

**Environmental Scientists and Environmental Policy Makers:
Discourse Assessment and Action Recommendations**

Written by: Dr. Yael Gavrieli

Research assistants: Emanuel Cohen-Shaham and Attorney Ronit Josto-Hanani

Steering committee: Chairperson: Prof. Tamar Dayan. Members: Dr. Binyamin Begin, MK Dr. Dov Hanin, Dr. Miriam Hern, Prof. Danny Levitan, Ran Levy, Carmel Varnia

English translation: Shaul Vardi

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This project is the product of dialogue with a wide range of individuals who have helped us to examine the discourse between scientists and decision makers.

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¹ Appendix 2 – List of Interviewees.

² AMNH, Center for Biodiversity & Conservation (CBC) and its Network of Conservation Educators and Practitioners (NCEP), New York City, NY, USA.

³ Project Director of the Network of Conservation Educators and Practitioners at the American Museum of Natural History and an Adjunct Associate Professor at Columbia University and at Duke University.

in contact by letter and in person for several years. At our most recent meeting we focused on a project promoting discourse between scientists and policy makers. Nora's diverse perspectives contributed greatly to the development of discourse between scientists and policy makers. My colleagues at the Aldo Leopold Leadership Program⁴ were always willing to share their experiences by email, Skype conversations and face-to-face conversations in the United States. Prof. Sheila Jasanoff of Harvard University is a leading researcher in the field of policy and science. Sheila welcomed me to her home one Sunday, and over a cup of coffee in her kitchen she explained the main points of her theory. Eric Chivian, MD, is a Nobel Prize recipient and director of the Center for Health and the Global Environment at Harvard.⁵ Eric and Kathleen Frith, the assistant director, invited me to lunch and shared their extensive and extremely successful experience in a programme that updates policy makers on the Capitol on science-related issues. James N. Levitt⁶ has been active for many years on the seam line between academia and nature conservation activism as director of the Program on Conservation Innovation and as a research fellow at the Ash Institute. Jim shared his insight with me frankly and patiently and, as always, it was a fascinating experience. Elizabeth Alling⁷ heads QLF, an international not-for-profit environmental organisation. Over dinner Beth and I discussed the complex politics of environmental organisations and the relations between these organisations and the academic world. The discussions with colleagues from the United States were intellectually stimulating as well as personally enjoyable. Those I met presented extremely diverse points of view. They expanded the borders of our discussion, but surprisingly they also helped crystallize the definition of the issues as reflected throughout this report. Their generosity in sharing their time and experience with a visitor from a distant land deserves the greatest appreciation and thanks.

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⁴ The Aldo Leopold Leadership Program (ALLP), now at Stanford University, Woods Institute for the Environment, Stanford, CA, USA.

⁵ Center for Health and the Global Environment, Harvard Medical School, Harvard University.

⁶ Director of the Program on Conservation Innovation at the Harvard Forest and a research fellow at the Ash Institute for Democratic Governance and Innovation at Harvard's Kennedy School of Government.

⁷ Executive Vice-President, QLF – Quebec-Labrador Foundation – Atlantic Center for the Environment.

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the legal and regulatory dimensions. Ronit and Emanuel took part in interviews in Israel and reviewed the main foci of decision making. Immanuel examined developments in Europe in the field of scientific-environmental communication in decision making and examined the forums for discussion of environmental science in local government in Israel. Ronit reviewed the discussions in the Knesset Internal Affairs and Environment Committee. This project would have been incomplete without their experience and contribution.

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Abstract

Nature Campus strives to strengthen the connections between the scientific community and the general public on issues relating to nature and the environment. One of the objectives of the activities is to nurture science-based policies on aspects relating to nature conservation. In order to focus the operational goals of Nature Campus over the coming years, we examined the discourse between scientists and decision-makers in the field of the environment and nature conservation and mapped the main connection points and areas of disagreement in the communications between the two communities.

This study is based on interviews with scientists, conservationists and decision-makers in Israel and abroad; an analysis of the operations of the Local Government Centre, the Forum of Fifteen and the Centre for Local Sustainability; an analysis of the minutes of meetings of the Knesset Internal Affairs and Environment Committee; an analysis of two case studies – marine agriculture in Eilat and the Dead Sea; a review of models for projects encouraging discourse between scientists and environmentalists in other countries; and a summarised review of the literature on the subject.

Environmental discourse usually begins with a description of the environmental problem couched in scientific terms: the extent of pollution, the size of the damaged area, morbidity rates, the number of species that have disappeared and so forth. In many cases, however, discourse then continues on two divergent tracks – a scientific discussion and a discussion relating to social, economic and legal aspects. Connections are not always made between these discussions.

The picture that emerges from this study, and indeed from many others, suggests that two communities may be identified in the field of environmental discourse: the scientific community and the non-scientific community. These two communities attempt to communicate with each other but encounter numerous difficulties in this process. Although some scientists wish to be partners in environmental discourse, diverse obstacles impair their ability to become involved and hamper their dialogue with decision-makers and with the general public. These obstacles include gaps in the perception of science and its importance in the discussion; communication problems resulting from different cultures (science and social activism), and psychosocial difficulties.

The first bone of contention in discourse between scientists and decision-makers is the attitude toward scientific authority. Indeed, this obstacle effectively strikes at

the heart of the broader relations between the public and science, and between scientists and the public. On the one hand, some factors encourage scientific authority, such as the profile of the culture of scientific thought and the belief that science and technology enable modern humans to exercise almost total control, planning and monitoring of nature. On the other hand, many factors challenge scientific authority. These also stem from the inherent character of science, and include incomplete knowledge, uncertainty and disagreement among researchers. While scientists view these features as an obvious component of the essence of science, the general public expects science to be unequivocal and absolute. The expectations gap creates a lack of trust that is sometimes exploited by political forces.

Moreover, science is not a monolithic entity. While the prevailing approach in the precise sciences is reductivistic, ecology seeks to achieve a holistic view of natural systems. Ecology seeks to identify and call attention to the heavy environmental price paid for human development. As such, it effectively challenges the hegemony of the culture of “progress” based on scientific and technological development. These insights are exploited by the environmental movement in order to fuel a broad social protest that includes an element of distrust of the foundations of modern society – science and technology.

The picture is even more complicated, however. Environmental discourse usually involves economic, political and/or ideological forces. Since science does not operate in a vacuum but within a given society and place, it is influenced by these factors. Accordingly, some critics have argued that the nature of scientific questions and the insights and conclusions drawn from these questions in terms of policy not only reflect scientists’ objective curiosity but are also the product of social, cultural and political influences. This reality casts a further shadow over scientific authority.

The ways scientists function in environmental discourse are the subject of discussion in scientific literature and professional conferences. It has been asked whether scientists should go beyond offering purely scientific opinions and also offer their positions regarding policy and management actions that should be taken. In the two examples we examined – marine agriculture in Eilat and the future of the Dead Sea – differences were observed in the role played by scientists, the way they functioned in discourse, and the dynamic that occurred. In the Eilat case, the involvement of political and economic forces was overt and obvious. Scientists on both sides of the divide took positions regarding policy and were accused of distorting science due to extraneous considerations. These were among the reasons why the discourse deteriorated into a bitter conflict. In the case of the

Dead Sea, all the political and economic forces involved ostensibly share the goal of addressing the falling level of the Dead Sea and the resulting environmental ramifications. However, some of those involved have challenged the functioning of scientists and particularly the fact that most of them have not expressed a clear position regarding policy.

Further difficulties in environmental discourse are the product of psychosocial barriers. Policy- and decision-makers and most members of the general public do not have a formal scientific education, and in many cases lack general scientific literacy in the environmental context. As a result they often feel threatened by science. This problem is compounded by cumulative experiences of disillusionment with scientific predictions and opinions and an unwillingness to accept pessimistic predictions. All these factors combine to create emotional barriers to communication between scientists and the general public, including decision-makers.

In many countries scientific consultants have become an important part of the system of government. In Israel there is no comprehensive infrastructure facilitating discourse between scientists and decision-makers on environmental issues, and substantial differences can be seen between environmental discourse on different issues. In recent years the local government system has begun to address environmental issues, but it has not yet formalised the position of scientists on the various environmental committees. In the discussions of the Knesset Internal and Environmental Affairs Committee there are no mechanisms ensuring that scientific opinions will be heard; the number of scientists who have participated in these discussions in recent years is extremely small. In areas addressed by governmental research bodies, environmental discourse is more highly consolidated than in areas in which governmental responsibility is limited to monitoring or inspection. Many government ministries have a chief scientist responsible for communication between the scientific community and decision makers, but numerous additional mechanisms are lacking. For example, although the community of researchers in Israel involved in nature conservation and the environment is relatively small, only a few of these researchers are known to policy makers or involved in decision-making processes. Researchers do not undergo any kind of training involving them for involvement in these areas and many of them feel that they lack the necessary skills for this purpose. In Israel there is no support network, connection to the world of practical activity, or meaningful discussion on the place of science in policy making or the desirable form of involvement of scientists in these processes. Above and beyond all these difficulties, scientists face a further problem: they do not receive any remuneration

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for their involvement in these areas, and indeed they are sometimes criticised for such involvement.

Science and the Environment – What’s the Connection?

Are environmental issues scientific issues?

Environmental protection agencies in Israel and many other countries invest resources in scientific research, receive advice from scientific committees and assure stakeholders that their decisions are scientifically grounded. The regulations they publish employ scientific concepts: scientific units of measurement, data requiring explanation by scientists, and scientific phraseology. Most conservationist organisations abroad also proudly declare that their work has a scientific foundation. Nature Conservancy, the largest conservation organisation in the world, uses a scientific foundation to develop its policy of Conservation by Design.⁸ The United Nations Environment Programme (UNEP) notes the study of environmental conditions among its key goals⁹ and devotes considerable resources to scientific research and evaluation programmes such as Global Environmental Outlook. The attention to the scientific foundation of environmental issues is consonant with the prevailing general approach that this foundation must be an integral part of the decision-making and policy-forming process in all fields, not only in the environmental sector.¹⁰ To this end most governments, as well as scientific and educational organisations around the world, invest enormous resources in promoting scientific literacy among the public and in nurturing channels of communication between scientists and the public.

Conversely, many environmentalists attribute less importance to the scientific foundation of environmental issues relative to other aspects, such as social, ethical and economic dimensions. David Orr, a leading figure in contemporary environmental education, argues that science cannot constitute the central axis in environmental discourse; this discourse must rather be based on values. Indeed, he argues that the environmental crisis is the product of science, a field that yields

⁸ The Nature Conservancy,
<http://www.nature.org/aboutus/howwwework/cbd/science/art19228/html>.

⁹ “United Nations Environment Programme: Environment for Development.” In United Nations Environment Programme. “What UNEP does: Assessing global, regional and national environmental conditions and trends; Developing international agreements and national environmental instruments Strengthening institutions for the wise management of the environment; Integrating economic development and environmental protection; Facilitating the transfer of knowledge and technology for sustainable development; Encouraging new partnerships and mind-sets within civil society and the private sector.”

¹⁰ For example, see the activities of major scientific bodies such as the American Association for the Advancement of Science (AAAS) and the British Association for the Advancement of Science (BAAS), as well as the activities of smaller organisations such as SciDev (Science and Development).

sufficient power to control the environment but is still ignorant about it.¹¹ Orr's book *Earth in Mind: On Education, Environment, and the Human Prospect* begins with an equally categorical statement:

*"If today is a typical day on planet earth, we will lose 116 square miles of rain forest, or about an acre a second. We will lose another 72 square miles to encroaching deserts, the results of human mismanagement and overpopulation. We will lose 40 to 250 species, and no one knows whether the number is 40 or 250. Today the human population will increase by 250,000. And today we will add 2,700 tons of chlorofluorocarbons and 15 million tons of carbon dioxide to the atmosphere. Tonight the earth will be a little hotter, its water more acidic, and the fabric of life more threadbare."*¹²

In order to create a broad foundation for his arguments regarding the severity of the environmental crisis, Orr chooses to open his book with a series of findings from scientific studies, despite his objection to the role of science in environmental discourse. This duality reflects the problematic status of science in such discourse. We shall examine below some of the reasons for this problematic situation with reference to three characteristics of science: The construction of scientific authority; the attitude of reductivistic science to nature; and the subversive approach of ecology to these two characteristics – authority and reductivism.

Scientific Authority

In the past, science was seen as an unchallenged authority, presumably since science provided solutions for many practical problems and contributed more than any other factor to the improvement in the standard of live, quality of life and duration of life. However, scientific authority was not due solely to its status as the product of technological development. It also reflected the fact that science had acquired an amazing quantity of knowledge about the world: The theory of evolution explained the processes of creation and extinction of species; the tectonic theory explained the form of the continents; models were developed for forecasting the weather; medicines were extracted from natural materials, and so forth.

The behaviour of research also contributed to consolidating the authority of science. The scientific method was developed with the goal of being objective and providing information free of bias or personal preferences. Over more than 1000 years of research, scientists made a concerted effort to consolidate their status as

¹¹ Orr, David. 1994. *Earth in Mind: On Education, Environment, and the Human Prospect*. Washington, DC, Island Press.

¹² *Ibid.*

the suppliers or reliable information. They perfected the ways in which they create and validate knowledge and the ways they critique their own work. Since the consolidation of science as a distinct field during the Enlightenment, members of the scientific community have been perceived by the public as individuals who investigate the world solely out of natural curiosity, without any personal considerations of profit or loss. Indeed, western culture came to sanctify science as an objective truth. This approach was sometimes exploited for political purposes; one of the most obvious examples of this is the use made of the theory of evolution by racist regimes. However, improper ideological bias in science, as well as sheer dishonesty, constitute the exception to the rule. It is commonly accepted in western culture that the norms of the scientific community are the investigation of the truth and adherence to the purity of science. Much of the authority of the scientists stems from these perceptions, and this authority thus depends on the extent to which scientists can persuade the public that these are indeed the norms to which they adhere.

Three important aspects of science generally enhance its status as a source of authority:

- A. Knowledge is considered more convincing when it is universal or global in character, since it is seen as being correct in any time and place.
- B. Knowledge is presented as the outcome of the work and consent of numerous scientists.
- C. Knowledge is considered more reliable when it is presented in numerical form.

These three aspects are manifested today in the way the scientific and environmental communities attempt to influence public opinion regarding the condition of planet earth. In recent years, several reports have been published summarising the consensus of thousands of scientists. The most prominent examples are the study of the Intergovernmental Panel for Climate Change and the work of the Millennium Ecosystems Assessment team.¹³

The Approach of Scientific Control of Nature

One of the most important issues in the relations between scientists and the public relates to scientists' values and to the worldview that shapes their scientific approach. Many environmental historians argue that a substantial proportion of

¹³ Bocking, Stephan. 2006. *Nature's experts: science, politics and the environment*. New Brunswick, New Jersey and London: Rutgers University Press. Miller, Clark A. 2001. "Challenges in the Application of Science to Global Affairs." In *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark A. Miller and Paul N. Edwards. Cambridge, Massachusetts; London, England: The MIT Press.

the environmental problems we now face are the result of the attitude of western culture to both science and nature.¹⁴

The origins of the approach to nature can be found in the Book of Genesis.¹⁵ According to the canonical text of western civilisation, humans received nature from God in order to control it and use it for their own good. Since the seventeenth century, science has played a central role in these relations of exploitation. Thinkers of the scientific revolution such as René Descartes, Francis Bacon, and many others, saw nature as a material, and examined it from a materialistic and reductivistic perspective.¹⁶ Above all, a belief emerged that science can enable humanity to regain the lost Garden of Eden.¹⁷ In other words, science came to enjoy almost unlimited dominion over nature and the environment. This dominion was reflected in the sometimes unbridled exploitation of nature, but also in actions for the management and protection of nature, such as the development of forestry and the management of nature reserves and hunted animals.¹⁸

To this day, the colonialist attitude of science to nature and the belief that almost every problem can be solved through technological innovation remain dominant among the general public and among many scientists from fields other than the environment.¹⁹ The cumulative experience of humanity reinforces this belief: developments in medicine, transportation, industry, and agriculture have secured unprecedented achievements and brought previously unknown comfort to large sections of the world. Over the past few decades an extreme manifestation of human control of nature and the reduction of nature to material can be seen in the

¹⁴ Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press, Merchant, Carolyn. 2003. *Reinventing Eden: The Fate of Nature in Western Culture*. New York and London: Routledge, Merchant, Carolyn. 1995. "Reinventing Eden: Western Culture as a Recovery Narrative." In *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon. New York and London: W.W. Norton & Company, Oelschlaeger, Max. 1991. *The Idea of Wilderness: From Prehistory to the Age of Ecology*. New Haven and London: Yale University Press.

¹⁵ Genesis 1:26-31.

¹⁶ Oelschlaeger, Max. 1991. *The Idea of Wilderness: From Prehistory to the Age of Ecology*. New Haven and London: Yale University Press, Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

¹⁷ Merchant, Carolyn. 2003. *Reinventing Eden: The Fate of Nature in Western Culture*. New York and London: Routledge, Merchant, Carolyn. 1995. "Reinventing Eden: Western Culture as a recovery Narrative." In *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon. New York and London: W.W. Norton & Company.

¹⁸ Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

¹⁹ This approach is also reflected in numerous films and television programmes, as detailed by Julia Corbett: Corbett, Julia B. 2006. *Communicating Nature: How We Create and Understand Environmental Messages*. Washington, Covelo, London: Island Press.

development of genetic engineering in agriculture, including both livestock and crops. Genetic engineering certainly sees living organisms as genetic packages that can be altered and reconstituted; this approach is a contemporary manifestation of the materialistic, reductivistic, and colonialist approach to the environment.²⁰

Ecology as a Subversive Science

Science does not constitute a uniform fabric of conception, methodology and perception. Ecology²¹ presents a completely different voice based on its own perception of nature and of the relationship between humans and natures. Indeed, Donald Worster²² argues that ecology is a subversive science: It disputes the reductivistic approach by regarding nature as a system all of whose components maintain complex mutual affinities, and argues that it is impossible to dismantle each individual component and study it independently.²³ In this respect ecology differs from many other fields of science, and particularly from the precise sciences. According to prevailing ecological perceptions, ecosystems are dynamic. The constant changes in ecosystems are due to changes in environmental conditions and to the responses of living and non-living matter to these changes. Since these systems are complex and chaotic, it is impossible to offer a perfect model or to predict future developments. The best that can be done is to suggest probabilities, and even this is by definition a limited process.²⁴ Moreover, many ecologists continue to attribute to nature an existence that goes beyond “matter in motion,” and view humans as just one of the many species that exist on earth.^{25,26} One of the most prominent examples of this is the Gaia hypothesis developed by James Lovelock, who suggested that these living systems create the conditions for

²⁰ Jasanoff, Sheila. 2005. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton and Oxford: Princeton University Press.

²¹ We include within the discipline of ecology other fields relating to the complete organisms, such as: evolution, systematics, biogeography and, of course, the study of nature reserves.

²² Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

²³ Keller, David R. and Frank R. Golley. 2000. "Introduction: Ecology as a Science of Synthesis." In *The Philosophy of Ecology: From Science to Synthesis*, eds. David R. Keller and Frank R. Golley. Athens and London: The University of Georgia Press.

²⁴ Simberloff, Daniel. 2000. "A Succession of Paradigms in Ecology: Essentialism to Materialism and Probabilism." In *The Philosophy of Ecology: From Science to Synthesis* eds. David R. Keller and Frank R. Golley. Athens and London: The University of Georgia Press.

²⁵ For example, Charles Darwin saw living creatures as our brothers; Henry David Thoreau saw nature as a temple of sanctity, and James Lovelock saw the ecosystem of the entire planet as a single living entity. Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

²⁶ This approach is not universally accepted. Although the ecologist Daniel Simberloff agrees with Worster's historical analysis, he argues that ecology must be materialistic in order to rid itself of the non-scientific cobwebs that have attached themselves to it. *Ibid.*

the existence of life on planet earth. Moreover, this system maintains strong affinities and has a dynamic capacity to reach equilibrium. The Gaia hypothesis effectively offers the metaphor of a living creature for the entire system. Some commentators have seen the Gaia approach as a connection between the scientific ecological approach and a broader philosophical and ethical perception of nature. As a result the Gaia hypothesis has been the subject of considerable criticism and continues to be considered controversial.

Scientific achievements often come at a heavy price to ecosystems. It is true that in many parts of the world the hunger crisis has been resolved thanks to the green revolution, which has enabled a dramatic increase in food production around the globe through the use of fertilisers, pesticides and the betterment of species. However, the use of vast tracts of land for the growing of standardised crops has wrought a heavy price from ecosystems: The conversion of undisturbed areas into agricultural fields; the pollution of over-exploitation of water sources; desertification and soil erosion; pollution of the sea and coasts due to pollutants carried in rivers, and so forth. As a science that investigates ecosystems, ecology has assumed the role of serving as a scientific lighthouse that identifies the impacts of technological and scientific development on the natural systems on earth and warns of existing and anticipated threats. This function also includes the role of the “ethical critic” regarding certain scientific achievements.

Factors in the Erosion of Scientific Authority

The numerous factors that have challenged scientific authority may be divided into two main categories. The first category derives from the inherent characteristics of science – partial knowledge, lack of agreement and uncertainty. The second derives from the characteristics of the relationship between science and society: the cultural structuring of science, the recruitment of science for political needs, and the alignment of scientists with interests of power and resources.

The result of this damage to scientific authority is that the positions presented by scientists are often subject to criticism that assumes that they may have extraneous interests. Such criticism poses numerous questions: Are particular scientists capable? Do they have the proper educational background? Can they ask the right questions? Are there any uncertainties? Has this information been coloured by extraneous economic or political interests? Is science being used legitimately or is its use intended to justify decisions taken on the basis of other considerations? Has peer review been implemented properly?

Such criticism is not confined to a specific scientific question, but has also been levelled at the management of science from a broader perspective: the formulation of policy for scientific development, the method of management of scientific research institutions and the ways in which resources are secured for research.²⁷

Incomplete Knowledge, Lack of Agreement and Uncertainty

“We would like you to enhance the certainty for us to some extent – not the uncertainty. We have very difficult feelings about living with uncertainty.”²⁸

In many environmental fields, from the impact of cellular radiation to the prediction of climate change, scientists are unable to offer clear, simple and future scenarios for the future. Ecology, earth sciences, atmospheric sciences, oceanography and the environmental health sciences all focus on complex systems

²⁷ Edwards, Paul N. and Stephan H. Schneider. 2001. "Self-governance and peer review in science-for-policy: the case of the IPCC second assessment report." In *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark Miller and Paul N. Edwards. Cambridge: MIT press.

²⁸ Chairperson MK Ophir Pines-Paz to Dr. Itai Gavrieli, a scientist from the Geological Institute, at a session of the Knesset Internal Affairs and Environment Committee (17th Knesset, Second Session, Protocol 217, Knesset Internal Affairs and Environment Committee, 2007, “The Erosion of the Dead Sea.”)

with multiple variables; accordingly, prediction in these fields can only be on the level of models and probabilities.²⁹

A further difficulty facing scientific authority derives from the lack of knowledge that faces the environmental sciences. In a world in which we know all living organisms, phenomena and processes, it is nevertheless difficult to offer any answer, let alone any single answer, to questions of management and policy. The result is that it is now globally accepted that the ability of science to understand the world around us is significantly limited.³⁰

The complexity of ecosystems, the unexpected nature of human actions and the sporadic and highly uneven distribution of scientific research create substantial voids in knowledge. At the same time, scientists are called on to answer increasingly complex questions. The most prominent example of this is the impact of greenhouse gasses on the global climate. More modest and localised examples can also be cited, however, such as the impact of climate change on natural ecosystems in Israel, or the impact of the proposed canal from the Red Sea to the Dead Sea on these two bodies of water and the Arava Valley that lies between them. Such questions relate to numerous dimensions of uncertainty and cover large geographical expanses; it is impossible to provide a single answer. Awareness of the limitations of knowledge and of predictive capabilities has led to a consensus among the leading environmental bodies in the world that a precautionary approach should be the guiding principle in formulating policy.³¹ However, decision makers from fields other than the environmental sciences still tend to seek an "objective" foundation for their decisions and demand that scientists supply the goods.³² The inability to provide an absolute answer to

²⁹ Bradshaw, G. A. and Jeffery G. Borchers. 2000. "Uncertainty as Information: Narrowing the Science-Policy gap." *Conservation Ecology* 4(1), Simberloff, Daniel. 2000. "A Succession of Paradigms in Ecology: Essentialism to Materialism and Probabilism." In *The Philosophy of Ecology: From Science to Synthesis* eds. David R. Keller and Frank R. Golley. Athens and London: The University of Georgia Press.

³⁰ Heinz Center for Science Economics and the Environment. 2002. "The State of the Nation's Ecosystems: Measuring the Lands, Waters, and Living Resources of the United States." ed. William C. Clark (Study Chair). Cambridge, UK.

³¹ European Commission. 2000. "Communication from the Commission on the Precautionary Principle." Brussels. One specific example of this is the attempt by scientists to cope with uncertainty when providing consultation for fishing management: Harwood, John and Kevin Stokes. 2003. "Coping with Uncertainty in Ecological Advice: Lessons from Fisheries." *Trends in Ecology & Evolution* 18(12):617-622. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST). 2005. "The Precautionary Principle." United Nations Educational, Scientific and Cultural Organization.

³² This approach is illustrated by the exchange between MK Ophir Pines-Paz and Dr. Itail Gavrieli from the Geological Institute at the Knesset Internal Affairs and Environment Committee, see note 28 above.

environmental questions challenges the status of science since it contradicts the prevailing perception that science offers a single, true description of the world.³³

Many scientific discussions reveal a lack of agreement among scientists regarding the facts and/or the manner in which facts are to be interpreted. In many cases the lack of agreement between scientists is perceived as reflecting a lack of professionalism or the presence of extraneous interests on the part of one or more of those involved – despite the fact that such disagreements are actually due, in many cases, to different disciplinary approaches or to alternative analyses and assessments of the same data.³⁴

Contrary to public expectations of science, the attitude of members of the scientific community to scientific culture takes a lenient view of many phenomena. Uncertainty is perceived as an essential reality given the infinite character of scientific research (an illustration of this is the closing line of many studies – “further research is required”). Unclear results are explained through interpretation, while the lack of agreement is seen as part of the process of building paradigms. Disagreement is often the product of different disciplinary approaches and, accordingly, is perceived as legitimate.³⁵ The result is that the gap between public expectations of science and what scientists are able to provide creates one of the main impediments to the consolidation of scientific authority. Uncertainty is perceived as inability; interpretation is seen as no more than an opinion; and disagreement is taken as evidence of the unreliability of science. The sight of scientists arguing as to which are the correct data, or analysing the same data in contradictory manners, violates the assumption of their objectivity. Disagreement is exploited by both sides in environmental arguments. Several cases are known in which large companies, such as DuPont, the coalition of oil companies, the motor industry and the tobacco industry, have worked together with their public relations agencies in order to create “scientific uncertainty” as part of their strategy for weakening their opponents’ stance.³⁶

Scientific Knowledge and Local Knowledge

Like the parents of a sick child in their contacts with the physician, the public judges the research actions of scientists and the positions and insights they present

³³ Bradshaw, G. A. and Jeffery G. Borchers. 2000. "Uncertainty as Information: Narrowing the Science-Policy Gap." *Conservation Ecology* 4(1).

³⁴ Ibid.

³⁵ Ibid.

³⁶ Corbett, Julia B. 2006. *Communicating Nature: How We Create and Understand Environmental Messages*. Washington, Covelo, London: Island Press.

on the basis of their local and/or individual knowledge. Just as parents – lacking medical education but with a profound knowledge of the subject – often identify unusual symptoms more successfully than the physician, so residents in a particular area, employees in a factory or farmers may all note subtle factors that cannot be identified by a stranger, even if the stranger is a scientist. Brian Wynne³⁷ argues that in these and other cases, the public judges science according to the following criteria:

- Does the scientific knowledge *work*?
For example: predictions fail.
- Do scientific *claims* pay attention to other available knowledge?
For example: do scientists pay attention to farmers' knowledge?
- Does scientific *practice* pay attention to other available knowledge?
For example: when scientists devise and conduct field experiments, do they consult with others who are familiar with the area?
- Is the science clear and recognizable?
For example: is the science expressed in familiar terms or in professional scientific language, so that it is impossible to address or absorb the scientific knowledge?
- Are scientists open to criticism?
For example: are they willing to accept experts who do not form part of the scientific community? Do they admit errors in their research methods, analysis and conclusions?
- What are the social/institutional affiliations of scientists?
For example: do they have extraneous political, economic or other interests? Does the organisation to which they belong have a reputation for reliability and scientific standing?
- What issue "overspill" exists in lay experience?
For example: Mistakes in the use of hazardous materials such as asbestos or DDT influence judgement in other cases involving the use of hazardous materials.

The public sometimes gains the impression that while scientists may hold academic degrees and have extensive theoretical knowledge, when they are asked to apply this knowledge to a specific and localised point they lack local knowledge and are in an inferior position to that of local residents.

³⁷ Wynne, B. 1992. "Misunderstood Misunderstanding: Social Identities and Public Uptake of Science." *Public Understanding of Science* 1(3):281-304.

Unclear Boundaries between Science and Politics

No-one questions that science is a key component in environmental issues; its function in this context, however, is accompanied by tensions and contradictions. Authoritative scientific knowledge, expressed in quantitative terms and created through a process of impartial and unbiased research, can be highly persuasive since it represents everything that politics is not. As a result, both scientists and politicians work hard to create a clear boundary between what is scientific and what is not. Conversely, there are those who argue that it is impossible to define the boundaries between objectivity and subjectivity, and that all science is structured in accordance with sociocultural values.³⁸

This duality – scientific authority on the one hand, and criticism of this authority on the other – is manifested on the playing field of environmental politics. The sources of scientific authority, the ability of science to provide theoretical and practical information about the world, and the prestige enjoyed by a conceptual approach that promises to examine reality in a critical yet objective manner, are all co-opted by various bodies – government, environmental, commercial and media – which nurture this authority for their own purposes. In many cases an attempt is made to find the solutions for complex environmental issues in scientific opinions, while evading other aspects of these issues.

The relations between experts and the public become more complex when the decision to turn to experts reflects a desire to substantiate a given political position. Activists involved in the campaign to conserve the “Deer Valley” green area in Jerusalem contacted Prof. Yoram Yom-Tov, a zoologist at Tel Aviv University, and asked him to provide an opinion that would strengthen their campaign by providing scientific arguments. Prof. Yom-Tov’s opinion was that the conservation of a flock of deer within the inner area of Jerusalem is meaningless in ecological terms and does not contribute to preserving biodiversity in Israel. The activists rejected this opinion.³⁹ A further example from the Israeli context: From the mid-1980s through the mid-1990s, a campaign was waged to prevent the establishment of a Voice of America transmitter in the Arava. The campaign was led by the Society for the Protection of Nature in Israel, which claimed that the transmitter would damage animals, the landscape and human

³⁸ Jasanoff, Sheila. 1990. *The Fifth Branch: Science Advisers as Policymakers*. Cambridge, Massachusetts London, England: Harvard University Press, Jasanoff, Sheila ed. 2004. *States of Knowledge: The Co-production of Science and Order*: Routledge.; Miller, Clark A. and Paul N. Edwards. 2001. "Introduction." In *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark A. Miller and Paul N. Edwards. Cambridge, Massachusetts, London, England: The MIT Press.

³⁹ Prof. Yoram Yom-Tov, Tel Aviv University, oral comments; Amir Balaban, Society for the Protection of Nature in Israel, oral comments.

health. As part of the campaign, Prof. Berry Pinshow of Ben Gurion University of the Negev was asked to examine the ramifications in terms of the population of fowl in the Negev. His study showed that the damage would be relatively negligible, a finding that was rejected by the Society for the Protection of Nature in Israel.⁴⁰

The need to reach decisions on environmental issues creates an opportunity for outside bodies, economic interests, political considerations, and ideology to attempt to influence scientific judgements. This is particularly evident during conflicts in which science can influence political and economic aspects. During the campaign to remove marine agriculture from the Gulf of Eilat, Israel Oceanographic and Limnological Research (the government company for oceanographic and limnological research) supported the position that the fish cages should remain in the sea. The Israel Union for Environmental Defense claimed that the position of the government body was influenced by the royalties it receives from the development of technologies for raising fish in cages. The IUED petitioned the Israeli Supreme Court⁴¹ against Israel Oceanographic and Limnological Research and other governmental bodies, claiming a conflict of interests and demanding that the governmental company's opinion be ignored. The awareness of such affinities, particularly when these are manifested in relations between industry and scientific research, blurs the boundaries between science and politics and hence impairs the status of scientists as objective experts.

The Cultural Structuring of Science

When environmental issues create an arena for confrontation between distinct and opposing world views, the description of reality offered by scientists themselves is also often attacked.⁴² In the debate over the future of the Dead Sea, the Friends of the Earth – Middle East (hereinafter – Friends of the Earth) and others have argued that water can again be permitted to flow into the River Jordan, thus rehabilitating both the river itself and the Dead Sea. This argument is based on the assumption that it will be possible to secure a substantial reduction in water consumption in Israel, particularly by cuts in agriculture. Indeed, Friends of the Earth argues that agriculture has been sanctified in Israel and that its presence is axiomatic and a product of Zionist settlement aspirations. The organisation views this as an ideological position that is incompatible with the realities of the twenty-

⁴⁰ Tal, Alon. 2002. *Pollution in a Promised land: An Environmental History of Israel*. Berkeley Los Angeles London University of California Press.

⁴¹ HCJ 7209/04 IUED]

⁴² Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

first century and the environmental position that the organisation itself advocates. This position on the part of Friends of the Earth was presented in response to the assessment by scientists that given the prevailing geopolitical realities in the region, it is unrealistic to renew the flow of water through River Jordan to the Dead Sea. In other words, Friends of the Earth reject that scientists' assessment on the grounds that it stems not from scientific truth but from a value-based and political ideology – the Zionist idolisation of agriculture and settlement.⁴³

Sheila Jasanoff argues that it is impossible to examine perceptions in democratic theory without also examining the culture and politics of science and the ways in which knowledge is created and used.⁴⁴ According to this approach, society and science maintain mutual affinities and influences that combine to create a new civil and political order. The challenge to use scientific information in a manner that does not thwart democracy, or even in a manner that empowers democracy, forms the focus of the understanding of the role of science in environmental politics. The demand to see scientific knowledge less as the objective representation of reality and more as the product of the cultural, economic and political context in which the scientific researcher operates thus aspires to a new type of dialogue between science and policy.⁴⁵

The Protest against the Values of Western Society

The environmental movement effectively serves as a voice for public protest against the negative ramifications of human development. The publication of Rachel Carson's *Silent Spring*⁴⁶ was one of the formative events in the process of challenging scientific authority and the sanctification of technological development. Carson, an ecologist who was employed for many years by the US Fish and Wildlife Service, wrote a book that presents a manifesto of protest against the levity with which humans change nature. The book created a tremendous wave of awareness of the heavy price the environment pays for scientific and technological development in industry, agriculture and afforestation. Carson was not the only scientist, and certainly not the only ecologist, who led the

⁴³ Gideon Bromberg, Israeli Director, Friends of the Earth – Middle East, oral comments.

⁴⁴ Sheila Jasanoff, Harvard University, oral comments. See also: Jasanoff, Sheila. 2005. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton and Oxford: Princeton University Press.

⁴⁵ Oral comments by Sheila Jasanoff who has led this direction. Jasanoff, Sheila ed. 2004. *States of Knowledge: The Co-production of Science and Order*: Routledge ; Miller, Clark A. and Paul N. Edwards. 2001. "Introduction." In *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark A. Miller and Paul N. Edwards. Cambridge, Massachusetts, London, England: The MIT Press.

⁴⁶ Carson, Rachel. 1962. *Silent Spring*. 1st edition: Houghton Mifflin Company.

protest movement against science-based economic and technological development. Other key figures included Henry David Thoreau, John Muir, Aldo Leopold, Jared Diamond, E.O. Wilson, Robert May.⁴⁷

In Israel, the draining of the Hula swamp is one of the examples of case where ecologists challenged the status of scientific and technological experts. The draining of the swamp was a tremendous endeavour in engineering terms, but Heinrich Mendelson and Amotz Zehavi, scientists from Tel Aviv University, led the opposition to the draining of the swamp and challenged prevailing social, political and scientific consensus concerning the “conquest of the wilderness.” In later years ecologists provided scientific support for the opposition to plans to increase the number of villages and towns in Israel,⁴⁸ a position that was extremely unpopular with the political echelons.

In Israel, as in other countries, the ethos of environmental organisations generally differs from that of nature conservation organisations. Nature conservation organisations have a history of nature studies and are supported both by nature preservation scientists and by nature enthusiasts. By contrast, environmental organisations emerged since the 1960s and have adopted a more critical view of western society and the culture of science and technology. The differences in the ethos of these two types of organisations also shape their approach to science and scientific authority.⁴⁹ While much of the environmental movement is organised in non-governmental bodies, nature conservation organisations in most countries are linked in one way or another with governmental organisations and bodies. Nature reserves, forests, hunting reserves, and the enactment and enforcement of nature conservation laws are all governmental matters; accordingly, nature conservation organisations work in tandem with the authorities. By contrast, the environmental movement includes more activists who come from a social, economic and legal background and is less involved in work with the authorities. As a result, this movement has acquired a more subversive and political character than the nature conservation organisations.

⁴⁷ Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

⁴⁸ An example is their opposition to the establishment of the community Michal: Klein-Zehavi, Nivi, 2004. “Background Document for Discussion: Establishment of the Community ‘Michal’ in the Gilboa – Positions of the Relevant Bodies.” Submitted to the Knesset Internal Affairs and Environment Committee. The Knesset: Research and Information Centre. Prof. Tamar Dayan, Prof. Yoram Tov-Lev, Tel Aviv University, oral comments.

⁴⁹ Yearley, Steven. 1996. "Nature's Advocates: Putting Science to Work in Environmental Organizations." In *Misunderstanding Science? - The Public Reconstruction of Science and Technology*, eds. Alan Irwin and Brian Wynne. Cambridge: Cambridge University Press.

The Function of Science in Decisions on Environmental Issues

Assuming for the moment that we accept the authority and reliability of science, is science really needed in decision-making processes on environmental issues? What place does science occupy in the priorities of the decision-making process? On the one hand, knowledge is obviously vital: we need to be familiar with the environment and with our impact on the environment if we seek to protect it. Does science really enjoy the authority claimed by some scientists, however? Does discussion of the impact of a road on the ecosystem take precedence over the economic and social factors that motivate the paving of the road, and is it more important than these? Does the impact of desalination plants on the sea come first when making decisions relating to the country's water needs? Above all, is the decision-making process a linear one, requiring agreement on the background and the scientific ramifications before moving on to discussion of the environmental issue from other standpoints (economic, social, etc.)?

In the series of interviews we conducted, we heard clear echoes of two voices, that which sees science as objective authority and that which sees it as no more than a tool in the hands of political forces. Most of the interviewees who are not scientists, and who by virtue of their activities have a political background, felt that the scientists are not and cannot be objective. Conversely, many scientists adhered passionately to their belief in their scientific integrity and their disregard for extraneous considerations, and particularly political ones. However, not a single respondent felt that scientists form part of the total range of forces that contribute to creating sociopolitical reality.⁵⁰

Among sociologists and political scientists a consensus appears to be emerging regarding the complex nature of decision-making processes on issues that include a scientific foundation. An examination of decision-making processes in the environmental sphere reflect three sources for the considerations applied: science, values and interests. Many commentators argue that these three sources are not separate and that, in reality, it is extremely difficult to draw the boundaries between them. Instead, they recommend that scientific knowledge should be integrated in policy decisions, while recognising the uncertainty, incomplete

⁵⁰ Dave D. White also analysed the discourse between scientists and the public and found similar patterns in the case of policy relating to the rehabilitation of salmon. White, Dave D. 2002. "A Discourse Analysis of Stakeholders' Understanding of Science in Salmon Recovery Policy." In *Forestry: Virginia Polytechnic Institute & State University* .

knowledge and value-based bias of this knowledge and while addressing the political character of science.⁵¹

If science is not only a source of objective facts, how can it play an appropriate role in addressing environmental problems?

The Role of Scientists in Decision-Making Processes

How, then, can science contribute to environmental decisions? Bocking⁵² identifies several key functions scientists can fill in the decision-making process:

- **Identifying and forecasting the environmental problem.** Many environmental problems were first identified by scientists. One of the most prominent examples of this, of course, is the identification of rising carbon levels in the atmosphere and the forecasts of the climactic changes that would ensue.⁵³ Several examples can also be quoted in the Israeli context, particularly the destruction of the coral reef in the Gulf of Eilat.⁵⁴ It is important, however, to be alert to the possibility that scientists undertaking basic and applied research may be unaware of the environmental ramifications of their discoveries, or may fail to share their findings with stakeholders.
- **Providing guidelines for action.** In some cases the scientific foundation of the environmental problem is so evident that immediate action can be taken to solve the problem. Examples of this pattern abound: the water shortage and the recommendation to encourage desalination and savings in water consumption; stream pollution and the recommendation to stop releasing pollutants into streams; the reduction of open areas and the recommendation to prefer dense construction patterns, etc.
- **Development of the theoretical background.** Much scientific research cannot be applied to the solution of concrete environmental problems, but permits the development of broad environmental understanding. For example, research into the biogeography of islands and the development of an understanding of the affinity between the size of an area and the number

⁵¹ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press, Jasanoff, Sheila ed. 2004. *States of Knowledge: The Co-production of Science and Order*: Routledge..

⁵² Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

⁵³ Scripps Institution of Oceanography - University of California - San Diego. "The Keeling Curve Turns 50".

⁵⁴ Loya, Yossi. 2007. "How to Influence Environmental Decision Makers? The Case of Eilat (Red Sea) Coral Reefs." *Journal of Experimental Marine Biology and Ecology* 344:35-53.

of species it contains⁵⁵ contributed more than any other factor to an understanding of the consequences of the reduction of habitats in terms of biodiversity. This realisation provided the scientific foundation for the struggle against the destruction and dissection of habitats.

- **Defining issues and raising awareness.** In some cases science helps define environmental problems, raise awareness of issues and create the momentum for action. The classic example, of course, is Rachel Carson and the growing awareness of the damage caused by pesticides.⁵⁶ A prominent example at present is the problem of invasive species. Although many of these species are popular with the public, scientists have warned of the damage they cause and recommend action to combat such species.
- **Supporting management.** Many studies were undertaken with the a priori objective of providing a foundation for management decisions. A prominent example is the activity of the Nature Conservancy, all of whose nature conservation operations are based on research.⁵⁷ In Israel, bodies such as the Jewish National Fund, the Nature and Parks Authority, the Ministry of the Environment, and the Ministry of Energy and Infrastructures approach research bodies and issue requests for studies on the management issues they consider. Some of the bodies and organisations engage in independent research on issues of relevance to their field of operations.
- **Auditing management.** Some applied studies relating to management are intended not to support management but to audit work in the field. An example is a study by Yael Mandelik, Tamar Dayan and Eran Feitelson on the subject of ecological impact assessment. The study examined the research methods and level of efficiency of these assessments.⁵⁸
- **Producing supporting grounds in environmental disputes.** In many environmental disputes unequivocal scientific grounds are needed in order to justify decisions. This is usually a difficult objective to meet for the reasons examined in this document – uncertainty, lack of agreement, multiple interpretations and so forth.
- **Preserving expertise.** The implementation of basic research alongside applied research facilitates the preservation of a high-level research capability

⁵⁵ MacArthur, Robert H. and Edward O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton, New Jersey: Princeton University Press.

⁵⁶ Carson, Rachel. 1962. *Silent Spring*. 1st edition: Houghton Mifflin Company.

⁵⁷ The Nature Conservancy. "Conservation by Design."

⁵⁸ Mandelik, Yael, Tamar Dayan and Eran Feitelson. 2005b. "Planning for Biodiversity: The Role of Ecological Impact Assessment." *Conservation Biology* 19(4):1254-1261; .Mandelik, Yael, Tamar Dayan and Eran Feitelson. 2005a. "Issues and Dilemmas in Ecological Scoping: Scientific, Procedural and Economic Perspectives." *Impact Assessment and Project Appraisal* 23(1):55-63.

and membership of the scientific community. This fact is self-evident in the case of universities. In Israel, the academic freedom enjoyed by members of government research institutes is substantially greater than that enjoyed by their colleagues in American research institutes. Accordingly, Israeli scientists and governmental research institutes manage to compete successfully within the scientific community in Israel and abroad.

- **Community building.** Environmental research can build communities around common interests that go beyond the subject of research. Civil science projects create communities that involve scientists and local residents who work together to promote science and the environment. Another type of example is the creation of regional partnerships and scientific communities.

Science and scientists can contribute to shaping policy at different stages of the process and in different ways in each process. In some cases the contribution made by science is embodied in the knowledge scientists create, while in others the important factor is the actual process of creating the knowledge. In some stages of addressing an environmental problem basic research plays a central role – for example, in the early stages of identifying the problem. In other stages applied research is more important, as for example when formulating management policy. In still other stages, the central aspect is the existence of a community and a network of experts enabling the flow of information and the maintenance of discourse between different partners.

In this context, it is important to reiterate Sheila Jasanoff's position. Jasanoff argues that the involvement of science in policy making does not come through a linear process of sequential stages: scientists discover facts, reach agreement, and on the basis of this agreement the decision makers determine new policy through a rational and controlled process. Rather, she suggests, policy creation is a coproduction based on the development of scientific research and policy making combined.

The Scope of Action of Scientists in Environmental Discourse

The Ecological Society of America, the Society for Conservation Biology and other scientific forums engage in lively debate regarding the function of scientists in environmental discourse and the boundaries to be demarcated between science

and policy.⁵⁹ In the space between politics and pure science, Roger A. Pielke⁶⁰ distinguishes four types of involvement by scientists:

- “Pure scientists” – these scientists generally focus on basic research and are remote from political processes. They provide decision makers with the theoretical background of science without any applied information.
- “Science arbiters” – these scientists aspire to remain distant from politics, but are aware of the need of decision makers for scientific information. Accordingly, they respond to their questions and provide them with specific information when requested.
- “Issue advocates” – these scientists concentrate on the ramifications of specific scientific knowledge in terms of the political agenda, and through the information they provide they direct decision makers to particular choices.
- “Honest brokers” provide decision makers with information about the possibilities open to them and the ramifications of each one, but do not express a personal position.

According to Pielke, neither “pure scientists” nor “science arbiters” relate to a specific decision. Rather, they function as a resource for policy shapers and decision makers. Despite this, they sometimes become “surreptitious issue advocates,” whether unknowingly or deliberately. Conversely, issue advocates and honest brokers provide the scientific basis for a concrete problem. The difference between them lies in the level of personal involvement in the desirable decision. While the issue advocate seeks to promote a particular course of action and attempts to limit the range of options available to decision makers, honest brokers present decision makers with the entire range of possible alternatives in an equal and unbiased manner, and leave the selection from among these alternatives to the decision maker. These four models are merely schematic. In reality there are many

⁵⁹ For example, at the 2006 annual meeting of the Society for Conservation Biology a discussion took place on the subject of the level of political involvement of scientists engaged in the study of nature reserves:

Advocacy in Conservation Science. Organized by J. Michael Scott (University of Idaho), Janet Rachlow (University of Idaho), and Robert Lackey (U.S. Environmental Protection Agency). Wednesday 28 June, 2006.

Two issues of the scientific journal of the Society for Conservation Biology – *Conservation Biology* – included a number of articles discussing the subject of science and involvement in nature reserves: Issue 10(3) from 1996 and issue 21(1) from 2007. In both cases the editors of the journal took the time to include prefaces emphasising the importance of discussion of these aspects:

Meffe, Gary K. 2007. "Conservation Focus: Policy Advocacy and Conservation Science." *Conservation Biology* 21(1):11-11, Noss, Reed F. 1996. "Conservation Biology, Values and Advocacy." *Conservation Biology* 10(3):904-904.

⁶⁰ Pielke, Roger A. 2007. *The Honest Broker: Making Sense of Science in Policy and Politics*: Cambridge University Press.

areas in which there are not diverse data or interpretations; accordingly, it is unclear whether it would be possible to be a pure scientist or a science arbiter in these cases.

Two key factors may influence the way in which scientists participate in environmental discourse. The first is the level of value-based consensus, and the second is the extent of scientific and political uncertainty.⁶¹ In keeping with Pielke's findings,⁶² the interviews we conducted also revealed a very low level of awareness regarding these factors. In most cases the scientists decided about their model of functioning through a blanket decision relating to all environmental discussions. Among the activist scientists, some adopted a value-based position and functioned as issue advocates while others argued that their scope of action was limited by scientific ethics solely to their field of expertise; regardless of the issue, they regard themselves as functioning as honest brokers. Moreover, in Israel there has not been, and there still is not, any discussion regarding the nature of the involvement of scientists in decision making processes. The questions addressed by the American scientific societies do not form part of scientific and environmental discourse in Israel.

Ecological Activists

One of the most prominent features of ecological research and the development of the ecological approach is that since their origins in the nineteenth century they have been accompanied by nature conservation action. In other words, ecologists have not engaged in science alone, but have immediately drawn conclusions from science in terms of political action motivated by value-based perceptions.⁶³ A very long list of ecologists have attempted to influence the way the public perceives nature and decision making processes. Prominent examples include John Muir, Aldo Leopold, Arthur Tansley, Barry Commoner, Rachel Carson, Eugene & Howard Odum, E.O. Wilson, Paul Ehrlich and many others. It is unclear what influence these ecologists have had on scientists active in Israel,⁶⁴ but in the Israeli

⁶¹ Ibid.

⁶² Ibid.

⁶³ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press, Oelschlaeger, Max. 1991. *The Idea of Wilderness: From Prehistory to the Age of Ecology*. New Haven and London: Yale University Press, Takacs, David. 1996. *The Idea of Biodiversity: Philosophies of Paradise*. Baltimore & London: The Johns Hopkins University Press, Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

⁶⁴ Danny Rabinowitz notes resistance among the founders of the field of nature conservation in Israel to influence from nature conservation approaches from outside Israel, and particularly from the United States: Rabinowitz, Danny. 1989. "Zionism or the Genesis Land: Requiem for David's Cliffs." *Sevivot* 23:195-215.

context, too, key figures from the field of research and conservation biology may be mentioned, such as Heinrich Mendelson and Amotz Zehavi, who raised many generations of conservation biology scientists.

It is often argued that ecology provided the foundation for the emergence of environmental values. A more detailed examination of the history of ecology suggests that the relations between ecology and environmental values are actually complex. Ecology developed simultaneously from a number of fields – the study of plant societies, the study of animal societies, and the study of the ecology of lakes. Each of these research areas maintained its independence throughout the twentieth century.⁶⁵ The organisations within which the different branches of ecology developed – governmental authorities, nature conservation organisations or academic research institutions – and the context in which they developed (whether this was basic science, agricultural research or research into hunting management) were highly diverse and had a completely different character in terms of values. Despite this, similar insights emerged in each of these fields in terms of the systemic, complex, mutual and uncertain nature of ecosystems.⁶⁶

From its inception ecology was characterised by disagreement concerning the desirable level of involvement of ecologists in nature conservation activities. In 1946 this disagreement led a group of scientists to resign from the Ecological Society of America (ESA); in 1950 they founded Nature Conservancy. Almost six decades later, Nature Conservancy argues that its achievements as the largest and most successful nature conservation organisation in the world are due to the scientific foundation created by the work of 720 scientists it employs.⁶⁷ Simultaneously, leading British scientists, including Arthur Tansley, worked to establish a network of nature reserves. The organisation they established, also called Nature Conservancy, sought to manage the reserves and to engage in supporting research.⁶⁸

From the mid-1980s, ecologists began to define a new field in science – conservation biology. This field seeks to address the mutual affinities between

⁶⁵ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

⁶⁶ Keller, David R. and Frank R. Golley. 2000. "Introduction: Ecology as a Science of Synthesis." In *The Philosophy of Ecology: From Science to Synthesis*, eds. David R. Keller and Frank R. Golley. Athens and London: The University of Georgia Press, Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. 2nd Edition: Cambridge University Press.

⁶⁷ The Nature Conservancy, "About Us."

⁶⁸ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

humans and nature. The field combines social, economic, policy and legal aspects with scientific discussion of issues relating to nature conservation. The journal *Conservation Biology* maintains lively discourse regarding the extent to which scientists should be involved in nature conservation issues. Barry & Oelschlaeger⁶⁹ argue that the field of conservation biology cannot be value-neutral or objective, since it is a field of research characterised as a mission-oriented, crisis discipline.⁷⁰ This character distinguishes it from other fields of biological research.

In addition to creating the new scientific discipline of conservation biology, ecologists also decided to take another unusual step: to rebrand nature. In 1986 they convened a national forum in the US to discuss the crisis facing nature.⁷¹ In order to change perceptions among the public, decision makers and scientists, they began to market nature under the brand *biodiversity* and to speak of the biodiversity crisis. David Takacs has studied the process by which this brand was created. He argues that “through the public campaign for what they refer to as *biodiversity*, conservation biologists are attempting to redefine the boundaries of science, politics, ethics, religion and nature and our perceptions of these fields. They believe that humanity and other organisms with whom we share life on earth are threatened by an unprecedented ecological crisis whose roots lie in a covert ethical crisis. *Biodiversity* is the protest cry of biologists in order to attract attention to the crisis, to include the full range of biological organisms and processes, and to serve as hosts for the values attributed to the natural world. A select group of scientists seeks to create a new ethic that respects, admires and, perhaps, even worships the value-based variance of biodiversity.”⁷²

Science in the Service of the State

Environmental research takes place not only in academic research institutes but also in government and local authority research institutions. In addition, various governmental authorities monitor and control different environmental factors. The establishment of ministerial authorities and divisions led to the transformation of scientific knowledge into professional fields of specialisation.

⁶⁹ Barry, Dwight and Max Oelschlaeger. 1996. "A Science for Survival: Values and Conservation Biology." *Conservation Biology* 10(3):905-911.

⁷⁰ "Conservation biology is in part distinguished from other conservation sciences by its character as a mission-oriented, crisis discipline." *Ibid.*.

⁷¹ The conference was entitled National Forum on BioDiversity and took place on 21-24 September 1986 in Washington DC under the auspices of the Smithsonian Institution and the National Academy of Sciences. The forum was attended by 14,000 people.

⁷² Takacs, David. 1996. *The Idea of Biodiversity: Philosophies of Paradise*. Baltimore & London: The Johns Hopkins University Press.

This process also led to the transfer of professional and scientific authority both to the group of experts and to the relevant ministry. This was the approach taken by the American professional authorities over the course of the twentieth century⁷³ with regard to all aspects of nature conservation: Environmental protection, forestry, nature conservation, protection of biodiversity, earth sciences, atmosphere science and oceanography, agriculture, and so forth.

In Israel the process took place at a later stage and in a much less structured manner. Two governmental research institutions currently function – the Agricultural Research Authority and the Geological Institute – as well as two government companies – the Geophysical Institute and Israel Oceanographic and Limnological Research. Alongside their work in applied research relating to Israel, these four research bodies also engage in applied research outside Israel, as well as in basic research. Unlike the situation in terms of agricultural research and research in the earth sciences, the study of biodiversity has remained the almost exclusive preserve of the academic research institutions. The field of nature conservation was transferred to what is now called the Nature and Parks Authority, but the Science Division in that authority does not engage in basic research at all, and the scope of its applied research activities does not compare in scope or scale with that of the other areas addressed by the governmental research institutes and companies. Other environmental issues that relate more closely to monitoring and control are addressed by the various government ministries, such as the Sea and Beaches Division in the Ministry of the Environment, the Environmental Health Department in the Ministry of Health or the Hydrological Service, a sub-division of the Water and Sewage Authority in the Ministry of National Infrastructures.

In the United States, the professional authority of governmental bodies became a favourite target of environmental organisations from the 1960s on. It was asked why scientists from the fields of agriculture and chemistry should make decisions about pesticide policy. Why should the Atomic Energy Committee be the sole body empowered to make decisions relating to nuclear energy? As a result, a dominant theme in the work of the environmental organisations is to transfer the focus of decision making from professional forums to public forums.

Echoes of this approach can also be identified in Israel, for instance during the debate on the fluoridisation of water. In an argument between Shimon Tzuk, who formerly served as the water scientist in the IUED, and Eitan Gavron, the

⁷³ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

national desalination engineer in the Ministry of Health, Tzuk argued against fluoridisation. In order to transfer the debate into the public arena, the IUED petitioned the Supreme Court. The petition was rejected and the activities then shifted to the media and public arena. Several discussions were held by Knesset committees.⁷⁴ However, one of the remarkable – if predictable⁷⁵ - phenomena is that both sides in the dispute sought to preserve the status and authority of science, and both based their arguments on scientific sources, majority opinions and peer review.

The presence of professional knowledge within governmental bodies enables decision makers to argue that their decisions are based on professional knowledge rather than on values or interests.⁷⁶ However, both our own interviews and a British study⁷⁷ found that the public is sceptical as to the scientific objectivity of the staff of governmental institutions relative to the scientific authority of academics.

Civil Society's Perception of Environmental Science

As far as the public is concerned, the natural and conceivable goal of science is the monitoring, control and forecasting of nature and the environment. The perception of scientists is that science cannot provide all these facets. Is it possible to bridge this gap?

Over the past twenty years there has been a dramatic rise in public awareness of environmental issues. In Israel, which has to date lagged behind most western countries in this respect, the turning point seems to have come with the publication of the IPCC report, the screening of the film *An Inconvenient Truth* and the awarding of a Nobel Prize to the IPCC team and Al Gore. Although this rising awareness has not yet been translated into political power and has not been reflected in the state budget, the environment is becoming increasingly prominent in the mass media. These changes are the result of two processes: Firstly, the

⁷⁴ Tzuk, Shimon. 2007. "Fluoride in Water? No Need." *Water Engineering* (50) (in Hebrew); Gavron, Eitan. 2007. "Fluoride in Water – Essential for the Dental Health of Israeli Citizens." *Water Engineering* (51) (in Hebrew).

⁷⁵ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

⁷⁶ Dr. Yeshayahu Bar Or, the chief scientist of the Ministry of the Environment, oral comments; Dr. Miriam Hern, head of the Environmental Management track at Ono Academic Campus, oral comments; Dr. Benny Begin, director of the Geological Institute, oral comments; Menachem Zlotzky, head of the Open Spaces Division in the Ministry of the Environment, oral comments.

⁷⁷ Hargreaves, Ian, Justin Lewis and Tammy Speers. 2003. "Towards a Better Map: Science, the Public and the Media." Economic and Social Research Council.

influence of global trends; secondly, the fruit of intensive efforts by civil society organisations in Israel.

In other countries there can be no doubt that a significant part of the rise in public awareness of environmental issues is due to the broad-based activities of reputed scientists and science-based organisations. In Israel, however, most members of the public – including the leaders of environmental and nature conservation organisations – are probably unfamiliar with researchers active in environmental issues, even those who are involved in environmental activities. An examination of the protocols of the Knesset Internal Affairs and Environment Committee for the period 2001-2007 revealed that scientists had participated in less than one-quarter of the discussions, and only some of these scientists were university academics.⁷⁸ Over this seven year period, just 54 research scientists (from research institutions and government research institutes) participated in the committee discussions – a small figure relative to the total number of researchers in Israel in these fields.

The media exposure of Israeli scientists is low relative to the attention paid by the media to environmental issues. Moreover, the scientists enjoy almost no personal reputation as individuals.⁷⁹ This is hardly surprising – the Israeli press does not have any regular column or supplement focusing on science or environmental science. Although the leading environmental reporters take a keen interest in science, they do not have a formal scientific education. The media is not connected to science and conveys this covert message to the general public. In most cases environmental problems are brought to the attention of the public by environmental organisations through the media. Some of the leaders of the environmental organisations have an ambivalent attitude towards science, and this position is naturally reflected in their contacts with the public and the media.⁸⁰

A wide range of opinions concerning science and scientists can be found in environmental and conservation organisations. As already noted, a distinction is sometimes proposed between environmental organisations and nature conservation organisations,⁸¹ though the borders between the two groups are not always apparent. The findings from our interviews confirm the formula proposed

⁷⁸ The protocols of meetings during the period 2001-2007 were examined; of these, 261 included discussions on environmental issues.

⁷⁹ This point was raised repeatedly in the interviews. Many scientists involved in nature conservation are not known to decision makers, from which we deduce that they are certainly not known to the general public.

⁸⁰ Yearley, Steven. 1996. "Nature's Advocates: Putting Science to Work in Environmental Organizations." In *Misunderstanding Science? - The Public Reconstruction of Science and Technology*, eds. Alan Irwin and Brian Wynne. Cambridge: Cambridge University Press.

⁸¹ *Ibid.*

above – regardless of the interviewee’s personal background, those from nature conservation organisations expressed a greater level of trust in science and had better contacts with scientists than those from environmental organisations.

In our interviews we found that the mistrust of scientists among Israeli environmental organisations is more pronounced the better known the scientist is. Israeli environmentalists who are not scientists respect large groups of scientists as well as leading individual scientists outside Israel. They are much more critical of Israeli scientists, in keeping with the saying “no prophet is accepted in his own country.”⁸² A prominent example of this approach was the establishment of a team of international scientists to examine the subject of the fish cages in the Gulf of Eilat. The sole advantage of the scientists chosen for the team was that they came from far away.⁸³ Indeed, the international team was much less well acquainted with the Gulf of Eilat than the Israeli scientists involved in the dispute, and Israeli scientists sharply criticised the report issued by the team.⁸⁴

Although they challenge scientific authority, environmental organisations also preserve this authority in two ways. Firstly, they contact scientists to request professional opinions and rely on the ability of scientists to identify climate changes, concentrations of pollutants or the functioning of ecosystems. In the past, for example, Friends of the Earth has issued requests for studies and reports. The second way in which environmental organisations reinforce scientific authority is to consolidate their own public status in a self-serving process. For example, most of the activities of the Society for the Protection of Nature in Israel are not based on science, and the organisation’s connections with Israeli research in the field of nature conservation are more limited than might be expected. Despite this, the SPNI turns to scientific authority when it identifies a need to reinforce its own positions in public debates; it also includes scientists as members on its board. Thus the SPNI preserves its professional authority in its dealings with the public.⁸⁵

Thus preserving the status of science is an interest not only of scientists but also of environmental organisations and governmental bodies. Accordingly, environmental discourse focuses on scientific facts, controversial though these

⁸² Ibid.

⁸³ Prof. Yehudit Birk is an Israeli and involved in agriculture, but she is not involved in marine agriculture. She was chosen for the team as the representative of the National Academy for Science.

⁸⁴ Loya, Yossi. 2007. "How to Influence Environmental Decision Makers? The Case of Eilat (Red Sea) Coral Reefs." *Journal of Experimental Marine Biology and Ecology* 344:35-53.

⁸⁵ Gershon Peleg, director of the Society for the Protection of Nature in Israel, oral comments; Yoav Sagi, director of the Open Landscape Institute, oral comments.

sometimes are, and draws away from the realm of values and interests, in which it is not always possible to secure consensus. The result is a paradox: the authority of science, which accrues from the perception that it can create objective and universally applicable knowledge, is reinforced or controlled according to local circumstances in the scientific community, environmental authorities and organisations and in public discourse.

The Mutual Affinities between Science and Policy

The relations between science and policy are the product of our cultural, political and social history as reviewed in the previous sections. These are not the only factors involved, however. Additional aspects also play a part in shaping the level of exposure of science. These aspects are essentially socio-psychological in character: emotional factors, relations of trust, communicative and expressive capabilities, a sense of relevance and an ability to learn. These factors are of enormous importance, often more so than the cultural and political factors discussed above.

Emotional Factors Shaping the Influence of Science

Many factors influence the efficiency with which scientists are able to influence political processes; these factors are not always obvious, predictable or rational. Sometimes the extent of influence of science depends on random events that create a particular context.⁸⁶ For example, we all learned about the impact of tsunami waves following the earthquake in the Indian Ocean in December 2004, when waves led to the death of over 200,000 people. What attracted public attention was not merely the force of the earthquake, but the fact that the event included factors enhancing personal identification – many people were affected, particularly children, and more significantly still some of the victims belonged to our own groups (Israelis, Europeans, etc.)

Many environmental public campaigns take place without any affinity to science or scientists: the paving of a new road, the destruction of a habitat or the erection of antennas are just some examples. In some cases these campaigns relate to issues that are self-evident in scientific terms: Fewer habitats means less nature; more pollution means more illness, and so forth. This is not always the case, however. For example, there are disagreements regarding cellular antennas and public action on this issue is not in line with expert opinion. Although it is impossible to address this issue without a scientific background, we find that science is unable to make an efficient contribution to the process. Experts are unable to overcome the prejudices and emotional positions of many members of the public. The uncertainty and lack of agreement the public is familiar with from other environmental and medical issues encourage citizens to err on the side of caution, even when science has a higher level of knowledge and can recommend courses of

⁸⁶ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

action.⁸⁷ Conversely, the warnings by the Ministry of Health in the summer of 2008 to avoid the use of cellular telephones, particularly by children, do not seem to have led to any significant reduction in the level of use of these devices by young people and the warnings went largely unnoticed.

In some cases a particular scientific approach does not enjoy broad consensus among scientists yet secures considerable public influence. For example, Bjorn Lomborg was quoted widely in the headlines after the publication of his book *The Sceptical Environmentalist*.⁸⁸ The media circus around the book continues to this day, but most of the academic world has savagely criticised Lomborg's findings.⁸⁹ Thus we can see that there is not always a correlation between the reliability of scientists, the level of scientific consensus or other aspects discussed in the previous sections, on the one hand, and the influence enjoyed by the scientific opinion, on the other. In more than a few cases, and particularly in the case of pessimistic scenarios, society in general and the media in particular tend to adopt the opinions they feel comfortable with, even if these represent a minority view in the scientific community.⁹⁰

The Level of Trust between Decision Makers and the Public and Scientists

If we wish to understand how science can be so important and yet so inefficient in its influence, the best place to start are those disputes to which each side brings its own science.

As mentioned frequently throughout this report, the example that comes to mind is the broad public debate on the subject of marine agriculture in the Gulf of Eilat. During the course of the debate, scientific opinions were issued both for and against the continued presence of marine agriculture in the gulf. Each side accused the other of extraneous interests, and particularly economic interests. Prof. Yossi Loya of Tel Aviv University was accused of formulating his opinion in return for financial support from the Zalul association, which led the campaign against the fish cages in Eilat.⁹¹ Conversely, it was alleged that the royalties received by Israel Oceanographic and Limnological Research led it to formulate its position in

⁸⁷ Weissman, Paz. 2008. "Cellular Antennas Are Responsible for Just 20% of Total Radiation". Ha'aretz, Economics Section, 2 July 2008.

⁸⁸ Lomborg, Bjorn. 2001. *The Sceptical Environmentalist: Measuring the Real State of the World*. Cambridge: Cambridge University Press.

⁸⁹ Rennie, John. 2002. "MISLEADING MATH about the EARTH." *Scientific American* 286(1):61-61.

⁹⁰ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

⁹¹ Prof. Yossi Loya, Tel Aviv University, oral comments.

favour of leaving the cages in the sea.⁹² Thus the debate was diverted from the political stakeholders to the subject of scientific reliability. Rather than discussing the economic value of the fish cages and the livelihood of the owners as weighed against the value of the coral reefs to science, nature conservation and humans, the discussion focused on the reliability of scientists and the mutual recriminations of the warring parties.

The question, then, is how to reinforce scientific reliability and hence reinforce the status of science. The usual strategy is to ensure the peer review of studies. This practice has also been replicated in the environmental field by various authorities in the United States: regulatory decisions are sent for examination by several scientists.⁹³ The International Panel on Climate Change also sends all its knowledge and decisions for extremely rigorous peer review. The Earth Portal was recently launched by the [National Council for Science and the Environment \(NCSE\)](#), a body which, as it claims, is known for its objectivity, responsibility and achievements in advancing the scientific foundation of environmental decisions.⁹⁴ The reports uploaded onto the portal emphasize clearly who wrote the article or news item and who reviewed it.⁹⁵ It is important to recall, however, that peer review does not constitute an absolute guarantee of consensus, quality or objective truth.⁹⁶

Communicative Ability and Relevance

One way to examine the effectiveness of science in influencing decision-making processes is to analyse the aspect of communication and to assess the factors that determine whether science is accessible and understandable to decision makers and the general public.

⁹² HCJ 7209/04 HCJ 7209/04 IUED

⁹³ Jasanoff, Sheila. 1990. *The Fifth Branch: Science Advisers as Policymakers*. Cambridge, Massachusetts London, England: Harvard University Press.

⁹⁴ http://www.earthportal.org/?page_id=2

⁹⁵ Various studies have found that peer reviews do not constitute an accurate indicator of the quality of articles or research proposals. Moreover, a study by the US National Science Foundation (NSF) into the selection process for research funding proposals concluded that the level of success of these proposals depended largely on luck in the composition of the peers reviewing the proposals:

Edwards, Paul N. and Stephan H. Schneider. 2001. "Self-governance and Peer Review in Science-for-Policy: The Case of the IPCC Second Assessment Report." In *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark Miller and Paul N. Edwards. Cambridge: MIT Press.

⁹⁶ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

The field of scientific communication has been studied in depth for more than four decades. There is agreement on a number of points: The content must be conveyed in attractive ways, including: use of interesting narratives, illustrations and pictures; the simplification of complex ideas; a preference for concrete rather than abstract information; explanations that relate to people's lives and experiences, and so forth. Environmental science communication is rich in metaphors: "silent spring," "acid rain," "ozone hole," "greenhouse effect," etc. These metaphors create a tangible image to which non-scientists can easily relate. Similarly, discussion of nature conservation is more meaningful when it is associated with charismatic species or familiar natural values.

In order for science to create substantive change, however, it must encourage dialogue and not merely provide knowledge for the "ignorant." Scientists must not merely disseminate knowledge but must also address the conceptual world and concerns of citizens in order to forge connections between the two. This recommendation reflects the common argument that scientists do not provide the knowledge and recommendations required by policy makers and those in the field. In many cases, it is claimed that scientists fail to provide information when it is needed; that the information is incomplete, the conclusions unclear, or the recommendations conditional and limited due to a lack of knowledge and uncertainty. Above all, many scientists have reservations about getting involved in regulatory and political processes.

These difficulties are the result of defects in communication and of the different priorities of scientists and decision makers. In particular, our examination of the discussions of the Knesset Internal Affairs and Environment Committee⁹⁷ suggests that scientists from government research institutes are more involved in policy processes. This fact is not surprising, of course, given that their institutional agenda includes such involvement, whereas the same involvement could mitigate against scientists being examined by promotion committees in institutions of higher education.⁹⁸

In Israel, the Neaman Institute and the Jerusalem Institute for Israel Studies have undertaken to fill the gap between science and politics and to produce summaries of knowledge for decision makers on relevant subjects. Their work focuses on academic discussion of issues of national importance, though it still tends to be academic in character. The activities of these two institutions take place on two

⁹⁷ See the section Examination of Environmental Decision-Making Processes in Local Government and the Knesset.

⁹⁸ Prof. Danny Levitan, rector of Tel Aviv University, oral comments.

tracks: commissioning studies from experts and publishing expert articles on issues of relevance to policy, and summarising the articles of other scientists.⁹⁹

Knowledge agents can play a significant role in the use of scientific knowledge for practical needs. People or institutions that understand both science and political processes can function as interpreters and mediators. Knowledge agents may be individuals such as Rachel Carson or Azaria Alon; public institutions such as nature museums; publications such as the science supplement of the New York Times; websites such as Nature Campus' Online Natural Resources; or projects linking science and the public, such as the Civil Science of the Ornithology Department of Cornell University in the USA. These knowledge agents help disseminate scientific knowledge in a way that is both scientifically accurate and effective in terms of communication with the general public.

Capacity for Intra-Organisational Learning

In order for science to influence activities relating to the environmental, there must be effective communication of environmental scientific information, including attention to the manner in which this connects with values and interests. This is not sufficient in itself, however. Another extremely important factor is the ability of society, and particular of social organisations, to process information, study, develop and respond to changing and uncertain realities. Unfortunately, this requirement is contrary to the nature of organisations, and particularly of bureaucratic bodies, which tend to be opposed to change and learning and to prefer efficiency and standardisation to innovation. A prominent example of this is the response to invasive species in Israel. Despite the large quantity of scientific knowledge that flows from research, mainly from abroad and in recent years also from within Israel, indicating the damage caused to ecosystems around the world by invasive species, the bodies responsible for this subject in Israel are opposed to changing their priorities in order to address this issue.¹⁰⁰

Environmental organisations may also resist the absorption of information that is incompatible with their agenda.¹⁰¹ Amir Balaban from the SPNI has led civil society activities in Israel in the field of conserving urban nature. The Open

⁹⁹ Friedman, Avraham (Rami) and Shlomo Hason. 2003. How Do Researchers and Policy Makers Exert Influence? Jerusalem: Jerusalem Institute for Israel Studies; Samuel Neaman Institute for Advanced Research in Science and Technology. Odot (in Hebrew).

¹⁰⁰ Josto-Hanani, Ronit. 2006. "Invasive Species in the Land and Maritime Environment in Israel – Ecological Aspects, Policy and Legal Tools". Zoology Department. Tel Aviv: Tel Aviv University (in Hebrew).

¹⁰¹ Bocking, Stephan. 2006. Nature's Experts: Science, Politics and the Environment. New Brunswick, New Jersey and London: Rutgers University Press.

Landscape Institute initiated discussions concerning the contribution made by urban nature to conserving biodiversity; the participants included ecologists from Tel Aviv University, staff from the institute, and Amir Balaban. During the discussions it emerged that the scientists believe that urban nature is important in order to recruit civil society to the struggle to maintain biodiversity, since these areas are the nature that is encountered daily by half the population. However, the scientists argued that nurturing urban nature has no real ecological impact in terms of protecting biodiversity. Although there was overwhelming consent among the scientists on this point, Amir Balaban refused to accept their insight.¹⁰²

Further obstacles to learning are created by experts within the organisation.¹⁰³ The Nature and Parks Authority employs numerous experts in its various divisions, particularly the Research Division. In recent years Tel Aviv University – through Nature Campus – has several times offered to run training courses for the staff of the authority in order to strengthen ties and improve the flow of knowledge between the academic research community and those working in the field. These initiatives have been unsuccessful; many staff members in the Nature and Parks Authority claim that the intra-organisational capabilities are adequate and that the organisation can study and organise training programmes by itself.

¹⁰² Discussions at Tel Aviv University, 4 June 2006, 7 March 2007; Brikner-Baron, Inbal. 2008. “Urban Ecology – Basic Concepts, Definitions and Divergent Approaches on Issues Relating to the Management of Urban Nature.” Open Landscape Institute (in Hebrew).

¹⁰³ Bocking, Stephan. 2006. *Nature's Experts: Science, Politics and the Environment*. New Brunswick, New Jersey and London: Rutgers University Press.

The Situation in Israel

Scientific research into decision-making and policy-shaping processes in Israel in areas of relevance to our discussion is relatively limited¹⁰⁴ and focuses more on environmental issues than on nature conservation. The limited body of research pays almost no attention to the role of science, and of scientists per se, in the different events.¹⁰⁵ In her doctorate thesis, “Process Networks: Shaping Environmental Policy in Israel,”¹⁰⁶ Yael Parag examined the functioning of scientists and research institutions in shaping policy relating to the environment (the quality of air and drinking water). Alon Tal’s book *Pollution in the Promised Land* (2002) describes the development of the environmental movement in Israel. Tal details the involvement of scientists in establishing the nature conservation bodies in Israel – the Society for the Protection of Nature in Israel and the Nature and Parks Authority. His analysis, as well as that of Regev,¹⁰⁷ suggest that the involvement of scientists in the establishment of nature conservation bodies came from an activist starting point. The scientists were motivated by a combination of the desire to preserve scientific values and romantic and nationalist perceptions relating to the conservation of natural values.

The establishment of nature conservation bodies in Israel was a late and limited phenomenon by comparison to western countries, earning Israel a reputation as an “environmental laggard.”¹⁰⁸ Accordingly, it is hardly surprising that discourse

¹⁰⁴ Prof. Eran Feitelson, oral comments.

¹⁰⁵ Several studies relating to the decision-making process on environmental issues were reviewed. On the subject of the construction of the Trans-Israel Highway:
Garb, Yaakov. 2005. "Constructing the Trans-Israel Highway's Inevitability." *Israel Studies* 9(2):180-217.

Maislish, Michal. 2005. *The Campaign against the Trans-Israel Highway – Documentation of an Environmental Campaign*. Jerusalem Institute for Israel Studies (in Hebrew).

On the subject of Israel’s adoption of the Barcelona Convention:

Weinthal, Erika and Yael Parag. 2003. "Two Steps Forward, One Step Backward: Societal Capacity and Israel's Implementation of the Barcelona Convention and the Mediterranean Action Plan." *Global Environmental Politics* 3(1): 51-71.

Regarding changes in the pattern of action of the Society for the Protection of Nature in Israel and its focus on the legal arena:

Morag-Levine, Noga. 2003. "Partners No More: Relational Transformation and the Turn to Litigation in Two Conservationist Organizations " *Law & Society Review* 37(2): 457-519 .

¹⁰⁶ Parag, Yael. 2005. “Process Networks: Shaping Environmental Policy in Israel.” Tel Aviv University (in Hebrew).

¹⁰⁷ Regev, Ofer. 1993. “Forty Years of Flourishing: The Society for the Protection of Nature in Israel” (in Hebrew).

¹⁰⁸ Vogel, David. 1999. "Israeli Environmental Policy in Comparative Perspective." *Israel Affairs* 5(2):246-264.

between scientists and policy makers is less developed than we would like, and that in many cases policy is based on shallow scientific foundations.

Academic Research Institutions

During the interviews we conducted, both scientists and environmentalists complained about the small number of scientists involved in studying the environment and, more acutely, the number of scientists involved in environmental discourse. No more than a dozen or so names of scientists were mentioned repeatedly in the discussions. According to figures from the ISI Web of Knowledge,¹⁰⁹ Israel is ranked in 26th place out of 100 countries in the field of the environment/ecology. Eighteen Israeli articles published over the past ten years are included in the category of “top papers.” One of these is one the subject of the environment; all the others are ecological papers.

This report did not include an evaluation of the scope of research or the number of scientists involved in nature conservation and the environment relative to the total scope of scientific research in Israel. On the basis of developments in Tel Aviv University, which is home to the largest and most comprehensive research centre in Israel in the field of nature studies, this areas has declined in recent decades and is suffering from a shortfall. In Tel Aviv alone, the faculty of scientists involved in research into the whole organism has fallen by 40 per cent over the past five years. This decline is three times greater than that in other sections of the Faculty of Life Sciences.¹¹⁰ Accordingly, in discussing the connection between science and policy it is important to recall that the number of scientists who could potentially be involved in such discourse is small by comparison to other western countries, and indeed by comparison to some Third World countries.

There are no incentives in Israel for academics to address the broader aspects of their research areas, to place their expertise at the disposal of society, or to disseminate their knowledge to the general public. Contrary to the policy of the

Weinthal, Erika and Yael Parag. 2003. "Two Steps Forward, One Step Backward: Societal Capacity and Israel's Implementation of the Barcelona Convention and the Mediterranean Action Plan." *Global Environmental Politics* 3(1):51-71.

¹⁰⁹ ISI Web of Knowledge. Thompson Reuters. Correct as of August 2008. See: <http://esi.isiknowledge.com/rankdatapage.cgi?option=C&searchby=F&search=Environment%2FEcology&sortby=1&currpage=2>

¹¹⁰ Prof. Tamar Dayan, Tel Aviv University, oral comments.

US National Science Foundation,¹¹¹ none of the competitive research funds in Israel rewards researchers for the broad impact of their studies beyond the advancement of science, or for the contribution they make to society. Indeed, the promotion of academics may actually be damaged if they show a high level of involvement in activities beyond the realm of scientific research.¹¹²

Governmental Bodies

The Ministry of the Environment is small and underfunded by comparison to other government ministries. There are enormous discrepancies between the different divisions of the ministry in terms of staffing and the nature of tasks. For example, the Sea and Beaches Division comprises 25 employees; the Environmental Planning and Assessments Division has eight employees; and the Open Spaces Division has just two employees.¹¹³ As a result, the level of involvement of the ministry varies considerably in different environmental issues.

In some fields, such as beaches and seas, planet earth resources, and potable water resources, government research authorities have been established: Israel Oceanographic and Limnological Research,¹¹⁴ the Geological Institute, the Geophysical Institute and the Hydrological Service. The first three of these bodies are governmental research institutes that engage in both basic and applied research. The Hydrological Service forms part of the Water Authority and engages mainly in applied research. The body responsible for the field of biodiversity is the Nature and Parks Authority. The authority includes a Science Division staffed by 41 professionals, only one-quarter of whom hold PhD degrees. The staff engage simultaneously in applied research, monitoring and enforcement in a diverse range of areas.¹¹⁵ It is important to note that there is no governmental body that is involved simultaneously both in applied research and basic research; in other words, the scope and scale of research in the field of biodiversity in the governmental authorities are relatively limited by comparison to other areas and by comparison to western (and other) countries.

¹¹¹ The NSF evaluates the quality of research proposals not only in scientific terms, but also in terms of broad impact. For example, see: National Science Foundation. 2006. "Merit Review Broader Impacts Criterion: Representative Activities July 2007".

¹¹² Prof. Danny Levitan, rector of Tel Aviv University, oral comments.

¹¹³ The figures were taken from the website of the Ministry of the Environment, "Structure of the Ministry".

¹¹⁴ Prominent bodies in fields touching on the environment include the Ministry of Health, the Antiquities Authority and the Agricultural Research Authority.

¹¹⁵ The figures were obtained from the website of the Science Division in the Nature and Parks Authority. "Functions of the Science Division in the Nature and Parks Authority."

According to Yael Parag,¹¹⁶ who studied the shaping of environmental policy in Israel, the governmental research institutes suffer from a dismissive attitude on the part of the state and are subject to constant cuts in funding. As a result, they are obliged to accept paid commissions and sometimes operate in areas that raise conflicts of interest. An example that is raised repeatedly in this context is the problematic work of the Israel Oceanographic and Limnological Research concerning the fish cages in the Gulf of Eilat.

In some areas, such as the establishment of science-orientated youth programmes and science teaching centres in the universities, Israel has been a pioneer in science communication. However, in the fields of science and environmental policy Israel has not always been at the forefront of developments. Unlike the United States,¹¹⁷ Israel has not developed mechanisms of scientific advisers and consultation bodies to assist the government on environmental issues. In most cases, procedures have not been developed ensuring a hearing for scientific opinions before decisions are made on these issues.¹¹⁸

Non-Governmental Organisations

Most environmental NGOs in Israel concentrate on the civil sphere – planning processes, environmental law and the promotion of social justice. Unlike leading organisations in other countries, most of these NGOs do not have a declarative commitment to fostering scientific activities, despite the fact that the staff members of the Israeli NGOs include individuals with a scientific education. This situation is unsurprising. The leading bodies in this field – the Heschel Center for Environmental Learning and Leadership, the Israel Union for Environmental Defense, Friends of the Earth – Middle East, and Life and Environment – were established by individuals from the social sciences, law and the humanities and continue to be run and staffed by individuals from these fields. Although the Society for the Protection of Nature in Israel was established by scientists, over the decades it has increasingly focused on legal and social aspects and has not tended to base its policy on scientific foundations.¹¹⁹ Some aspects of the work of the Society for the Protection of Nature in Israel are science based, such as the activities of the Open Landscape Institute and the Ornithological Center, but in

¹¹⁶ Parag, Yael. 2005. "Process Networks: Shaping Environmental Policy in Israel." Tel Aviv University (in Hebrew).

¹¹⁷ Jasanoff, Sheila. 1990. *The Fifth Branch: Science Advisers as Policymakers*. Cambridge, Massachusetts London, England: Harvard University Press, Jasanoff, Sheila ed. 2004.

¹¹⁸ Ophir Pines, Chairperson of the Knesset Internal Affairs and Environment Committee, oral comments.

¹¹⁹ Morag-Levine, Noga. 2003. "Partners No More: Relational Transformation and the Turn to Litigation in Two Conservationist Organizations " *Law & Society Review* 37(2):457-519.

many other areas the SPNI has a profile closer to that of an environmental organisation than a nature conservation body.

The Flow of Knowledge between Scientists and the Public

The flow of scientific knowledge from research institutions to policy makers and the general public takes place through specialist channels such as policy institutes, seminars, environmental websites and paraprofessional publications, and through general channels such as the electronic media and the press. In her study, Yael Parag¹²⁰ notes numerous difficulties inherent in this communication due to a lack of channels, inadequate capabilities and the absence of appropriate governmental arrangements.

Two research institutes in Israel focus specifically on environmental issues: The Jerusalem Institute for Israel Studies and the Samuel Neaman Institute for Advanced Research in Science and Technology. These institutes public reports prepared by their own staff or commissioned from scientists employed in other research institutions. The institutes also run seminars during which researchers meet decision makers. In addition to the research institutes, the Knesset includes a Research and Information Centre that provides position and background papers for Members of Knesset on various issues, including environmental subjects. The Centre supplies data, reviews, international reports and comparisons, economic documents and estimates of costs for Members of Knesset, Knesset committees and the various units of the Knesset. The purpose of these documents is to process and analyse data relating to issues being discussed by the Knesset plenum, committees and members, in response to requests or on a proactive basis.

No detailed study has been undertaken to date regarding the influence of policy institutes on decision-making processes relating to environmental issues. The Neaman Institute gauges its influence in terms of the number of surfers visiting the institute's website and the number of downloads of its reports from the website.¹²¹ The Jerusalem Institute organised a seminar for researchers and subsequently published a collection of articles evaluating its activities to mark its twentieth anniversary. The publication did not include the environment, which is a relatively recent addition to its areas of involvement.¹²² However, there can be no

¹²⁰ Parag, Yael. 2005. "Process Networks: Shaping Environmental Policy in Israel." Tel Aviv University (in Hebrew).

¹²¹ As noted by the director of the institute, Prof. Nadav Liron, on its website. Samuel Neaman Institute for Advanced Research in Science and Technology. "A Word from the Director."

¹²² The Environmental Policy Centre in the Jerusalem Institute for Israel Studies was established in 2000.

question that in other fields the institute has managed to bring together researchers and decision makers and/or to strengthen existing connections.¹²³

Every year various research institutes, government ministries, public bodies and NGOs hold dozens of seminars on a wide range of environmental topics. Some of these gatherings focus on science, while others concentrate on social, planning, economic, policy and legal aspects. In a considerable proportion of cases the discussions are comprehensive and address a range of topics, both scientific and other. On the basis of personal impressions, the presence of environmentalists is not evident at scientific forums such as the conference of the Israeli Society for Ecology and Environmental Sciences, the conference of the Zoological Society of Israel and the conference of the Israel Geological Society. Similarly, seminars run by the environmental organisations include a relatively limited presence of scientists as speakers, and even less so as members of the audience. Nevertheless, there are numerous seminars that make a successful effort to bring together different bodies.¹²⁴

Hebrew-language websites provide environmental information at varying levels of specialisation. The largest and most comprehensive site is the website of the Ministry of the Environment. All the bodies involved in environmental issues also maintain websites providing information about their activities, content relating to the environment and, in some cases, the possibility to download their publications. However, by comparison to the enormous wealth of material available in English, the existing knowledge in Hebrew and about Israel is relatively poor. This is particularly apparent with regard to the availability of study sites including explanations about information behind the headlines. In recent years Nature Campus has attempted to meet the need for study sites and has launched two such sites: The Invasive Species site,¹²⁵ which provides information about this phenomenon and also includes a database of invasive species in Israel,

¹²³ Friedman, Avraham (Rami) and Shlomo Hason. 2003. *How Do Researchers and Policy Makers Exert Influence?* Jerusalem: Jerusalem Institute for Israel Studies.

¹²⁴ Examples from 2008: The seminar *Protecting the Mediterranean Sea: An Examination of the Work of the Permits Committee for Discharges to the Sea*, organised by the Faculty of Law – Environmental Practice and Policy Clinic at Bar Ilan University and the Department of Geography – Environmental Management, Planning and Policy Track at the Hebrew University (Bar Ilan University, 28 February 2008); the *Jerusalem Conference on the Environment and Nature*, organised by the Society for the Protection of Nature in Israel (18-19 May 2008, Jerusalem Conference Center); the seminar organised by the Health and Environment Fund: *Environmental pollution and Disease Trends in Israel - what we know, what we don't know and what we should know* (2 June 2008, Air Force House, 15 Jabotinsky St., Herzliya).

¹²⁵ The Invasive Species site of the Nature Campus is the only source of information in Hebrew about this phenomenon, including a database of invasive species in Israel. Nature Campus – Tel Aviv University. "Invasive Species."

and the Online Natural Resources site,¹²⁶ which presents Israeli readers with abstracts of international reports relating to the current condition of ecosystems.

At present there is no paraprofessional journal in Hebrew focusing on environmental issues – a lack that is sorely felt. Between 1993 and 2001, a journal appeared entitled Ecology and Environment: Quarterly Review of Ecology, the Environment and Nature and Landscape Protection. Since this journal ceased publication no replacement has emerged. Ecology and Environment provided a forum for scientists, conservationists and environmentalists and also served as a knowledge resource for students, teachers and the general public.

The Israeli media does not pay the same level of attention to scientific and environmental subjects as the media in other western countries and the field of scientific and/or environmental journalism is relatively undeveloped. None of the daily newspapers issues a scientific and/or environmental magazine. Although the scope of reporting has increased over the past decade it still leaves much to be desired.

An Examination of the Decision-Making Processes on Environmental Issues in Local Government and in the Knesset

We examined two levels at which discussions take place relating to environmental policy: the local level, in the local authorities, and the national level in the Knesset Internal Affairs and Environment Committee. Naturally, the nature of the discussions in these two branches of government varies considerably.

Nevertheless, some environmental issues appear in both levels of government, albeit in different guise. These include attention to pollutants, waste and radiation, among others.

The examination of environmental projects in local government focused on the Union of Local Authorities in Israel (ULAI) and, in particular, on its Environment and Sustainability Unit;¹²⁷ the Forum of Fifteen;¹²⁸ and the Local Sustainability Center.¹²⁹ We assumed that the activities of these bodies serve as an index for developments in the local authorities themselves, since they lead the work of local

¹²⁶ The Online Natural Resources site is a content-based website relating to the condition of planet earth, forecasts for the future and ways to promote sustainability. The content is based on diverse sources, including international and local reports and scientific articles. Nature Campus – Tel Aviv University. “Online Natural Resources.”

¹²⁷ See the website of the Environment and Sustainability Unit: http://www.iula.org.il/htmls/hebrew/eichut_sviva.html

¹²⁸ Website of the Forum of Fifteen - <http://www.forum15.org.il/>

¹²⁹ Website of the Local Sustainability Center - <http://www.kayamut.org.il/>

government. The question we sought to examine was whether these decision-making foci maintain formal discourse with scientists; we examined their activities on the basis of publications on their websites.¹³⁰

The function of the ULAI Environment and Sustainability Unit is to advise and act among the local authorities in order to meet diverse challenges relating to the environment. The functions of the Environment and Sustainability Advice Unit include supervising legislative and regulatory processes in the environmental sphere; creating partnerships and encouraging bodies to join the effort to advance environmental issues in local government; and examining the feasibility of environmental projects and promoting and initiating such projects. Although the activities of the ULAI Environment and Sustainability Unit are impressive, it is difficult to discern the presence of science or scientists in its operations.

Local authorities are required by law to establish the environmental committees.¹³¹ The law specifies the composition of the committees; the provisions regarding the membership of the committees do not require that these include persons with a scientific education or persons involved in scientific activity.

The Forum of Fifteen is an umbrella body of the independent municipalities in Israel. These are strong municipalities that lead local government activities in Israel. Their website also shows no evidence of the presence of science or scientists.

The third body we examined is the Local Sustainability Center. This body aims to respond to issues of sustainable development on the level of the municipalities and the local and regional councils. The Center provides tools and training sessions and creates a network of diverse bodies involved in local sustainability. The Center works in cooperation with the Ministry of the Environment, the Heschel Center, the Porter School of Environmental Studies at Tel Aviv University, and ICLEI; it receives funding from the Life programme of the European Union. The Center is based in the Heschel Center, which operates the activities, and offers a diverse and rich package of activities and is one of the most influential bodies on the local level in Israel. Once again we could not discern the presence of science or scientists, such as the production of leaflets providing scientific background, the involvement of scientists, or discussion of the scientific aspects of environmental issues.

¹³⁰ The websites are detailed and update and apparently constitute one of the arms for their operations; accordingly we felt the websites accurately reflect the spirit of the organisations.

¹³¹ Amendment of the Municipalities Ordinance Law – Environmental Committees, Law to Amend the Municipalities Ordinance (No. 98), 5765-2005.

Together with the Heschel Center, these three bodies shape the environmental agenda of the local authorities. They concentrate mainly on environmental issues and on the social, planning and legal dimensions of the urban environment.

On the national level, we examined discourse by means of an analysis of the protocols of discussions by the Knesset Internal Affairs and Environment Committee during the Seventeenth Knesset. This committee serves as the forum for discussion of environmental issues regulated by public policy, legislation or other governmental action. The participants in the discussions included invited guests from various sectors (NGOs, scientists, government ministries, local authorities and other stakeholders). The meetings discuss issues requiring clarification and reflect diverse interests.

The protocols of the meetings of the Internal Affairs and Environment Committee provide an effective tool for assessing the role and contribution of scientists in decision-making processes on environmental issues in Israel. This is particularly true with regard to such questions as the level of interest shown in the opinions and professional experience of scientists, the extent to which they are involved in processes and the weight attached to their comments. Moreover, the committee proceedings can also cast light on the communications dynamic between scientists and decision makers.

We examined the level of involvement of scientists and attempted to evaluate the contribution they made to the decision-making process on environmental issues. During the course of our study we reviewed the protocols relating to the committee's activities in the period 2001-2007. A total of 261 discussions (20 per cent) related to environmental issues and nature conservation. Of these discussions, 68 (26 per cent) included the participation of scientists from institutions of higher education, government research institutes, government ministries and the Nature and Parks Authority, NGOs and private scientists:

	Institutions of higher education	Government research institutes	Governmental authorities	NGOs	Private consultants
No. of appearances in the committee	50	20	30	6	14
No. of different scientists	42	12	14	2	7

Table 1: Distribution of participation by scientists in the meetings of the Knesset Internal Affairs and Environment Committee in discussions on environmental issues, 2001-2007

The level of participation by scientists from institutions of higher education is higher than the remaining categories. However, if we take into account the total number of scientists in these institutions the participation in percentage terms is much lower than in the other categories. Moreover, most of the scientists from institutions of higher education participated in just one meeting each.

An analysis of the comments made during the meetings reveals several important aspects in terms of the discourse between decision makers and scientists. These aspects are discussed in detail below, and include disagreement among scientists; scientific uncertainty; differing perceptions of science on the part of decision makers and scientists; the recruitment of scientists as overt and covert activists; mutual distrust; difficulties in interpersonal communication; and poor communication skills – excessive detail, use of professional jargon, scientific language, etc. The detailed discussion of these findings is integrated in the discussion of research literature on this subject.

Examination of Local Examples

An analysis of the discourse between scientists and decision makers in a specific instance may help illuminate the dynamics of the interpersonal relationships and the relations between the different bodies. There has been relatively little research in Israel regarding the relationship between science and policy (see the section The Situation in Israel). The project summarised in this report did not seek to fill this void. However, during the interviews we conducted we asked a considerable number of questions relating to two examples – the debate about marine agriculture in Eilat and the discussion about the future of the Dead Sea. Scientists

were / are involved in extensive discourse with decision makers on both these issues. Many of the interviewees shared their experiences with us, and we included these in our review of the literature and our description of the situation in Israel.

The Debate on Marine Agriculture in Eilat

The marine agriculture in the Gulf of Eilat sparked a fierce and stormy debate in the scientific community involved in marine biology.¹³² Raising fish in cages for commercial purposes began in the mid-1990s. In the early 2000s scientists from Tel Aviv University and the Hebrew University who have studied the ecology of the gulf for decades began to warn that the coral reef was deteriorating; they associated this phenomenon with the fish cages. Israel Oceanographic and Limnological Research, which developed the technology used to breed fish in the waters of the gulf, rejected this hypothesis. The bodies caught in the middle in the row between these two sides included the fish raising companies, the Municipality of Eilat, the Ministry of the Environment, the National Planning and Building Council, the government, and NGOs. All these bodies were forced to decide which opinion they would accept. After the debate reached fever point, an international committee was also convened, although in practice it seems to have added more than a little fuel to the fire itself. The issues at stake included not only scientific truth and the prestige of the scientists on both sides of the divide, but also considerable sums of money and the livelihood of a large number of people.

The struggle to remove the fish cages from the Gulf of Eilat was one of the most protracted and complex environmental campaigns Israel has witnessed to date. It included almost all the components of the relations between scientists and decision makers: Scientific uncertainty and disagreement among scientists; the reliance on science and the challenging of scientific authority; casting aspersions at scientists for political reasons; the use of the media and public opinion, and so forth. The three scientists who found themselves at the centre of the storm are still licking their wounds.¹³³

The Discussion on the Future of the Dead Sea

The second case study we examined was the discussion about the future of the Dead Sea.¹³⁴ Over the last one hundred years enormous changes have occurred in

¹³² For a review of the scientific debate, see the article by Prof. Yossi Loya: Loya, Yossi. 2007. "How to Influence Environmental Decision Makers? The Case of Eilat (Red Sea) Coral Reefs." *Journal of Experimental Marine Biology and Ecology* 344:35-53.

¹³³ Oral comments by several participants in the discussion.

¹³⁴ Eidelman, A., G. Cohen and A. Bein. 2006. Eidelman, Amir, Galit Cohen, Amos Bein and Moti Kaplan 2006. Eds. *A Policy Document for the Dead Sea Basin: Evaluation of the*

the basin of the Dead Sea, damaging the landscape, tourism, infrastructure and economy of the region. The ongoing fall in the sea level and the increasing damage to infrastructures along the shores have created uncertainty regarding the future course of these phenomena, their avenues of development, and the risks and economic damage they will entail. As a result, a scientific and policy discussion has been underway for three decades regarding the future of the Dead Sea. The discussion focuses on two broad approaches to coping with the situation: The first adopts the assumption that the conditions that have led to the current situation in the Dead Sea – the water shortage in the region and the presence of the potash plants – cannot be changed in the foreseeable future. Accordingly, efforts should focus on coping as best as possible with the situation that has emerged in order to minimise the damage. The second approach, by contrast, advocates proactive and urgent intervention in order to change the situation, either by restoring most of the flow of water in the River Jordan to its former state or by establishing the “Seas Canal.” The discussion has acquired an intensive character over the past decade and has become the subject of considerable interest not only on the local level but also in the regional and international arenas.

A Comparison of the Case Studies

Numerous differences may be noted between the example of the Gulf of Eilat and the case of the Dead Sea. The following are the main differences:

- In the case of the Gulf of Eilat, the disagreement related to the condition of the ecosystem, the extent of the damage incurred, the sources of the anthropogenic damage and, of course, all the policy implications accruing from these factors. Conversely, in the discussion about the Dead Sea there is no disagreement regarding the opening data. It is universally agreed that the ecosystem of the lake and the surrounding area has changed beyond recognition over the past one hundred years. Neither is there any substantive disagreement in terms of the forecasts for the future. Accordingly, the discussion focuses mainly on the ways to cope with this situation and the policies that should be adopted.
- The case of the Gulf of Eilat was relatively simple in terms of the connection between the scientific finding and the operational conclusion, and a single stage separated the two. The process went as follows: (1) If the raising of fish in cages damages the coral reef, and (2) if the reef is important, then (3) the raising of fish in the Gulf of Eilat should be stopped. The scientific finding dictates policy in an almost precise manner in a period

when many agree that coral reefs must not be damaged. Conversely, the issue of the Dead Sea is highly complex and not ready for the presentation of recommendations. There is no scientific disagreement about the current state of the lake and the reasons for this situation, but the expected environmental ramifications following the implementation of various solutions remain unclear. Given this uncertainty (and the level of knowledge will not improve before 2011), no-one can responsibly present policy recommendations. In the case of the Dead Sea, the connection between the expected scientific finding and policy is complex and goes beyond the expertise held by scientific research bodies. Any policy recommendation may be connected, for example, with the water policy of the Israeli government, and this in turn is based on such values as the importance of agriculture. A recommendation to construct a canal between the Gulf of Eilat and the Dead Sea may be based in large measure on the strategic interests of the Israeli government in terms of the stability of the Hashemite Kingdom of Jordan, alongside the environmental consideration and awareness of the potential damage such a project might cause. None of these issues concern scientists in professional terms.

- In both case studies background research has been undertaken over the years in universities and in governmental research institutes. In the Eilat case, however, the dominance of scientists from universities is notable, alongside those from the relevant governmental research institute – Israel Oceanographic and Limnological Research. In the discussion on the future of the Dead Sea, by contrast, the presence of scientists from the universities is relatively limited and most of those involved are scientists from the Geological Institute.
- In each of the case studies scientists undertook a completely different role: In the case of the Gulf of Eilat, the university scientists adopted an activist approach, warning of the damage to the ecosystem and demanding that a particular policy be applied. In some stages of the campaign they even joined forces with NGOs.¹³⁵ In the case of the Dead Sea, however, the Geological Institute – despite its intensive involvement in the discussions – claims that it is not advancing any particular policy direction and is focusing solely on the scientific aspects. The institute’s researchers who are involved in discourse attempt to maintain the role of honest brokers and refrain from expressing a position regarding policy.¹³⁶

¹³⁵ This coalition soon broke down, however, due to the different methods of the two sides on the level of principle. Prof. Yossi Loya, Tel Aviv University, oral comments.

¹³⁶ Dr. Benny Begin, director of the Geological Institute, oral comments. Dr. Itai Gavrieli from the Geological Institute during a discussion by the Knesset Internal Affairs and Environment

These differences reflect the distinct patterns of behaviour in the discourse between scientists and decision makers in each case. Since this examination relates to just two instances, it is difficult to derive generalisations regarding the relations between scientists and decision makers in Israel. However, these two issues attracted considerable interest among scientists and the public over a relatively extended period. Accordingly, it may reasonably be assumed that those involved in the discourse on these issues were not caught in the eye of the storm by chance. Our conclusion from this is that even in a small society such as Israel different models exist for behaviour in environmental discourse.

Personal Perspectives: The Relations between Scientists and Decision Makers in Israel

The series of interviews we conducted with a wide range of individuals involved in environmental discourse raised a wide range of issues concerning the relations between scientists and decision makers in Israel. We present below a selection of comments and quotes illustrating the diversity of opinions and relations described in these discussions. Eighteen scientists, conservationists, civil servants, and employees in Israeli NGOs shared their thoughts with us regarding the discourse between scientists and decision makers on environmental issues. We selected a range of individuals in key positions who have acquired experience in the relations between science and policy and who represent the various profiles of those involved in environmental discourse. We invited the interviewees to share their insights, opinions and recommendations. Each interview lasted between one and three hours.

The conversation was based on a questionnaire. We began by getting to know the interviewee and learning about his/her scientific orientation, relations with scientists, and the weight he/she attaches to science in decision-making processes in his/her work. We also asked questions relating to science-based policy: How important is it that policy be science-based? What should the roles of scientists be in decision-making processes? We asked the interviewees to map the existing situation regarding discourse between scientists and decision makers, including contacts between the two groups; the existence and accessibility of information sources; the authority of science and scientists; the ways scientists are involved; the forums in which they meet; and their personal impressions. At the end of the interviews we asked the interviewees about the gap between the desirable situation

and the current state of affairs and invited them to recommend ways to bridge this gap.

The conversations with the interviewees were not limited by the questionnaire and included discussion of the areas of involvement of each interviewee. It is impossible to codify or quantify the responses; the only possible method is a qualitative analysis. The transcripts of the interviews were used as the basis for analysing the findings.

The conversations raised reservations regarding the quantity and quality of ecological and environmental research in Israel; the level of involvement of scientists in policy discourse; the ability of scientists to communicate with the general public; difficulties in communication between scientists, decision makers and members of the public; the learning capacity of environmental organisations, and other aspects.

The following are the main reservations raised during the interviews:¹³⁷

All the interviewees¹³⁸ felt that it was important to connect science and policy and to bring together scientists and decision makers in the interests of both policy and science. There was also agreement that the present situation requires improvement. However, there was no clear consensus in terms of the nature of involvement of scientists in decision-making processes.

- Some environmentalists noted that they request scientific opinions in order to support their political positions.
 - “Scientists in Israel have a strong opinion about everything. When people invite scientists to take part in a discussion the objective is for them to present a position that was already very clear.”
 - “Scientists who are invited to discussions will always come, both for reasons of ego and in order to make their voice heard.”
 - “In these kind of cases we will be obliged to contact an academic in order to support our position and advance our agenda.”
- Scientists saw the phenomenon of requesting scientific opinions merely in order to support an existing position as a very dangerous pattern that damages the credibility of scientists and scientific authority:

¹³⁷ We have noted the number of interviewees whose comments suggested that they agree with each particular statement. The selected quotes underneath each statement illustrate and amplify the point.

¹³⁸ When a particular opinion was typically found only among the scientists or non-scientists this is noted. In other cases the reservations were raised by both groups.

- “The Society for the Protection of Nature in Israel contacts professionals in order to advance their own agenda. That’s very dangerous for the professionals involved.”

Four interviewees expressed the opinion that environmental science in Israel has a weak profile:

- There is a lack of local research and a quantitative shortage of scientists who can participate in environmental discourse:
 - “Israeli academia is a bit weak when it comes to the environment.”
 - “Questions relating to nature and landscape conservation often arise in the planning institutions. There’s a real shortage of knowledge there and a lack of scientists who can come and say, ‘We’ve done such-and-such a study and here are the results.’”
 - “In general terms there is a problem in Israeli academia... An objective shortage of research and a subjective shortfall in terms of researchers who are unable to channel their studies into effective directions and gain influence.”
 - “They haven’t really examined the situation in the field so they can’t offer alternatives.”
- Two of the interviewees specifically mentioned ecology by contrast to other scientists:
 - “The question is not just how scientists are perceived but how ecology is perceived as a science. In some ways ecology is perceived as a ‘stepson’ of science, not as a precise science.”
 - “[Environmental] researchers are often too specific... In Israel we don’t have any scientists who explain things across a broad base and use their status as professors in order to offer a broad explanation of various issues.”
 - “The community is very small since nature conservation is not considered a legitimate field in the Israeli academic community. If there aren’t any scientists in the field of nature conservation that’s a real problem.”
 - “In most cases Israeli scientists do not have knowledge in conservation biology, so they cannot propose policy guidelines. There is no-one in the Israeli academic world who can prepare an action plan.”¹³⁹
 - “Scientists in academia should read more literature about conservation biology.”

¹³⁹ The interviewee is referring to an action plan for management and policy.

Eight of the interviewees claimed that academics tend to stay in their ivory towers and that most scientists are afraid to meet the people or enter the field of politics:

- “The academic community is passive.”
- “There’s a systemic problem here. The universities need to decide to get involved in the ‘real world’ – that means an academia that takes the initiative, influences things and plays a part in public discourse.”
- “There’s a lack of contact. Academic scientists are afraid to get themselves dirty by dealing with politics and to lose their credit as people who stay in their ivory towers.”
- “The forecasts are cautious – they are afraid of saying anything that isn’t 100 per cent certain. In the United States there’s an organisation called Science and Social Responsibility – there isn’t anything like that in Israel.”
- “The level of involvement of academics [in conservation biology and the environmental] is inadequate relative to the situation in other countries.”
- “They have to take a risk – scientists have to come out of their corner and function as public intellectuals who speak on the basis of their status.”
- “The impression is that they [scientists] are cut off from life and think they are ‘sully’ themselves.”
- “In the past there have been cases when researchers have refused to work with us because they were afraid –because they saw us as a political organisation.”
- “In the case of the Separation Fence in the north of the Judean Desert, all the academics adopted a position of refusing to touch the issue because of the political sensitivity of the area and because they are unfamiliar with the area in ecological terms.”

Another important issue raised by the environmentalists was their doubts regarding the personal credibility of scientists or scientific authority in general.

- Nine interviewees (including six non-scientists) doubted the ability of scientists to set aside their value-based perspectives and present science without any bias:
 - “In the case of the fish cages in Eilat, the way scientists expressed themselves really bugged me. I couldn’t help feel that the scientists were emotionally and ideologically involved as individuals rather than focusing on the scientific facts. I didn’t find them convincing.”

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- “The way the researcher sees the world has a very strong influence on the way they present the data.”
 - “It’s a distorted way of looking at things to imagine that science is something objective and free of values. Every scientist has their own world view. There is always a connection between values and facts. Yet we are still stuck with outmoded positivistic ideas about an academic distinction between values and facts.”
 - “The arguments among scientists weaken everyone. Scientific understanding isn’t important enough, and they decide on the basis of other directions.”
- Scientists from the governmental research institutes are the object of additional criticism. Four interviews doubted the credibility of scientists from the governmental research institutes by comparison to scientists from the academic world:
 - “A question: Scientists also sit in the governmental research institutions. Do they function differently? The answer: yes. My impression is that they function differently to academic researchers. But we take their position with a grain of salt.”
 - “You have to bear in mind that the status of a scientist in [a government institute] is less secure and depends on the director. So scientists in the governmental research institutes are severely restricted. It’s only in the academic world that you have scientists involved in ‘pure’ research. In the other cases it’s problematic because they are not engaged in ‘pure’ research.”
 - “The public is very suspicious and does not believe government ministries and bodies such as [mentions one of the governmental institutes]. The public has more confidence in academia.”
 - “The public is much more inclined to believe a professor from Tel Aviv University than a professor from [a governmental institute].”
 - “There’s a problem with scientists who work in the government system, because there is often a conflict between organisational ethics and scientific ethics.”

All the interviewees agreed that even when scientists get involved in environmental discourse, many obstacles impair productive communication between scientists and decision makers:

- Nine interviewees stated that there are not many formal channels or forums for contacts between academics and decision makers:
 - “The problem is that even when there are studies, they don’t reach anyone outside the academic world.”

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- “Sometimes there isn’t any research, and sometimes the problem is more about disseminating knowledge to the public.”
- “Most scientists don’t initiate contacts with decision makers. But when they are contacted they are almost always happy to come and express their opinion.”
- “Most researchers aren’t interested in contact with the media. We aren’t crazy about it and maybe it even puts us off a bit.”
- Seven interviewees claimed that scientists have poor and ineffective public communication skills:
 - “I don’t have the ability to be a ‘media star...’”
 - “There are some academic researchers who are very interested in media exposure and are very skilful in media appearances, but they are an unrepresentative minority.”
- Three interviewees mentioned the complex personal relations between scientists and decision makers that impede the connection:
 - “Scientists think that decision makers are stupid because they can’t understand the simplest subjects. Decision makers bring a sense of inferiority with them when they come to discussions.”
 - “The problem with scientists is that they don’t come with the purpose of engaging in dialogue as equal partners, but rather to explain to the public why a particular position is best. There’s a patronising attitude here on the part of the scientists.”

Six interviewees commented on the environmental literacy and knowledge of governmental and non-governmental environmental organisations:

- All the interviewees who commented on this aspect, most of whom were environmentalists, noted the weak scientific and environmental literacy of the environmental organisations:
 - “There’s a real problem among the public, including the environmental organisations. On the one hand, environmental issues aren’t just about science... But at the same time they certainly have scientific aspects, and every environmentalist should at least have some basic understanding of science. You need basic scientific literacy.”
 - “There’s a problem with the organisations. People don’t take part in training and don’t keep up to date with current discourse and new methods. We need round table discussions to deal with dilemmas in an organised way. Another problem is that the organisations do not

try to validate issues from a scientific standpoint, but only on the political level.”

- “[In the Ministry of the Environment] the professional level is generally poor. The library is very small and impractical. They do not attend many professional conferences and they don’t read much professional literature.”
- “Scientists who are not from the academic world [in environmental organisations] should keep themselves better informed.”
- One interviewee accused the media:
 - “The public isn’t even aware of scientific discussion, let alone ecological or environmental discussion. Our media always concentrates on the political contexts... sometimes they give a little bit of background but there aren’t any science reporters. The environmental reporters do not have a scientific education.”

It was noted that the relatively low level of involvement of scientists is due to the fact that they did not receive a sufficiently broad training and lack the natural skills to make up for this.

- Six interviewees felt that scientists lack civil literacy, media skills or the ability to be involved in decision-making processes:
 - “Scientists don’t have any philosophical training. Their broad education is inadequate.”
 - “What matters is an understanding of the rules of the game. When a scientist sitting around a table with decision makers thinks that he is back in the academic world and behaves accordingly, that’s a problem. Someone needs to explain the rules of the game to scientists.”
 - “As a generalisation, academics do not usually have any idea of what goes on in real life. They really do live in an ivory tower. For example, university lectures make no mention of what happens in reality. In other words, we don’t just want to get them involved so they can help us, but we also want to make current issues part of the content of courses and lectures.”
 - “Even when there is no scientific certainty, other issues arise – values, precaution, environmental management and the balancing of interests. In these cases I expect scientists to make a distinction between science and reality and to draw conclusions on the basis of those constraints. They need to understand that there’s a difference between science and reality and they need to take a stand.”

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- “Scientists aren’t sophisticated enough to present alternatives. Usually they just present a general perspective.”
- “Scientists in Israel have a strong opinion about everything. When people invite scientists to take part in a discussion the objective is for them to present a position that was already very clear.”
- “It’s very important for scientists to take part in workshops where they can learn how to talk to decision makers more successfully.”
- “Sometimes scientists make fools of themselves. They need to realise who is the target population in these campaigns. It’s ridiculous for them to start talking about ‘approximately’ and ‘roughly,’ ‘more or less’ – what people want is black and white. Anything else sounds hesitant and unreliable.”
- “Credibility and practicality aren’t mutually exclusive. Environmental impact assessments include an objective scientific section and a conclusions section, which effectively means expressing a position. There isn’t any problem of credibility in this respect.”
- “There’s no problem once the distinction is accepted – when you’re in the academic world you act according to academic standards, and when you’re appearing before decision makers you act according to appropriate standards.”

Conclusion

This document does not claim to constitute a thorough academic study. Our aim has been to outline some of the features of discourse between scientists and decision makers in Israel.

The research literature on the subject presents a complex picture of the relations between the two communities and the inherent obstacles to dialogue. The situation in Israel is similar to that in other countries. As in other areas, however, the relations in Israel seem to be closer, more intertwined and more sensitive than elsewhere, on the basis of the research literature and personal conversations with sources in other countries.

Nurturing discourse in Israel requires a range of steps including in-depth research into the mutual relations between scientists and decision makers; discussion among scientists and raising their awareness of their role in discourse; improving scientists' communication skills; promoting professionalisation among environmentalists and providing them with tools and knowledge enabling them to understand the scientific background of the issues they address.

This report has indicated some general directions. We hope it will inspire other bodies to initiate projects to nurture discourse between scientists and decision makers in Israel and to reinforce the scientific foundation of environmental protection in Israel.

Appendices

Appendix 1 – The Project Team

Management and writing the report: Dr. Yael Gavrieli

Yael Gavrieli has been involved in the field of science communication for the general public for 15 years. Yael established Nature Campus eight years ago and has directed the project since then. Yael previously served as director of the Science-Orientated Youth Programme in the Ministry of Education's Science and Technology Authority. As part of this position she was responsible for the inspection and support provided by the Ministry of Education for informal science education in science museums and in the science-orientated youth units. Yael has a PhD in biology, and MSc in oceanography and a BSc in agriculture, all from the Hebrew University of Jerusalem, as well as a certificate in museum studies from Tel Aviv University.

Research assistants: Immanuel Cohen-Shaham and Attorney Ronit Josto-Hanani

Immanuel Cohen-Shaham is a PhD student at the Faculty of Life Sciences in Tel Aviv University, under the supervision of Prof. Tamar Dayan. Immanuel's doctorate thesis focuses on environmental policy and ecology. Immanuel has a BSc degree in environmental science and biotechnology from Tel Chai College and an MSc in environmental studies from Wageningen University in the Netherlands. Immanuel worked for five years in the Ministry of the Environment as an external relations coordinator in the International Relations Division and as biodiversity coordinator and coordinator of the National Programme for Biodiversity in Israel in the Open Spaces Division. Immanuel speaks a number of foreign languages and has experience studying and working abroad. Together with her work in the Ministry of the Environment, this gives her a profound acquaintance with the field of conservation biology in Europe.

Attorney Ronit Josto-Hanani is a PhD student in the Faculty of Life Sciences in Tel Aviv University, under the supervision of Prof. Tamar Dayan. Ronit's doctorate thesis discusses policy in science, technology and the environment. Ronit has a BA in law and an MSc in the life sciences (ecology and environment track). In addition to her PhD studies, Ronit is also studying for an MA in law at Tel Aviv University. She has experience practicing law in the civil and commercial field. During the course of this work, Ronit encountered issues relating to environmental conflicts and decided to move to the field of environmental law,

focusing on contemporary ecological issues. Ronit's MA thesis discussed legal and policy tools on the subject of biological invasions in Israel.

Steering Committee

The committee was chaired by Prof. Tamar Dayan, director of the natural history collections at Tel Aviv University. Tamar was one of the initiators of Nature Campus and serves as chairperson of its scientific steering committee.

Committee members:

Dr. Benny Begin, geologist, former minister and Member of Knesset; at the time of writing, Dr. Begin serves as director of the Geological Institute.

Dr. Miriam Hern, biochemist, former chief scientist and director-general of the Ministry of the Environment; at the time of writing, Dr. Hern is head of the Environmental Management Studies Track at Ono Academic College.

Mr. Carmel Varnia was formerly chief scientist of the Ministry of Trade and Industry; at the time of writing, he is a businessman and a member of the board of Tel Aviv University.

MK Dr. Dov Hanin is a legal expert and an active member of Green organisations.

Mr. Ran Levy is the representative of Yad Hanadiv, which is overseeing the project

Prof. Danny Levitan is a mathematician and rector of Tel Aviv University.

List of Interviewees

Dr. Yeshayahu Bar-Or, chief scientist, Ministry of the Environment
Attorney Gideon Bromberg, director, Friends of the Earth – Middle East
Dr. Yochai Carmel, Technion and head of the Israeli Society for Ecology and Environmental Sciences
Liron Din, open spaces coordinator, Ministry of the Environment
Yael Dori, landscape architect and town planner, Israel Union for Environmental Defense
Dr. Amir Eidelman, environmental project coordinator in the Jerusalem Institute for Israel Studies
Prof. Eran Feitelson, policy and planning researcher, Hebrew University
Dr. Eliezer Frankenberg, deputy chief scientist and director of the Scientific Information Systems, Nature and Parks Authority
Attorney Tzippi Isser-Itzik, CEO, Israel Union for Environmental Defense
Prof. Yossi Loya, marine ecologist, Tel Aviv University
Ruth Osterin, director, Health & Environment Fund
Orly Peled, Shatil
Gershon Peleg, director, Society for the Protection of Nature in Israel
MK Ophir Pines, chairperson, Knesset Internal Affairs and Environment Committee
Yoav Sagi, director, Open Landscape Institute
Dr. Eilon Schwartz, executive director, Heschel Center for Environmental Leadership
Sigal Yaniv, director, Green Environment Fund
Menachem Zlotzky, head of the Open Spaces Division, Ministry of the Environment

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