ENVIRONMENTAL SCIENCE AND PREVENTIVE PUBLIC POLICY

PRECAUTION

Edited by

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Precaution, Environmental Science, and Preventive Public Policy

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The completion of a volume such as this can rarely ever be attributed to a lone editor. Rather, this book is the product of many dedicated scientists, policy analysts, and advocates. It is the outgrowth of several years of discussions among of wide range of experts from around the world about how science and policy can more effectively support preventive, precautionary decisions in the face of uncertain and complex risks. In the United States, these discussions began with the Wingspread Conference on the Precautionary Principle held in January 1998. I had the great privilege of co-coordinating that landmark conference and co-editing the book *Protecting Public Health and the Environment: Implementing the Precautionary Principle* that followed. Discussions about the precautionary principle have evolved to a great degree since 1998. The present volume reflects the discussions that have taken place with regards to the relationship between science and precaution.

I would like to personally thank the many individuals who have helped shape the book's content and who have ultimately given it life. I am completely indebted to my colleague Sara Wright for the countless hours she put into the book—editing, communicating with authors, and dealing with the often frustrating task of formatting—all with a wonderful sense of humor and dedication. Drs. David Kriebel and Kenneth Geiser have served as great mentors and colleagues, providing me with ideas, inspiration, and moral support. The staff of the Lowell Center for Sustainable Production at the University of Massachusetts, Lowell, particularly Cathy Crumbley, its program director, have been an important source of support, especially when working on controversial issues around science and precaution.

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Many thanks go to those who helped in planning the International Summit on Science and the Precautionary Principle—the conference that provided the background to this volume. They helped shape the discussions, questions, and topics that were the book's foundations. These individuals include Richard Clapp, Ted Schettler, Molly Anderson, Paul Epstein, Colin Soskolne, Andrew Stirling, and Finn Bro-Rasmussen. I would like to extend special thanks to Lee Ketelsen from the Clean Water Fund who has worked tirelessly to ensure that our work on science and precaution serves an important role in informing preventive policies. Of course, I greatly appreciate ideas and vision that each of the participants at the summit contributed.

I am deeply grateful to all of the chapter authors for their contributions and their dedication to reevaluating science and policy. Authors graciously spent large amounts of time answering questions and clarifying issues in their chapters. As a result, we have compiled a book with sufficient detail for experts in particular subjects, but simple enough to engage a broad audience. It was important to learn from the authors' experience in scientific research and policy analysis from throughout the world. The breadth of expertise and disciplinary perspectives contained in this volume is its greatest asset.

Heather Boyer at Island Press has been exceptionally supportive of this work from the beginning and has helped me work through the various "crises" that have occurred through the editing process. Her patience and input are greatly appreciated.

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INTRODUCTION

Joel A. Tickner

Policy makers often mistakenly view science as an incontrovertible source of knowledge on which to base policy decisions. However, in the context of complex environmental and health risks, it is much more useful to think of science and policy as dynamically informing each other: science provides important information on which to base policy, and public policy outlines critical societal research and knowledge needs. Science is critical to solving some of our most pressing environmental and health problems. As environmental science faces the increasing challenges of more complex risks with greater uncertainty and ignorance, the nexus between science and preventive policy becomes even more important. As an applied science, it seems appropriate to understand how it can better inform policy, without sacrificing objectivity.

The precautionary principle was established in the 1970s in response to concerns about the limitations of science and policy structures to adequately address complex and uncertain risks and in recognition of the severe consequences to health and the economy from damage to health and ecosystems. The precautionary principle bridges the gap between science and policy by encouraging policies that protect human health and the environment in the face of uncertain risks. In this broad sense, it is not new. Precaution is at the heart of centuries of medical and public health theory and practice. A part of the Hippocratic Oath, "First do no harm," underscores a duty to prevent damage to health as well as the concept of primary prevention in public health.

The precautionary principle was characterized in the 1998 Wingspread Statement on the Precautionary Principle as follows: "When an activity raises threats of harm to human health or the environment, precautionary measures

should be taken even if some cause and effect relationships are not fully established scientifically." The statement listed four central components of the principle: (1) taking preventive action in the face of uncertainty, (2) shifting burdens onto proponents of potentially harmful activities, (3) exploring a wide range of alternatives to possibly harmful actions, and (4) increasing public participation in decision making (see Raffensperger and Tickner 1999).

As a principle of decision making, the precautionary principle has its roots in the German word *Vorsorgeprinzip.* An alternative translation of this word is "foresight or forecaring principle," which emphasizes anticipatory action. It is more proactive than "precaution," which to many sounds reactive and even negative. Although it has its roots in German environmental policy, over the past twenty years the principle has served as a central element in international treaties addressing North Sea pollution, ozone-depleting chemicals, persistent organic pollutants, genetically modified organisms, fisheries, climate change, and sustainable development. The European Union has espoused precaution, along with prevention of pollution at source and the polluter pays principle, as a central element of environmental health policy.

Discussion about the role of the precautionary principle in the development of environmental policy has greatly intensified during recent years, in part due to science and policy debates over the complex, global health risks such as those posed by beef hormones, genetically modified organisms, toxic chemicals, fisheries, and global climate change, among others. Much of the recent debate about the precautionary principle has focused on the questions of whether precaution poses a barrier to trade and of what specific level of evidence is sufficient to justify action to prevent harm.

Science and Precaution

When the precautionary principle has been discussed in the context of its relationship to science, it has often been portrayed either as antiscience (inconsistent with the norms of rational, science-based decision making) or as a risk-management principle that is implemented only after objective, expert scientific inquiry takes place. Both of these claims appear to be based on a misunderstanding of environmental science.

There are ways in which the methods of scientific inquiry can implicitly impede precautionary action, making it more difficult for policy makers to take action in the face of uncertainty. Too often scientific research focuses on narrowly defined issues, whereas the problems we face are complex and require interdisciplinary research methods. Current scientific practice also often attempts to minimize uncertainties and focus on those aspects of a problem that are quantifiable. This may mean narrowing the research focus so much that important aspects of the problem are missed. Our current selection of

scientific tools and the ways they are used may not be sufficiently refined to deal with some of the complex, multigenerational environmental issues, such as global warming, that decision makers face today.

Yet, environmental science has a critical role in implementing the precautionary principle, by providing insights into the normal functioning of natural systems, the ways they are disrupted by technologies, opportunities for prevention and restoration, and gaps in our understanding of phenomena. To support the precautionary principle, science and policy must be able to identify and anticipate harm to health or the environment and support the development of options for precautionary action. This requires scientific methods, tools, and institutions that are adequately adapted to decision-making problems that policy makers face.

A shift to more precautionary policies creates opportunities and challenges for scientists to think differently about the way they conduct studies and communicate results. If the precautionary principle is presented to environmental scientists as an opportunity for more and better science—rigorous and transparent about uncertainties—it may be possible to find support from researchers who are presently unaware of such developments, or even hostile to a perceived "attack" on science. Scientists are also needed to respond to critiques of precautionary decisions, particularly when the uncertainties in science are misrepresented.

Background to This Volume

While the precautionary principle and its background, history, and implementation have been discussed at length in a variety of books, journal articles, and other publications (see Raffensperger and Tickner 1999; O'Riordan et al. 2001), this is the first compilation of essays dedicated entirely to the role of science and the science-policy interface in implementing the precautionary principle. Although the relationship between environmental science and precaution—referred to as precautionary science or the "ecological" paradigm (see chapter 8) (Barrett and Raffensperger 1999; Wynne and Mayer 1993)—has been discussed by numerous scientists during the past ten years, this volume provides an in-depth, multidisciplinary examination of ways environmental science can limit or better support precautionary, preventive decisions. It extends the often political discussion of precaution into the realm of science. It is meant to expand upon existing literature on the precautionary principle by broadening the range of disciplines and individuals thinking about its implications for science.

This volume begins with the presumption that the precautionary principle, as defined in the Wingspread Statement, is an important principle of environmental and health policy under uncertainty. Our bias is toward protection

of health and ecosystems under uncertainty. The merits of the precautionary principle or critiques of it are not discussed. Rather, the focus of this book is on how science can more effectively address complex, uncertain environmental risks and lead to precautionary actions.

Some analysts have claimed that the health and ecosystem risks we face are exaggerated and that precautionary policies are unnecessary (Lomborg 2001; Bailey 1995). We disagree. Although industrialized activities have certainly improved health in many ways throughout the world in the past century, these human activities have also brought with them substantial costs to health and the environment that could have been avoided through better foresight. These include devastation of some fish stocks, deforestation, species loss, global climate change, ozone depletion, and disease in humans and wildlife caused by toxic substances. We believe that science, technology, and policy can be harnessed more effectively for prevention and innovation in safer, cleaner technologies and practices.

The book builds on more than two years of discussions held with an interdisciplinary group of scientists to understand how the conduct of environmental science can hinder or facilitate the implementation of precautionary policies (see Kriebel et al. 2001).

The underlying theme of the book is that the role of science must be a central aspect of discussions about the precautionary principle. Even if the reader disagrees about the merits of precautionary principle, we believe that most scientists can agree that there are important issues to discuss about whether the tools and methods we currently employ in environmental science and the ways we characterize uncertainty and ignorance are adequate to address the complex, sometimes global risks we face. Thus, the precautionary principle is relevant to environmental science. We have found that even among scientists who support the concept of precaution, issues of hypothesis generation, scientific method, and the use of science in policy are highly challenging and debatable. There are no simple answers.

The primary objective of this book is to build better understanding of the role of science in implementing the precautionary principle. To achieve this, the chapters in this book (1) outline how the current practice of science can both support and limit precautionary decision making, (2) envision and explore changes needed in the practice and application of science that would better support the precautionary principle, and (3) discuss cultural and sociopolitical differences across nations that affect how science is applied in decision making.

Obviously, the question of what to do in the face of uncertainty is a political question and must be left to the political process, with a multitude of societal stakeholders involved. The questions of science and precaution cannot be separated from questions of economics, political power, and institutional

capacity and will. These are important considerations that in some cases may be far more important than science in determining whether precautionary decisions occur or do not occur. Nonetheless, we have purposely chosen to avoid those questions to the degree possible and focus primarily on science and the science-policy nexus.

Structure of the Book

Through case studies, analyses, and commentaries, written by an international, interdisciplinary group of leading scientific, legal, and policy scholars, the book provides an overview of some of the limitations in current approaches to science for policy and tools and a vision for a more forward-looking, anticipatory environmental science. We have found that case studies are a critical educational tool for scientists and others. They provide concrete examples of problems and solutions as well as lessons learned when damage does occur to health or ecosystems. Such concrete examples are even more important when discussing a broad, difficult-to-conceptualize principle like precaution and its application in science and policy.

The book is divided into six parts that frame the various aspects of the implications of the precautionary principle for science and science policy. In general, the chapters in this volume provide overviews to particular limits in science, methodological changes, and ways to improve the science-policy interface. It would be impossible to take any one scientific issue—for example, genetic engineering—and give it the thorough scientific treatment it deserves. It would also be impossible to engage in a detailed discussion on particular methods in science—for example, differences between frequentist and Bayesian statistics.

Our goal with this book is to allow scientists to step back from the detailed, issue-specific debates in which they engage daily and to consider the broader implications of their work and environmental science in general. Many of the issues discussed throughout the book—how we characterize uncertainty, how cumulative and interactive effects are examined, the integration of qualitative data into science, and the role of interdisciplinary collaborations—are not limited to single disciplines. They are part of a broader debate on the evolution of environmental science and its role in policy. One novel issue that the book brings to the fore is the need to build links between scientists studying risks and those studying and developing solutions. A more precautionary approach to policy requires both.

The authors in this volume represent a wide range of disciplines and cultures. Many have been active participants in the evolution of the science and policy issues they address in their chapters. As such, they bring vast practical experience into the evaluation of complex environmental and health risks—

and the often controversial nexus of science and policy. Although the precautionary principle has often been portrayed as a concept of Western, industrialized countries, it is important to note that some of the authors in this volume are from developing countries.

Part I presents reflections and analyses from the perspective of three scientists on the importance and role of the precautionary principle in science and policy.

Part II discusses the implications of the ways we choose to act or not act in the face of uncertainty. A starting point for exploring science and the precautionary principle is to discuss the foundations of science and changes in its underlying assumptions and practice that would be needed to more effectively deal with complex risks.

Part III is the heart of the book. A number of case studies—on fisheries, chemicals, climate change, genetically modified organisms, and biodiversity—explore the various types of uncertainties in studying complex risks and how they are currently addressed in science, as well as the implications of uncertainty for public policy. The case studies provide concrete examples of how the conduct of science can inhibit precautionary policies and how it can support them.

Part IV explores the complexities of the science-policy interface and how that interface differs between regions. The section also examines lessons for improving the way science is integrated into public policy.

Part V outlines a new, forward-looking role for science in implementing precautionary policies—that of developing alternatives and solutions to harmful activities and technologies. Many environmental scientists have been trained to avoid intervening in production systems and products: that is the realm of policy and engineering. The authors in part V argue that science can be a much more effective tool if we use it to achieve positive goals for society, while avoiding the unintended consequences of human activities, although these can never be risk free.

Part VI builds on the earlier case studies and analyses to begin outlining a road map for a scientific method that more effectively addresses uncertainty, has a more dynamic interface with policy, and can lead to early warnings and anticipatory, preventive actions.

We believe that the chapters in this volume can inform critical reflection on environmental science and its application in policy. Such reflection is necessary if we are to avoid the problems of past and leave our children a diverse, healthy world.

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CONTENTS

PART I

Scientists' Perspectives on Precaution, Science, and Policy

Through case studies, analyses, and commentaries, this volume presents a series of perspectives on the role and implications of the precautionary principles in the conduct of environmental science and policy. In this section, three scientists analyze the influence of the precautionary principle on science, policy, and their own work.

In chapter 1, Joel A. Tickner examines some of the limitations and opportunities for environmental science in supporting precautionary decisions. He argues that the principle presents environmental scientists with a unique opportunity to help refine scientific tools and structures and to participate in a more proactive use of science that not only anticipates harm but contributes to the integrity of health and ecosystems.

Based on his involvement in environmental science and policy debates at home in the Philippines and internationally, Romeo F. Quijano has developed a conceptual framework for thinking about the precautionary principle in science and policy. In chapter 2, he argues that precaution requires substantial changes to the way science is conducted for policy and to the policy structures themselves.

Barry Commoner, considered by many to be the father of the American environmental movement, reflects in chapter 3 on his experience addressing risks where precaution was not taken. He notes that because so little is known about human and ecological systems, the sensible approach to complex risks, such as chemical and biotechnology, is to be cautious.