. This is also the phase where the issue may be reframed and where additional resources are devoted to it.

Next, Downs argues, comes the action phase where debate moves into the bureaucracy and where some public policy action may be taken. This is followed by the post-emergent phase where the issue gets specialized attention from specialized institutions and groups.

The Issue-Attention Cycle is relevant to this report, in part, because it helps identify how and when science plays a role in shaping policy. Scientists are often the first players to become aware of an issue during the pre-emergent phase. However, by the time the issue emerges on the public agenda, messages to influence

[1] For a discussion and definition of ecosystem services, see the 2000 report of the Ecological Society of America Ecosytem Services: A Primer, available at http://www.actionbioscience.org/environment/esa.html

[2] **Palmer et al**, 2004, *Ecology for a Crowded Planet*, Science 304: 1251-1252.

[3] **Downs**, 1972, *The Public Interest* 28: 38-50.

public opinion are mostly framed by advocacy groups, and scientists may find themselves marginalized or even 'used' by competing political agendas. In turn, the more astute among scientists may use the emergent and action phases of the cycle to obtain research funding to address emerging issues, sometimes leading to charges that scientists themselves have an agenda.

We argue in this report that science can play a more constructive role in environmental policy by integrating, synthesizing, and communicating research results earlier in the Issue-Attention Cycle. Furthermore, we propose that for this to happen, institutional structures must be in place to facilitate the integration and synthesis of research results in a policy relevant form and that scientists must have skills and incentives to effectively communicate their results to the public and policy makers.

2.2.2 The Information Value Added Chain

The Information Value Added Chain (Table 1) conceptualizes the simple idea that value is added to scientific data by synthesizing and communicating it in a form useful to decision makers. In the context of environmental policy and decision making, synthesis means, at a minimum, reviewing all of the relevant scientific evidence pertaining to a particular issue and summarizing it in non-technical language easily understood by decision makers, clearly pointing out areas where there is consensus of scientific opinion and areas where there is still disagreement in the scientific community.[4] Synthesis may also go beyond purely scientific discourse and consider the consequences of various policy options by integrating scientific information with social and economic concerns.

Economists use the term value added to refer to the additional value of a processed commodity over the cost of the raw goods used to produce it. Just as furniture has more value than unprocessed wood, integrated, synthesized, and interpreted scientific data has far more use in the decision making process than does the raw data from which it is derived. Carrying the analogy one step further, a nation can enrich itself by extracting more value from its investment in science by also investing in the synthesis and communication of scientific data.

Table 1 outlines the three main links in the Information Value Added Chain:

1. Exploration and Discovery,
2. Integration and Synthesis, and
3. Interpretation and Communication.

A weakness at any point in the chain can hinder the incorporation of scientific information into sound decision-making. The information value added chain also identifies a number of steps that can be taken to improve the flow of policy-relevant information from scientists to decision makers, beginning with stakeholder involvement in the identification of high priority science needs. Other critically important steps are knowledge assessment and identification of knowledge gaps, synthesis of existing scientific information in a policy-relevant form, and evaluation of the consequences of management and policy decisions. In a properly working information value added chain, this last step (evaluation of consequences) informs the identification of new issues in an iterative, adaptive feedback process.

[4] For a good example, see the *'Summary for Policymakers' in the Climate Change 2007: Synthesis Report* published by the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/).

Table 1. The Information Value Added Chain [5]

Exploration & Discovery ⇒	Integration & Synthesis ⇒	Interpretation & Communication
a. Balancing "curiosity driven" with "problem oriented" science	a. Information systems to improve data management, data quality, and data access	a. Development of science communication expertise \ and educational opportunities
b. The involvement of stakeholders in issue identification	b. Knowledge assessment and identification of knowledge gaps	b. Scientist participation in decision making process and policy development
c) Standardized inventory and monitoring for long - term trend assessment	c. Synthesis of existing information and development of consensus scientific opinion	c. Evaluation of the consequences of decisions and policies

Much of the emphasis in science, especially science as practiced at academic institutions, is on the communication of results to other scientists in specialized, technical journals rather than Interpretation and Communication of synthesized scientific information to decision makers. As a consequence, although scientists often believe their research results are relevant to decisions and policies being made, they rarely participate in the decision making process, and, even when they do, they are often not sufficiently skilled in communicating results in a form useful to decision makers to make a difference. They also typically lack access to information on "windows of opportunity" to provide policy-relevant science to decision-makers at critical junctures in time when decisions are being made. Decision makers, on the other hand, rarely have the time or training required to read the primary scientific literature and when they seek advice, they are frustrated by disagreements among scientists and the difficulty in gaining timely access to "top line" policy relevant scientific findings and conclusions. As a result, decision makers often lament the lack of relevant, synthesized information representing scientific consensus, while scientists feel their information is relevant to decisions being made but ignored by decision makers.

Of course, there are always some weaknesses in each link of the Information Value Added Chain and, in this regard, the Advisory Committee expected to find weaknesses in the flow of information from science to policy in Israel. Formalized institutional structures are available in some countries to promote the timely, systematic flow of information from scientists to decision makers. Accordingly, the Advisory Committee examined how, in general, science is incorporated into environmental decision making in Israel and, in particular, what formalized institutional structures exist or might be created to strengthen linkages between science and policy.

[5] Adapted from **Guiding Conservation Action, NatureServe Strategic Plan**, 2007-2011. http://www.natureserve.org/aboutUs/PressReleases/strategic_plan_2006.jsp

2.2.3 The Conservation Paradigm

The Advisory Committee paid special attention to how natural resources are managed in Israel. Around the world, approaches to environmental conservation have evolved continuously as practitioners seek to expand the impact and durability of conservation decisions. During most of the last century, conservation practice was generally characterized by defensive interventions focused on preserving key elements of biodiversity through the creation of protected areas and the adoption of restrictive management policies. Generally, the world conservation community now recognizes the need to move beyond a focus solely on biodiversity and protected areas per se to a more comprehensive view that embeds species protection and protected habitats in the broader context of sustainability, working landscapes, and protecting ecosystem goods and services.

While it is generally conceded that the 'biodiversity reserve' approach to conservation has yielded many important victories, limitations of the approach have become increasingly clear. With its fundamentally defensive posture, this approach focuses on symptoms instead of root causes, and addresses them in isolation rather than with a systems view. As a result, while the conservation victories it yields are important, they are also unable to achieve the scale and durability required to truly "turn the tide" of the overall trend towards mounting degradation of natural systems and the ecosystem goods and services they provide.

Increasingly, natural resource practitioners have been pursuing innovative solutions for overcoming the limits of the biodiversity/protected areas paradigm, by experimenting with more proactive and systemic approaches for achieving conservation outcomes. Accordingly, the Advisory Committee paid special attention to how natural resource decisions are made in Israel and the extent to which resource managers and policy makers are using the protected areas conservation paradigm in a proactive way, and, as appropriate, moving beyond it.

2.3 Who makes Environmental Policy in Israel?

The individuals and groups who influence environmental policy can be broadly divided into formal actors (i.e., government) who formulate policies and non-formal actors (i.e., civil society) who influence policies indirectly but have no official position. Scientists can play a role both as formal actors in as much as there are institutional structures that directly involve scientists in decision-making and policy formulation roles and as non-formal actors through their roles in academia and in non-governmental organizations (NGOs). Here we briefly review our understanding of how environmental policy is formulated in Israel with a particular emphasis on the role of science and scientists in the environmental policy making process.

Responsibility for developing and implementing environmental policy in Israel is shared among the Office of the Prime Minister, a number of committees of the Knesset, a number of ministries, especially the Ministry of Environmental Protection, and the courts. In both the Knesset and the ministries, this authority is fragmented among numerous committees and offices.

According to the information gleaned by the Advisory Committee, within the Knesset itself, there is relatively little professional staff and no formalized institutional support structure to link science to environmental policy. This makes it difficult for members of the Knesset and parliamentary aides to obtain timely objective and credible scientific information for developing policy, for assessing the effectiveness of ministries in developing and implementing policy, and, finally, for reformulating policies and laws to be more efficient and effective in achieving the intended environmental goals.
The Ministry of Environmental Protection was established in 1988 (from the earlier Environmental Protection Service) and shares authority for environmental matters with a number of other ministries, which creates challenges of coordination and conflicting interests among ministries, driven largely by the constituencies to which they respond. Yet, based on what we heard, it appears that the Ministry of Environmental Protection is responsible for initiating the development of much of Israel's environmental policies and for implementing and enforcing these policies once they are enacted in law.

In Israel, as in most countries, the ministries responsible for environmental policy have both political and career/professional leadership. Given the nature of Israel's political system, the ministers (i.e., the political leadership), who are chosen from among the members of the ruling party, often have short tenures. It is therefore difficult to develop and implement a long-lasting environmental policy agenda. On the other hand, the career professional corps, appears to be relatively stable and offers the opportunity to provide for continuity in the development and implementation of environmental policy, though, at present, it appears to have limited scientific staff and capacity.

The Advisory Committee did not get a clear sense of the role of the judiciary in developing, implementing, and enforcing environmental policy in Israel. As in other countries however, it is likely that the judiciary is lacking in the internal scientific expertise needed to address complicated environmental issues. Mechanisms for improving the delivery of scientific information, presented in a way suitable for the legal arena, is worthy of further investigation.

There are many non-formal actors in Israeli civil society who are increasingly engaging in environmental policy issues. These include business and industry groups, environmental NGOs, professional organizations and scientific societies, academia, and the media. Business groups, as in many other countries, appear to have the financial resources to ensure that they have a voice in the development of environmental policies. Environmental NGOs have an important role to play in the development of environmental policy through their ability to focus public attention on a problem and to influence the implementation and enforcement of environmental policies through litigation. NGOs and other civil society groups vary widely in their ideologies, resources, size, and effectiveness in contributing to policy development.

Israel has many outstanding environmental scientists and ecologists, including a number of internationally recognized experts. These scientists, both individually and collectively through their professional and scientific societies can play an important role in policy development as credible sources of expert opinion and synthesized scientific information. It would appear that, in Israel, scientific societies have not played a major role linking science to environmental policy for a variety of reasons, both internal to the scientific and academic community (i.e., cultural and scientific norms of academia, ability to clearly communicate complex scientific ideas) and intrinsic to the Israeli policy process itself. In particular, it appears to the Advisory Committee that scientific input into policy making in Israel is severely limited due to both a lack of formalized institutional structure for integrating, synthesizing, and communicating consensual scientific opinion, and a lack of a non-formal culture that seeks scientific advice and input into policy decisions as a normal part of the policy process.

The Advisory Committee also considered the role that international organizations play in the development and implementation of environmental policy in Israel. Israel is a small country and, as noted above, has a highly talented scientific community. Nonetheless, not all of the research and information required to develop sound environmental policy and laws needs to be developed inside Israel. In some instances, data and standards can be adapted from work done abroad. In addition, Israel's desire to join the Organization for Economic Co-operation and Development (OECD) creates a need for the development of environmental policies and standards that meet the requirements of the OECD.

The media also has a critical role to play in increasing public awareness and getting issues on the policy agenda. It would appear that a media focus on environmental issues is emerging with several journalists now focusing primarily on environmental topics. Working to strengthen the relationship between the media and the scientific community could be important to promoting public awareness of environmental issues and, thereby, advancing environmental policy in Israel.

Finally, we note that Israel is a small country, and that the regional context in which it sits inherently challenges efforts to fully address and resolve issues of environmental sustainability. Issues of current concern, such as water and biodiversity, have significant cross-border dimensions, both in regard to their causes and prospective solutions, that render them difficult, if not impossible, to address within national boundaries. It is also difficult to focus scientific and societal attention to address, in a preventative manner, significant long-term threats to environmental sustainability, such as climate change. Yet Israel's small size, entrepreneurial spirit, and highly educated populace also allow for the development of personal relationships between individuals in Government, the private sector, and civil society that, if properly cultivated and nourished, will facilitate communication and cooperation in finding solutions to common problems.

3 GENERAL FINDINGS AND DISCUSSION

3.1 General Findings

Linking science to environmental policy requires development, synthesis, and communication of scientific knowledge relevant to the environmental issues faced by decision makers. The Advisory Committee came to Israel expecting to find a strong environmental science community because of the international reputations of several eminent environmental scientists known to committee members. Our impressions of strong basic environmental science and ecology in Israel were reinforced by what we learned on our visit; nonetheless many of the scientists, managers, and policy makers interviewed by the Advisory Committee commented on the lack of connection between science and decision-making. Scientists complained that their information was often ignored, managers said that the information offered by scientists was not relevant, and policy makers lamented that they did not know how to find pertinent scientific information.

Based on our interviews, reading, and discussions, the Advisory Committee formed a number of opinions regarding the linkages between environmental science and policy in Israel. Here, we summarize some of our findings in the form of what we see as the strengths and assets and the weaknesses and gaps in the current structures linking science to decision-making and policy.

3.1.1 Strengths and Assets

Israel has a many important assets that can be utilized in strengthening the connection between science and environmental policy.

Strong scientific community:
Israel has a strong scientific community and places high value on science and technology. There are a large number of PhD scientists, many of whom have international training, and are actively engaged in scholarship. In general, their scholarship is at or above the level of other developed nations and a significant number are recognized as international experts in their specialized fields of research.

The environmental and ecological scientific community is large for a small country and is connected through the ISEES and informal networks. The scholarship and the potential for collaboration in this community also appear strong relative to other countries.

International partnerships:
Israel has strong international scientific partnerships and individual scientists frequently participate in international scientific meetings and collaborations.

Strong planning laws and rules:
Government ownership of almost all the land in the nation coupled with a stringent system of planning and permitting allows for strong science-based land and biodiversity conservation. Similarly, there are strong water management systems and mechanisms to incorporate scientists and scientific processes into water management.

Size of the country:
The relatively small size of the nation is an attribute in that many environmental scientists and environmental policy participants know each other through both formal and informal networks. It should be relatively easy to build additional networks to strengthen relationships within and between these communities.

Educated populace:
Education is an important value in Israeli society and the general population is highly educated. This provides a basis for policymakers and other non-scientists to communicate with scientists and science interpreters and develop common understanding.

Popular interest in environmental issues:
The Israeli people are very connected to the land. Even those who are not involved in agriculture and natural resource professions are active participants in hiking and other outdoor activities. There is a reasonable level of awareness of environmental issues, especially the increasing water crisis and threats to nature conservation, and an increasing level of concern, particularly among younger Israelis.

Environmental and conservation organizations:
There is a variety of environmental organizations. Of the organizations that we met, three – the Israeli Union for Environmental Defense (IUED), the Society for the Protection of Nature in Israel (SPNI), and the Heschel Centre -- appear to have sufficient ability and resources to influence environmental policy at the national level.

3.1.2 Weaknesses and Gaps

In addition to the strengths and assets mentioned above, there are also important weaknesses and gaps both within and between Government and scientific communities and these, in the opinion of the Advisory Committee, significantly limit the linkages between environmental science and decision making in Israel.

Lack of institutional arrangements to connect science and environmental policy:
The most important gap identified by the Advisory Committee is the almost complete lack of governmental and quasi-governmental structures that are formally charged with connecting environmental science and policy.

Lack of demand for science to inform environmental practice and policy:
Few environmental laws and regulations explicitly require a scientific basis for environmental policies and actions; few influential voices in civil society are calling for improved science-based policymaking.

Lack of mutual understanding and communication between science and policy communities:
The environmental science community, while interested in environmental policy, lacks formal training in the science-policy interface. There are some individuals with experience in connecting science and policy whose expertise can be used to help engage others. We found little evidence of the environmental policy community seeking involvement of the scientific community.

Uneven strengths within the scientific community:
The ecological and environmental science community may lack expertise in certain critical environmental fields. For example, the Advisory Committee was informed of a lack of taxonomic expertise. Similarly, we saw little evidence of expertise in the environmental and societal impacts of climate change. The committee also perceived a lack of appreciation, especially within the leading academic institutions, of the importance of applied, or "use-inspired," research.[6]

Underdeveloped and underutilized professional societies:
There is at least some disconnect between ISEES and its counterpart zoological society. ISEES is to be commended on recently hiring an executive director but still lacks some fundamental elements of a fully functional professional society, including a formal membership structure.

Fragmentation of environmental issues among ministries:
Although the Ministry of Environmental Protection has existed for more than 20 years, it is still a small ministry and it has limited jurisdiction over natural resources and general environmental protection. For example, the Ministry of Interior controls land planning and the Ministry of National Infrastructures controls related programs in the energy sector as well as the water and sewage authority.

Lack of scientific capacity within environmental NGOs: Although environmental NGOs appear to be engaged in many environmental issues that require scientific input, most Israeli NGOs appear to have few if any scientists on their staffs, advisory committees, or boards of directors and limited formal connections with scientific institutions.

[6] **Stokes**, 1997, *Pasteur's Quadrant: Basic Science and Technological Innovation*, Brooking Institution Press, 196 pp.

3.2 Knowledge Creation and Synthesis

As noted above, Israel has a strong basic environmental science community and a number of Israeli environmental scientists have international reputations. However, the creation of new knowledge by basic research does not ensure that relevant information is available to decision makers when they need it. Investment in basic research is essential to the long-term prosperity of any nation and often pays off in many unanticipated ways. However, basic research alone is not enough; it must be accompanied by a strong program of problem-oriented or use-inspired research targeted to the specific needs of decision makers. More importantly, there must be a concerted effort to integrate and synthesize research results and to communicate the weight of scientific opinion to decision makers.

The Israeli Science Foundation (ISF) is the predominant source of competitive research funding in Israel and, therefore, plays a key role in the creation of new scientific knowledge to address environmental issues. Accordingly, the Advisory Committee urges the ISF to increase support for applied and problem-oriented research to address emerging environmental issues. Since most environmental issues cross disciplinary lines and require the expertise of biological, physical, and social scientists, we further urge the ISF to develop new mechanisms to support multi-investigator, cross-disciplinary research.

As important as the role of the ISF is, the Advisory Committee does not view the level of research funding per se, especially funding for basic research, as a critical impediment to improving the linkages between science and policy. Rather, in the opinion of the Advisory Committee, the primary impediments are the lack of sufficient **human capacity** in problem-oriented science and at the science-policy interface and the lack of appropriate **institutional structures** to synthesize, translate and communicate science to decision makers. Of course, the ISF must play a role in strengthening both the human capacity, through funding for the training of more problem-oriented researchers, and the institutional structures, by funding assessment and synthesis activities as described below.

3.2.1 Human Resources

Our interviews and discussions with Israeli environmental science and policy leaders led us to conclude that, in part, the apparent disconnect between science and policy stems from the fact that there are too few Israelis trained in the interface between environmental science and policy. Accordingly, the Advisory Committee identified opportunities and needs for **developing human resources capacity** at every level of education and professional development. Chronologically, these include:

Undergraduate Education: Israeli universities and colleges appear to offer very little course work that integrates environmental science, management, and policy, especially at the undergraduate level. For example, we found no evidence of undergraduate natural resource (forestry, conservation biology, or wildlife ecology) degree programs, and very few courses available, despite the need in Israel for trained professional foresters and wildlife experts. Although no substitute for advanced training offered in graduate programs or professional schools, undergraduate programs can prepare students for entry level positions in NGOs and natural resource agencies; furthermore, introductory coursework is often necessary for students to determine whether or not to pursue an advanced degree.

Existing departments could help remedy this situation by developing new courses in environmental science, management and policy. Many environmental issues are, by nature, interdisciplinary and outside the bounds of traditional university departments. Accordingly, universities could offer new interdisciplinary majors across departments or even across universities and colleges when necessary. Philanthropic foundations could play a pivotal role in improving undergraduate environmental instruction by providing initial funding to university faculty to provide teaching relief while new interdisciplinary courses are being developed. It could also provide funding for individuals with undergraduate degrees to gain professional experience before entering graduate programs.

Graduate Education: To meet the growing need for people trained at the science-policy interface the Advisory Committee strongly recommends development of new Professional MS Degree Programs to train students to work at the science-policy interface. The new degree programs would differ from traditional MS degrees by an emphasis on interdisciplinary course work, practical experience through internships, and the option of a project-based degree as opposed to a traditional thesis-based thesis research degree. Such programs exist at some of the strongest environmental schools in the US, including Yale University, Duke University and the University of Michigan as well as in many conservation biology programs. [7]

There has been a virtual explosion of similar new degree programs under the rubric of Professional Science Masters in the US in just the past few years. These programs often combine development of a stronger foundation in science with a set of courses and experiences in business or public policy or with application of science and an internship or related work experiences that form the basis for a non-thesis Masters project (see the Council on Graduate Schools report: http://www.cgsnet.org/Default.aspx?tabid=120).

The Advisory Committee further recommends appropriate Israeli philanthropic foundations encourage the development of one or more such degree programs by inviting competitive proposals for initial development and start-up of such programs. The Pew Foundation served a similar role in creating the field of conservation biology in the US in the 1980s. ISEES could also play a role by developing standards and guidelines for new interdisciplinary degrees and by developing a professional certification program for the graduates of such programs.

The Advisory Committee further recommends that internships become an option in environmental graduate programs to provide opportunities for graduate students to work on practical issues and connect with stakeholders. Agencies and NGOs directly benefit from having interns work with them and in many cases may be willing to provide funding. Competitive intern fellowships and grants could also be provided by foundations or the universities themselves. The Doris Duke Conservation Fellowship funded by the Doris Duke Foundation and ad ministered

through the University of Wisconsin (www.nelson.wisc.edu/grad/funding/fellowships/duke/) is a good example of a foundation-funded graduate fellowship program.

Postgraduate: Fellowship programs such as the Science and Technology Fellows Program of the American Association for the Advancement of Science (AAAS, www.fellowships.aass.org/) provide one- or two-yearlong experiential education opportunities in the science-policy interface. This US program places highly qualified scientists into scientific advisory positions in the legislative and executive branches of Government. Other countries such as Switzerland and Australia have also looked to replicate this program and a new similar program is being established in the state of California.

The Advisory Committee also strongly recommends development of Environmental Internship and Fellowship Programs to provide graduate students and recent graduates with practical experience at the interface between science, resource management, and policy. We recommend these programs should provide fellowships for graduate study similar to the Doris Duke fellowship mentioned above, and offer both graduate student and postgraduate internship opportunities. In addition to placing interns in science advisory roles in the Knesset and Government ministries, we recommend that internships provide opportunities to place scientists in non-governmental and quasi-governmental organizations.

Faculty Training: Many university and college faculty are interested in becoming more involved in environmental management decisions and environmental policy but do not have the training and communication skills necessary to be effective in this capacity. Short-term fellowships or training programs could be provided for faculty members to better understand the public policy process and to enhance their public communication skills.

The Advisory Committee strongly supports the development of an Environmental Leadership Program to train mid-career and senior scientists to participate more effectively in the policy process. The Aldo Leopold Leadership Program (http://leopoldleadership.stanford.edu/) administered by Stanford University's Woods Institute

[7] For a description of the Master's of Environmental Management (MEM) at Duke University, see .http://www.nicholas.duke.edu/programs/professional/mem.html

for the Environment is an excellent example of an existing program of this type. Another good example is the newly established California Science and Technology Policy Fellows operated by the California Council on Science and Technology (http://fellows.ccst.us/).

There are many other mechanisms to increase science faculty participation in environmental management and policy. The US National Science Foundation (www.nsf.gov) requires all proposals for funding to include a statement on the "broader impacts" of the work and for principal investigators to include dissemination, education, and other activities that connect science with society. We encourage the Israel Science Foundation to provide similar incentive for problem-focused science. Another way to connect university faculty to environmental policy is to provide funds to enable faculty members to spend sabbaticals or other time periods in employment by Government agencies and other related academic institutions. In the US this is enabled by "Interagency Personnel Agreements (IPAs)" that fund the salary of individuals to work with other institutions. IPAs can be used to enable academics to work in Government and vice versa.

Finally, there are a number of international meetings that emphasize the science-policy interface, including the AAAS annual meeting and the National Conference on Science, Policy and the Environment (convened by the National Council for Science and the Environment) in the US and similar meetings in many European countries, including UK, France, Italy, and Spain which can provide a Mediterranean focus to these issues. Funding could be provided to allow Israeli scientists and graduate students to attend these meetings.

3.2.2 Institutional Resources for Knowledge Synthesis

The Information Value Added Chain (Table 1) identifies a number of key steps needed to improve the flow of information from scientists to decision makers. The need for many of the steps is obvious but, nonetheless, they frequently are not taken without formalized institutional structures to promote them. Although there are many forms such structures can, and do, take in different countries, here we focus on a few institutional structures that the Advisory Committee feels would most enhance the science-policy linkages in Israel.

A key first step in linking science to policy is an organized forum for issue or problem identification where scientists meet with key stakeholders to identify emerging or neglected issues and develop plans to address key questions that are necessary for science-based decision-making. Such forums can range from informal roundtables where scientists and policymakers periodically meet to discuss emerging issues to well-funded and staffed commissions[8] that are assigned responsibility or identifying and filling key gaps in research knowledge needed to address a specific issue of policy concern.

To be effective, issue identification must be accompanied by synthesis of existing information and assessment of the state of knowledge, asking what we know and what do we need to know to improve decision making for the particular topic. In the US, two of the most prominent institutions involved in synthesis and assessment of environmental knowledge are the National Research Council (NRC) and the National Center for Ecological Synthesis (NCEAS).

The National Research Council (http://sites.nationalacademies.org/nrc) is part of the US National Academy of Sciences, chartered by the US Congress since 1863. The mission of the NRC is to improve Government decision making and public policy, increase public education and understanding, and promote the acquisition and dissemination of knowledge in matters involving science, engineering, technology, and health. One very important role often played by the NRC is convening panels of scientific experts from diverse fields and perspectives to review the state of knowledge on a topic of policy importance and to present a consensus opinion of what is known and not known.

[8] For example, the National Commission on Science and Sustainable Forestry was funded by a collaboration among several private US foundations to promote the use of science in promoting sustainable forestry practices. (http://ncseonline.org/NCSSF/)

The core services involve collecting, analyzing, and sharing information and knowledge. The independence of the institution, combined with its unique ability to convene experts, allows it to be responsive to a host of requests.

The National Center for Ecological Analysis and Synthesis (NCEAS), funded by the US National Science Foundation is a unique institution with an explicit mission to foster ecological synthesis and analysis. Scientists working at NCEAS (www.nceas.ucsb.edu/) do not gather new data but rather review, analyze, and synthesize existing information to turn information into useful understanding. Although the core staff is small, hundreds of scholars, including postdoctoral associates, sabbatical fellows, and visiting scientists organized in focused working groups, collaborate each year at the center on scores of projects.

The Advisory Committee strongly recommends creation of a National Environmental Synthesis Center to assess environmental knowledge, synthesize existing information, and provide a forum for developing scientific consensus. The center would focus on the synthesis of existing scientific information, the assessment of state of current knowledge, and the translation of scientific knowledge into a form useful to resource managers and policy makers.

A National Environmental Synthesis Center in Israel would perform many of the functions of the US National Research Council (NRC) and the National Center for Ecological Synthesis (NCEAS), as described above. Among the most important products produced by the center would be the following:

Consensus Studies: Scientists themselves have many opinions on topics of policy relevance and such competing opinions can hinder policy development. Comprehensive studies carefully designed to bring together experts with a range of opinions and backgrounds to focus on controversial policy issues can help to assess the weight of scientific opinion while clarifying points of agreement or disagreement.

Knowledge Assessments: A National Environmental Synthesis Center could play a key role in resolving critical resource management and policy disputes and setting research priorities through targeted knowledge assessments. The Advisory Committee saw several examples of controversial issues (e.g., fire management in nature reserves and fish depredation by birds in aquaculture ponds) where there are major disagreements about management options and for which a knowledge assessment would clarify what is known and help set priorities for future applied research.

Program Reviews: Another useful role that could be served by a National Environmental Synthesis Center is the review of environmental programs in Government agencies and Government sponsored institutions. For example, if our recommendation below (see section 3.3.2) to strengthen the role of the Science Advisor and create a Science Advisory Panel in the Ministry of Environmental Protection is adopted, the center would be a logical place to review the success of that program.

The availability of credible and synthesized information by itself does not ensure better communication of scientific information to decision makers unless scientists are better trained at communicating the results to decision makers and the public at large. The effectiveness of a National Environmental Synthesis Center depends on the effective development of human resource (see section 3.2.1) with the capability of generating relevant scientific information, assessing the state of available knowledge, synthesizing information in a policy relevant form, and communicating the synthesized information to appropriate decision makers. The overall process is cyclical – as new information is generated and communicated and as the science is applied to policy processes, new questions of science and its application will arise.

3.3 Knowledge Advising Synthesis

Science and politics are distinct social domains, each functioning according to its own priorities and time scales and each characterised by specific knowledge, processes, discourses, and norms. For example, science and politics have different norms as to what constitutes reliable evidence, a convincing argument, and procedural fairness, and, naturally, such differences impede communication between the two domains. Interactions between scientists and other actors in the policy process at the science-policy interface allow for exchanges of ideas, mutual understanding, and, ultimately, the joint construction of knowledge, thereby enriching decision-making.

Science aims to generate new knowledge in the form of explanations of the world and predictions of how it might change. Pursuing the ideal of objectivity, science depends on processes that allow for its premises and conclusions to be criticised and, potentially falsified, on the basis of 'objective' evidence. Science may therefore be described as a process of both inquiry and 'organised scepticism' based on the best available logic, evidence, and free discussion. For many environmental scientists and ecologists, of course, scientific inquiry is also informed and motivated by core values and desires to help ensure a sustainable biosphere.

By contrast, making choices between conflicting alternatives effecting public welfare belongs to the realm of 'the political'. Recognizing that political discourse is never free from ideology, passions and emotions, some theorists envisage 'the political' as a space of freedom and public deliberation, others see it as a space of power, conflict, and antagonism. Regardless of which view is correct, connecting the political and scientific realms is essential to having better environmental governance.

Knowledge advising is a powerful means of transferring information and expertise across the science-policy interface. Recognizing that knowledge advising is a two-way street, construction of new knowledge at the science-policy interface requires both specific skills and common language. Unfortunately, the scientists who have performed valuable environmental research are often not in a good position to communicate their results to policy makers and both scientists and other actors in the science-policy interface need training and practice to ensure success.

3.3.1 Mechanisms for Science Advising

Many activities, both formal and informal, can enhance the flow of information, in both directions, across the science-policy interface in Israel. One of the simplest and least expensive to implement is better development of web portals to key institutions. The present set of portals in Hebrew with some in English is a good step in this direction, but more could be done. For example, Chief Scientists in the ministries could utilise websites to advertise events and activities, as well as perhaps having a blog feature to promote issues to the public. A good example here is the website of the U.K. Commission on Sustainable Development (http://www.sd-commission.org.uk/). Similarly, a scientific society like ISEES could utilize web technology to make policy relevant scientific studies and 'scientific consensus' reports available to decision makers and the public.

Other activities worth pursuing in the category of knowledge advising include establishing regularly-scheduled science-policy roundtables for issue specific discussions with a wide section to seek innovative solutions to pressing environmental issues, e.g., the Dead Sea sinkhole issue, promoting renewable energy sources versus biodiversity conservation, or finding solutions to climate change stress on shrublands, forests, and water resources. Other worthwhile activities include workshops promoting interactions between scientists and journalists and a more informed press corps, and continuing education courses in science-based issues for policy makers.

3.3.2 Science Advisors

The Advisory Committee met with the Chief Scientist in the Ministry of Environmental Protection and was told of similar positions in other Government agencies. Chief Scientists can have a critical role in the science-policy interface, potentially providing a key mechanism for translating science into policy relevant information and communicating directly with top officials involved in decision-making and policy formulation. A respected and well-qualified Chief Scientist has the ability to have conversations across the science-policy interface, talking directly with the science community on the one hand and the policy making community on the other, thereby, ensuring a steady flow of appropriate scientific input into policy making. However, it appeared to the Advisory Committee that, at present, there is a lack of authority and resources associated with this position and that the role of Chief Scientist, in some cases, has been diminished to that of administering a small research fund.

The Advisory Committee strongly recommends strengthening the capacities of the Chief Science Advisors in the ministries in order to improve science input into management decisions and policy formulation. There are a number of good models in other countries for chief scientists in Government agencies that may be directly applicable to Israel. In the U.K., each ministry has a Science Advisor, whose role is to act as the science "interpreter" to senior policy makers, and to provide independent scientific advice where needed to ministers. There is also a Government Chief Science Advisor who meets every 6 months with the chief scientists in the separate ministries to discuss important Government-wide issues that are emerging. Chief Scientists are typically active in professional societies dealing with themes with which their ministry has legal or policy concern and are able to find qualified scientific advice on a wide range of issues.
In Australia, the Prime Minister's department has a Chief Scientist who deals across all ministries on scientific issues, although there are also Science directors in some ministries. And there is also the national research institution, the Commonwealth Scientific and Industrial Research Organization (CSIRO), which is largely Government funded, and provides access to Government for advice and practical short-term work.

In order for the Chief Scientists in the ministries to be more effective in Israel, the Chief Scientist needs a more substantial budget and the authority and resources to convene Advisory Committees. No matter how well qualified, no Chief Scientist has the breadth of experience

and expertise necessary to adequately advise the ministry on the full range of issues relevant to its mission, without assistance. In some cases, the Chief Scientist may need dedicated internal staff to deal with specialized topics, for example biodiversity obligations under international treaties (see Appendix 2: Biodiversity as a Case Example).

In many cases, however, the Chief Scientist may more effectively and economically be advised by outside specialists serving on formal or informal advisory panels. We recommend a Standing Advisory Committee consisting of respected scientific generalists who are familiar with a range of topics and issues regularly dealt with by the ministry. This committee should meet regularly and serve as the Chief Scientist's sounding board for emerging issues and should be available to be called into special session on short notice when required.

In addition to a standing Advisory Committee, a Chief Scientist needs to have budget and authority to convene ad hoc advisory groups, as necessary, to study specific emerging issues and provide consensus scientific opinion on controversial issues as they emerge. Close contacts between the Chief Scientist and scientific societies like ISEES could well play a key role in convening ad hoc advisory groups on short notice.

3.4 Creating Demand for Science-Based Decision making

Israel has substantial potential to improve environmental policymaking through establishing and strengthening key mechanisms and incentives for more effective input from the nation's strong environmental science community. However, many of our interviews, as well as those reported by Gavrieli,[9] suggest that key actors in Israeli society—from senior officials in relevant ministries to members of the Knesset to leaders of environmental NGOs to the media—may often not perceive that environmental policymaking is hampered by the lack of scientific input. Moreover, where input from the scientific community is seen as important, the views of international experts may often be viewed as having inherently greater value than those of highly-qualified Israeli scientists (**Gavrieli**, 2008).
If unaddressed, this lack of perceived need by key actors for strong Israeli scientific input into environmental policymaking may substantially hamper progress. Restructuring and enhancing the science advisory capacity in key ministries, for example, may require that tight ministry financial resources be redirected towards this purpose. Some interviewees have suggested that strong civil society (i.e. environmental NGOs) calls for strengthening this capacity will be essential to ensure that funds are made available. Absent a shared understanding of the value of strong science advice in the ministries, however, such calls are unlikely to be forthcoming.

Strengthening demand for science-based environmental policymaking can take several forms. In light of the credence given to international experts, for example, this committee's creation, participation in extensive stakeholder meetings, and the distribution of our report's recommendations to key actors may itself help strengthen awareness of both the high value and opportunity to improve the scientific basis for environmental policy in Israel.

Israel's increasing participation in key intergovernmental bodies that have established norms of behavior for environmental policy can be a source of strengthened international demand. In particular, Israel's anticipated membership in the OECD will establish expectations for environmental policymaking that are consistent with the norms of member states,[10] and provide an international assessment of Israel's progress towards meeting domestically-established environmental objectives as well as international commitments.[11]

The forthcoming release of a major international assessment of the projected impacts of climate change on the eastern Mediterranean region[12] can be used by both Israeli environmental scientists and NGOs to help raise awareness within Israel of the potentially severe impacts of climate change on water resources, public health, agriculture, and other climate-sensitive issues. Well-designed outreach on this issue could foster greater demand for scientist

[9] **Gavrieli, Y.** *2008 Environmental Scientists and Environmental Policy Makers: Discourse Assessmentand Action Recommendations.* Tel Aviv University, unpublished manuscript provided to the Advisory Committee;

http://campusteva.tau.ac.il/upload/Microsoft%20Word%20-%20Environmental%20scientists%20and%20environmental%20policy%20140109.pdf.

[10] **OECD, 2009a**. *Environmental Policies and Instruments. Environmental Directorate, Organization forEconomic Co-operation and Development.*

http://www.oecd.org/department/0,3355,en_2649_34281_1_1_1_1_1,00.html

[11] **OECD, 2009b**. *Environmental Country Reviews. Environmental Directorate, Organization for Economic Co-operation and Development.*

http://www.oecd.org/topic/0,3373,en_2649_34307_1_1_1_1_37465,00.html

[12] **Cyprus Institute**, 2009. *Climate Change Impacts in the Eastern Mediterranean and the Middle East.* http://www.cyi.ac.cy/climatechangemetastudy

engagement in developing increasingly refined impact assessments, as well as sound adaptation and mitigation strategies.

The implementation of several recommendations described in previous sections of this report may indirectly help build demand for stronger science-based environmental policies. For example, a well-designed fellowship or internship program (see section 3.2.1) that brings junior to mid-career scientists to work at key ministries or for members of the Knesset should help build demand simply by demonstrating to policymakers the high value of having scientists engaged in supporting the decision-making process.

3.4.1 State of the Environment Report

As an important means of raising environmental awareness and increasing demand for science-based environmental policy, the Advisory Committee recommends establishment of a Government-sanctioned commission to design and oversee the implementation of a "State of the Environment" report that summarizes environmental conditions and trends in Israel[13] Furthermore, we recommend that the requirement for the report be articulated in a National Environmental Policy that requires that environmental trends be monitored and provides a legal basis for using environmental assessments in policy formulation.
To our knowledge, there exists under Israeli law no requirement that the Government regularly produce a synthetic assessment of the status, trends, projections, and implications of changes in environmental conditions within the nation. Such a requirement, as established under law in other nations[14], could provide a core foundational basis for assessing environmental priorities and building demand among policymakers and the public for strengthening environmental policies and their implementation. A strong "State of the Environment" report, would:

- Cover the full suite of environmental and sustainability issues facing Israel;
- Consider global and regional as well as national factors affecting environmental quality and sustainability;
- Be developed with significant input from experts across relevant disciplines, drawn as appropriate from academia, Government, the private and non-profit sectors;
- Be developed in a transparent peer-reviewed process and made publicly available upon completion; Be updated on a regular (three to five year) basis.

3.4.2 Strengthening Science in Environmental NGOs

As another means to create demand for science based environmental decision making, the Advisory Committee recommends strengthening the working relationships between Israeli environmental scientists and environmental and conservation NGOs. Our interviews, and those of Gavrieli (2008) indicate that environmental and nature conservation NGOs within Israel have a highly variable relationship with the Israeli environmental science community. Several academic scientists with whom we spoke indicated distrust of the NGOs use of science in their outreach and policy advocacy; several NGOs speak of the importance of science in their work, but have limited engagement with relevant Israeli expert community.

Despite the perceived tensions between science and policy advocacy, these two communities have much to offer one another. In the U.S., for example, NGOs with high quality scientists on their staff and Boards of Directors play a central role in strengthening the scientific basis of environmental policymaking. Several Israeli environmental and conservation NGOs would similarly benefit from greater engagement of scientific experts. Conversely, Israeli NGOs have established public outreach and media capacities as well as relationships with ministries and members of the Knesset not broadly available to Israeli environmental scientists – and hence, provide a potential institutional conduit through which scientists can help strengthen both public awareness and environmental policymaking.

[13] Similar reports are already established in several countries, including the United States. (http://www.environment.gov.au/soe/) and Austrailia (http://www.heinzctr.org/ecosystems/)

[14] **Council of Environmental Quality**, 2009. *The National Environmental Policy Act of 1969*, http://ceq.hss.doe.gov/Nepa/regs/nepa/nepaeqia.htm

[15] For an example, see American Rivers, 2009. Scientific and Technical Advisory Committee. http://www.americanrivers.org/about-us/stac/stac.html

Some additional options for strengthening the science within the environmental NGO's include:

- Place some of the "AAAS-type" science fellows and postgraduate interns within key NGOs.

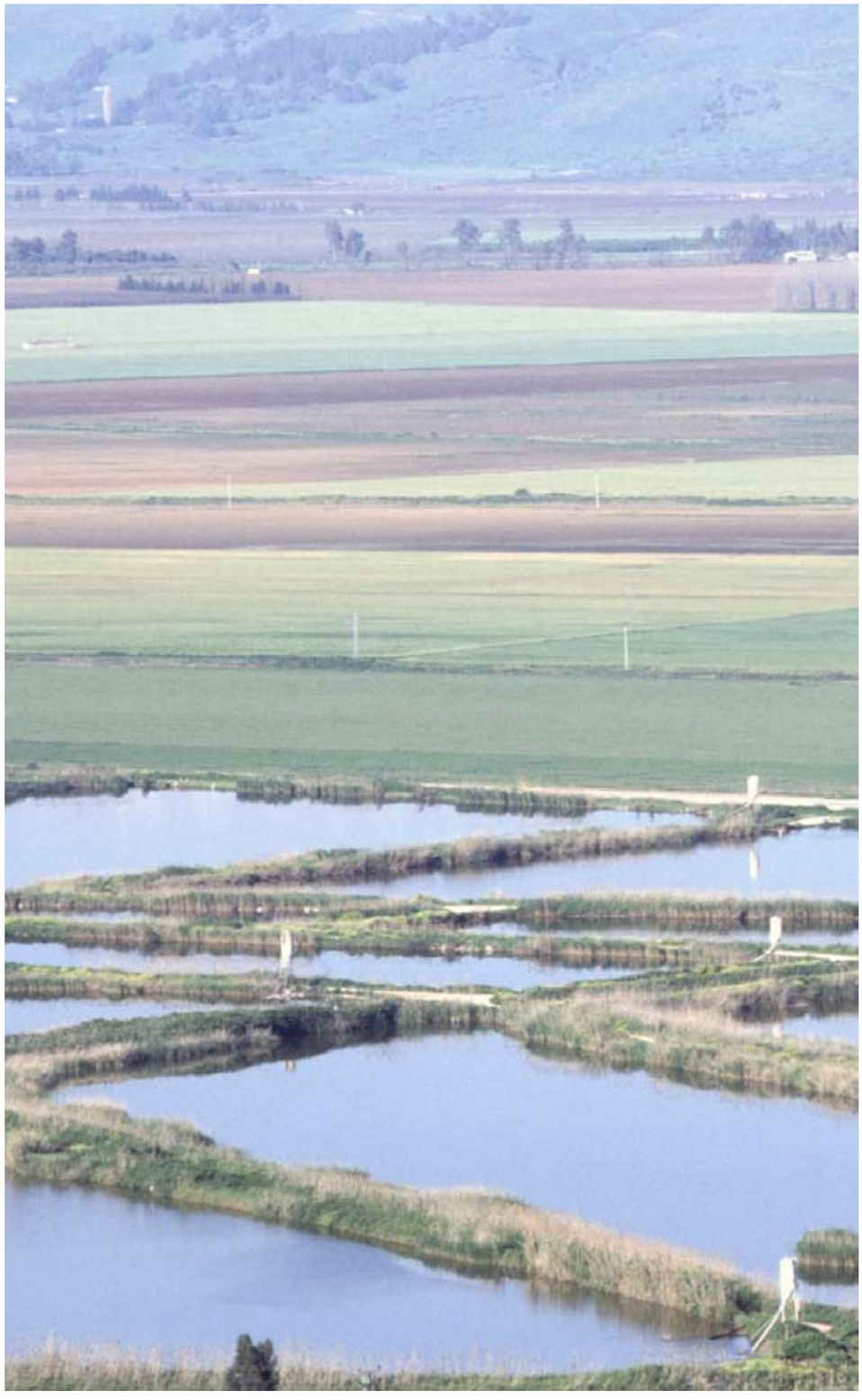
- Encourage NGO's to establish standing science advisory committees to help inform,review, and support their work.[15]

- Establish formal or informal partnerships between ISEES and one or more NGOs on selected projects (as, for example, the partnership between the Ecological Society of America and the Union of Concerned Scientists in developing regional assessments of climate change impacts in the U.S.).

The ISEES could play an important role in providing environmental science support for the environmental NGO community once the society has fully established its core operations at the science-policy interface. For example, an established relationship between the ISEES and the appropriate committee of the Israeli Bar Association could provide an important forum for informal discussion of the science behind environmental law and policy.

Finally, the Advisory Committee recommends support for greater environmental science reporting in Israel. Our committee had only a limited opportunity to assess the state of environmental journalism in Israel. Gavrieli (2008) notes that environmental issues are most often brought to public attention by environmental NGO's through the media, and that environmental and nature reporting in Israel rarely addresses scientific issues or profiles leading Israeli environmental scientists.

The Aldo Leopold-type training program described above should help strengthen the effectiveness of Israeli environmental scientists in their interactions with the media. Mechanisms might also be established to strengthen the effectiveness and incentives for Israeli journalists to cover environmental science issues. One simple mechanism would be to establish an annual prize for the best coverage of science and the environment in Israel, with the evaluation of the prize determined by a high-quality panel of Israeli (and perhaps international) scientists and journalists. The awarding of such a prize would itself be news, and hence positively reinforce public interest and awareness.



3.5 Concluding Remarks

Of the many recommendations considered by the Advisory Committee, the following six stand out as our **highest priority recommendations:**

- **Development of new professional MS Degree Programs** to train students to work at the science-policy interface.
- **Development of Environmental Internship and Fellowship Programs** to provide graduate students and scientists with practical experience at the interface between science, resource management, and policy.
- **Development of an Environmental Leadership Program** to train mid-career and senior scientists to participate more effectively in the policy process.
- **Creation of a National Environmental Synthesis Center** to assess environmental knowledge, synthesize existing information, and provide a forum for developing scientific consensus.
- **Strengthening the capacities of the Chief Science Advisors in the ministries** in order to improve science input into management decisions and policy formulation.
- **Establishment of a commission to develop and oversee the implementation of a "State of the Environment" report** that summarizes environmental conditions and trends in Israel.

Although all six recommendations stand on their own, in as much as each has the potential of improving the linkage between science and environmental decision making regardless of whether or not the others are adopted, we here point out the synergies between the recommendations that make them more than the sum of their parts.

The Advisory Committee used the information value-added chain to help identify weaknesses in the links between science and policy in Israel. Although there are always weaknesses at every link in the chain, we found the greatest weaknesses to be in the Integration and Synthesis and the Interpretation and Communication links of the chain. Accordingly, we have focused on recommendations to strengthen the human and institutional resources necessary to better integrate and synthesize environmental information and communicate consensus scientific opinion in a policy relevant manner.

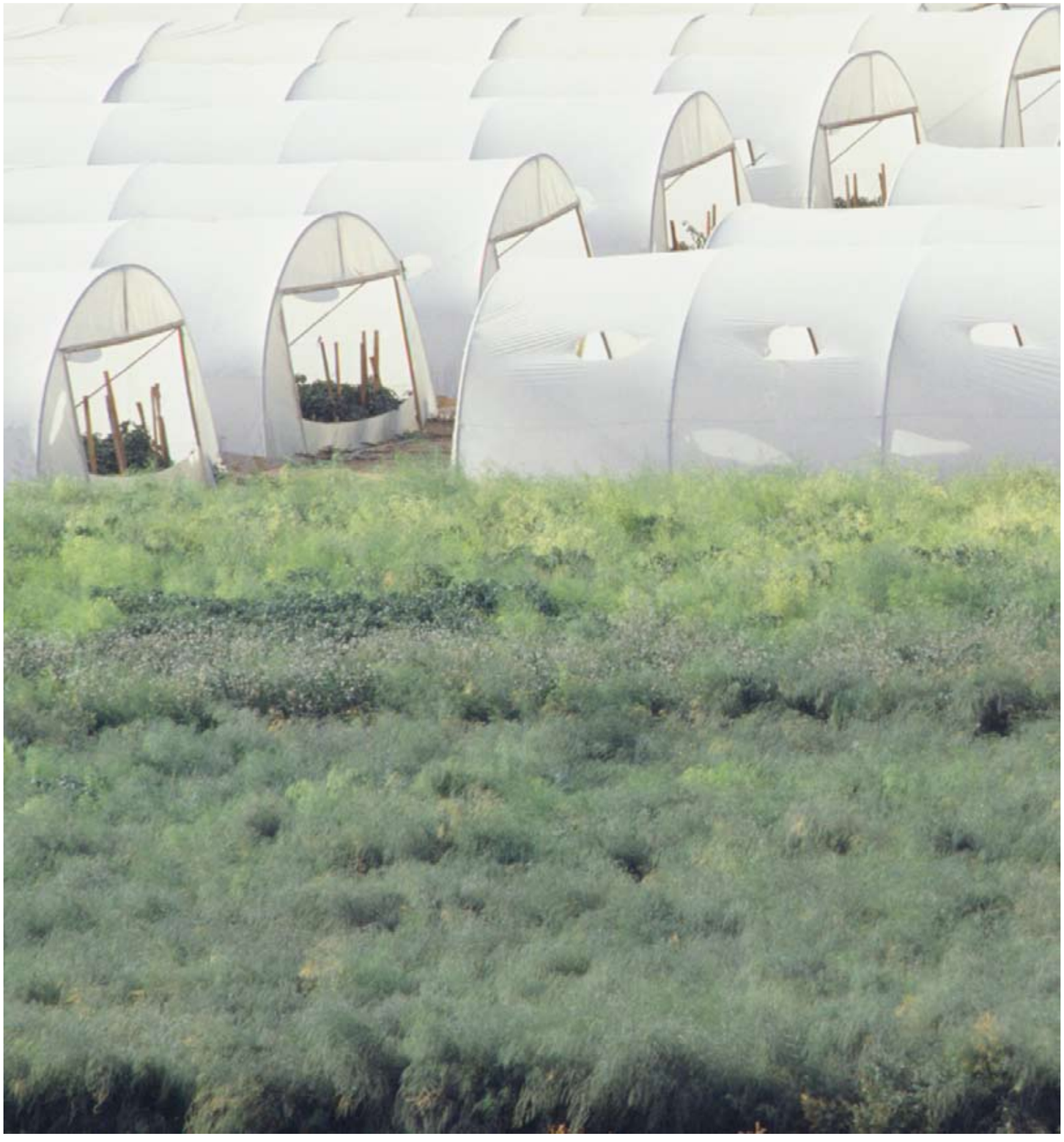
Regarding the integration and synthesis of information, the Advisory Committee strongly recommends the creation of an environmental synthesis center to assess environmental knowledge, synthesize existing information, and provide a forum for developing scientific consensus. In making this recommendation, the committee understands that integration and synthesis of information is an essential part of linking science and policy but will be insufficient unless there is a new generation of scientists with the combination of scientific expertise and communication skills needed to integrate scientific information into policy formulation and decision-making.

Recognizing the importance of practical experience in the science-policy interface and the need to communicate science in a policy relevant manner, the Advisory Committee also recommends new professional MS degree programs to train students to work at the science-policy interface, new internship and fellowship programs to provide practical experience, and an environmental leadership program to train mid-career and senior scientists to participate more effectively in the policy process.

The training of a new generation of scientists who can work at the science-policy interface is a long-term goal but more immediate benefits can be achieved by strengthening of the roles and responsibilities of the chief science advisors in the ministries. In particular, providing the chief scientists with the authority and resources needed to engage the science community by forming standing and ad hoc advisory committees is a cost effective way to improve science input into management decisions and policy formulation in the short-term.

Finally, we recognize that having both better integrated science and scientists trained at the science-policy interface will not lead to better environmental policy unless there is a culture that demands better scientific information in the decision making process. Accordingly, we recommend the establishment of a Government-sanctioned national commission to develop and oversee implementation of a "State of the Environment" report in Israel and a National Environmental Policy that articulates the requirement that environmental trends be monitored and used in environmental policy formulation.

All of the recommendations, taken as a whole, fit together and reinforce one another.
A new generation of scientists trained at the science-policy interface provides the human capacity required to communicate science to policy makers. Enhanced human capacity and awareness also create demand for integrated and synthesized science relevant to environmental decision making. In turn, creating demand for quality scientific information necessitates the monitoring of environmental trends, the synthesis of scientific information, and a trained corps of professionals capable of working at the science-policy interface.



Appendix 1

List of Workshop Participants, Speakers, and Special Guests that met with the Advisory Committee

Hosts:

Professor Yohay Carmel
Faculty of Environmental Engineering at The Technion
And Chairman, Israel Society of Ecology and Environmental Sciences

Hanoch Ilsar
Director, Israel Society of Ecology and Environmental Sciences

Ran Levy
Program Director, Environment
Yad Hanadiv

Dinner Speakers and Special Guests

Dr. Eilon Schwatz
Executive Director, Heschel Centre for Environmental Learning and Leadership

Professor Tamar Dayan
Professor of Zoology, Tel Aviv University

Professor Uri Shamir
Professor Emeritus, Faculty of Civil and Environmental Engineering, The Technion

Dr. Sarit Ben Simhon-Peleg
Director of Research, Harold Hartog School of Government and Policy

Yoav Sagi
Director, Open Landscape Institute, Society for the Protection of Nature in Israel

Tours and Visits to Field Sites

Dr. Adi Naali
Former Forest Manager, Israel Forest Authority, JNF

Dr. Itay Fischhandler
Department of Geography, The Hebrew University

Dr. Hillel Wust-Bloch
Department of Geophysics, Tel Aviv University

Professor Dan Yakir
Department of Environmental Sciences and Energy Research, The Weizmann Institute
Zev Labinger, Israeli Avian Center

Dr. Didi Kaplan
Ecologist, Northern District, Israel Nature and Parks Authority

Hugo Jan Trago
Director, Ramat Hanadiv Nature Park

Prof. Avi Perevolotsky
Agricultural Research Organization, The Volcani Center

Participants in the May 11, 2009 Workshop on the Role of Science in Environmental Policy-Making in Israel

Valerie Brachia
Former Senior Assistant Director, Planning and Policy, Ministry of Environmental Protection

Hanoch Tzoref
Manager, Mountain District and LTRE Station, Jewish National Fund

Dr. Eli Groner
Director, Israel Long Term Ecological Research Network.

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Appendix 2

Biodiversity as a Case Example

Israel has many international obligations where science advising is critical and where strong science advisors within the ministries could play an effective role in fulfilling international obligations. We illustrate this point using the case of international conventions and agreements regulating biological diversity and the critical role that science advising plays in meeting these obligations.

There is widespread agreement that the governance of biodiversity is not as effective as it could be, or as it should be. Despite a multiplication of policy processes addressing biodiversity and an increase of high-quality biodiversity research, in natural and social sciences, as well as through interdisciplinary endeavours, it seems inevitable that the target endorsed by the 2002 World Summit on Sustainable Development in Johannesburg to achieve by 2010 a significant reduction of the current rate of biodiversity loss will not be met. According to the Millennium Ecosystem Assessment[16] (MA), this trend of loss will even accelerate in the future.

In addition to purely domestic policies, the State of Israel is signatory to the following biodiversity-related Conventions and agreements:

- UN Convention on Biological Diversity (http://www.cbd.int/)
- The Ramsar Convention on Wetlands (http://www.ramsar.org/)
- UN Convention on International Trade in Endangered Species of Wild Fauna and Flora (http://www.cites.org/)
- UN Convention on the Conservation of Migratory Species of Wild Animals (http://www.cms.int/); Including the following agreements for which Israel is a range state;
  - Bats in Europe
  - Cetaceans of the Mediterranean and Black Seas
  - African-Eurasian migratory waterbirds
- Convention Concerning the Protection of the World Cultural and Natural Heritage (http://whc.unesco.org/en/convention/)
- International Union for the Protection of New Varieties of Plants (http://www.upov.int/index_en.html)
- UN Convention to Combat Desertification (http://www.unccd.int/)

Israel is also a signatory to the UN Framework Convention on Climate Change (http://unfccc.int/2860.php), and eight global and regional marine and other conventions, dealing with pollution matters,
as well as the Barcelona convention, which deals with sustainable development issues in the marine environment.

Adherence to these Conventions and agreements creates special responsibilities, including the development of national reports, and ongoing contribution to the implementation mechanisms of the Conventions and agreements. These international obligations should not be seen as (and are not) separate from domestic needs and requirements. Indeed, well-organised domestic reporting structures can ensure the international obligations are relatively light and not a distraction from undertaking domestic actions and activities.

[16] The Millennium Ecosystem Assessment reviewed the consequences of ecosystem change for human well-being.
For a guide to the many MA reports see http://www.millenniumassessment.org/en/index.aspx.

Appendix 3

Recommendations for the Israel Society of Ecology and Environmental Sciences (ISESS) for professionalization and integration with policy

Overview

The ISEES has a strong base through 35 years of collaboration among environmental scientists and ecologists. The Israeli environmental and ecological scientific community is large for a small country and is connected both through the ISEES and informal networks. The scholarship in this community also appears to be strong. The potential for multidisciplinary partnerships is strong relative to other countries.

ISEES only recently hired an executive director and still lacks many fundamental elements of a fully functioning professional society, including a formal membership. It is ready to take significant steps towards professionalization and becoming a major player in the Israeli environmental science and policy scheme.

We strongly recommend that a strategic planning process be undertaken to engage the society "members" in reaching consensus on future directions for the society and to set priorities, goals and objectives among the many recommendations presented below.

Professionalism

Membership base – dues structure, membership records. Currently there is no formal membership structure in ISEES. We recommend that a dues structure (including student membership) and a membership infrastructure should be established and a membership solicitation be initiated.

Types of members – Presently ecologists and environmental scientists are affiliated with the society through participation in the annual meeting. These individuals should be encouraged to become members. Additionally, the society should reach out to social scientists and others who study environmental policy and the environment-society interface. We recommend that a membership campaign extend outside academic sector (to scientists in NGOs, government, business, etc). Consideration should be given to inclusion of non-scientists such as those involved in environmental law, business and related professions. This would enable cross-cultural learning and partnerships. The goal should be to develop a membership that includes a broad range of environmentally-associated fields.

Strategic plan – Many of these recommendations represent a major change from a society that is currently organized around a single meeting whose purpose is scholarly exchange to a professional organization that is strategically positioned at the science-policy interface but that maintains the strongest scientific credibility. It is critical that the key stakeholders (particularly the society members) be supportive of this process.

We strongly recommend that ISEES undertake a formal strategic planning process. This process should include development of a long-term vision, short-term goals and objectives and processes to meet these goals and objectives. Membership surveys and other means of consultation should be used to ensure that the society leadership does not get too far ahead of the desires of the members. The Society for Conservation Biology has twice undertaken this kind of strategic planning in the past decade and could be consulted for advice (www.conbio.org). Additionally, the Institute for Ecology and Environmental Management in the UK (IEEM www.ieem.net) may be able to offer advice here.

Committees – It will be beneficial to the society to set up a committee structure to allow members interested in particular issues to communicate and collaborate. In addition to standing committees related to operations (membership, meetings, communications), there may value in creating committees for topics such as policy, education (interface with formal education), and others.

Journal – A nnative Hebrew-language journal has the potential to increase professionalism and scholarly exchange.

Communications – The society will need to create mechanisms to facilitate communications among members and with the external scientific and policy communities. We recommend the following:

An internal – website, listserve, newsletter, "linked in" group, Earth Portal community (http://earthportal.net) or other web-based communications group

An external – website and as a means of providing communication with the general public

Science - Policy Interface

Conferences – The annual conferences could include mix of scholarly scientific presentations and special sessions with a science/policy focus on particular issues (e.g. Marine, Water, Biodiversity). The special sessions would provide opportunities for policymakers and other decision-makers to identify issues of concern and for there to be interactive discussion sessions to develop recommendations, action plans, and generally increase the mutual understanding of scientists and policymakers. There is great potential for these conferences to become a significant venue for scientists, civil society and policymakers to come together to better understand the scientific parameters and societal considerations of the critical environmental challenges facing Israel. They can also become opportunities for experiential education in the science-policy interplay through workshops and breakout sessions along the model of the National Council for Science, Policy and the Environment's annual National Conference on Science, Policy and the Environment (www.NCSEonline.org/conference)

Partnerships – We recommend that ISESS create formal and informal relationships with other Israeli professional societies, environment committee of Israel bar assn; international professional societies There appears to be at least some disconnect between ISEES and its counterpart zoological society. ISEES leadership should reach out to the zoological society leadership and discuss their respective plans and should consider holding joint conferences. ISEES might also consider partnering with the Israeli bar association to form a joint committee on environmental law and environmental justice.

We recommend that ISEES establish formal or informal partnerships one or more NGOs on selected projects (as, for example, the partnership between the Ecological Society of America and the Union of Concerned Scientists in developing regional assessments of climate change impacts in the U.S.).

Outreach documents for decision-makers – ISEES can produce a variety of documents to summarize environmental science in ways that are relevant to Israeli policymakers.
Tools include white papers, brief communications, an outreach journal (such as Frontiers in Ecology, Ecological Applications or Conservation in Practice or Issues in Science and Technology, this needs to be done with great skill and understanding and should be implemented only after considerable scoping and planning).

Other outreach means – ISESS could organize topical briefings and workshops for policymakers, journalists and other potential users of science based information.

Awards – It is important that those who go beyond the boundaries and engage in science and policy interface be recognized and appreciated for these efforts. There may be backlash from "pure academics" particularly in other basic science disciplines. Awards and other recognition to scientists and decision-makers at various levels of their career will reinforce those individuals and show them as role models.

Student awards – Awards should be presented to students not only for research but for communication of research.

Continuing professional education for members – ISEES can provide a variety of means of education for its members on the science-policy interface. These range from webinars (perhaps including international partners) to hosting programs such as science-policy fellowships.

A final note

There is much that can be done and needs to be done. However, it is important that the society proceed in a measured and strategic way and not take on everything at once. Establishment of a stronger society structure and formal membership and initiation of strategic planning should be the first steps.

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