Chapter 2

THE PRECAUTIONARY PRINCIPLE IN PRACTICE: A MANDATE FOR ANTICIPATORY PREVENTATIVE ACTION

David Santillo, Paul Johnston, and Ruth Stringer

Our ability to protect our environment and to ensure that our exploitation of ecosystems is sustainable depends on our capacity to identify environmental threats and to prevent serious or irreversible harm before it occurs. At the same time, we must recognize that ecosystems are complex entities that can neither be defined explicitly nor described fully, other than through creation of artificial boundaries. This leads effectively to the exclusion of some elements of the ecosystem from further consideration; that is, such elements are "externalized" and are not amenable to description or quantification. Berg and Scheringer (1994) derive the term "overcomplexity" to describe the manner in which the spatial relationships and evolution of ecosystems over time are both unpredictable and impossible to examine to a degree sufficient to reveal their detail and derivative properties. Furthermore, characteristics of undamaged ecosystems (reference conditions) that are meaningful and representative, including variability in time and space and against which ecosystem stresses and damage can be gauged, are likely to be impossible to define.

Scientific research undoubtedly has the ability to improve our understanding of ecosystems, particularly the relationships between organisms and their environment and pathways of energy, nutrient, and contaminant flows.

This may, in turn, lead to a reduction in the level of those uncertainties that have been identified. Nevertheless, all scientific determinations are bound by the largely arbitrary constraints of experimental design and the need to control, as far as possible, all variables that lie outside the study boundaries. Further analysis of a particular system can never address those properties about which we remain ignorant, other than if such properties are identified by chance and are then amenable to analysis. Moreover, natural systems are characterized by complex processes and networks of interaction. It is generally not possible to define precisely where, or even if, chains of cause–effect relationships begin and end. Substantial irreducible uncertainties, or indeterminacies (Dovers and Handmer 1995; Wynne 1992), will always remain as barriers to comprehensive descriptions and predictions of ecosystem function (see figure 2.1).

The Regulator's Dilemma

It is this background against which regulatory decisions are required in order to avoid systematic environmental degradation. With regard to the limitation of damage to ecosystems and the maintenance of their viability through protection or sustainable exploitation, it has long been recognized that "prevention is better than cure" (Bodansky 1991). Clearly the deferral of action until such time as a potentially impacted system can be fully described and the consequences of a particular stressor can be reliably quantified or predicted is not a responsible option, first because such analytical certainty will never be achieved and second because serious or irreversible damage may result in the meantime. Research frequently demonstrates that ecosystems possess greater complexities and are harder to define and predict than previously thought. Overall, while much research funded as part of ongoing regulatory processes is invaluable, it is rarely able to resolve the dilemmas that lead to its commissioning. Environmental regulators are frequently presented with the need to take action to prevent, or avoid the potential for, damage to the environment or human health in the face of considerable uncertainty, an unquantifiable degree of ignorance, and inherent indeterminacies, a situation Bodansky (1991) terms the "regulator's dilemma."

Numerous approaches have emerged in attempts to resolve, or avoid, this dilemma. Approaches based on the assessment and management of risk have perhaps received the greatest attention in recent years, relying essentially on the application of techniques developed in engineering sciences to the forecasting of trends and impacts in more complex and poorly defined natural systems. Risk-based approaches extend from the view that environmental risks can be quantified and managed at sustainable and "acceptable" levels,

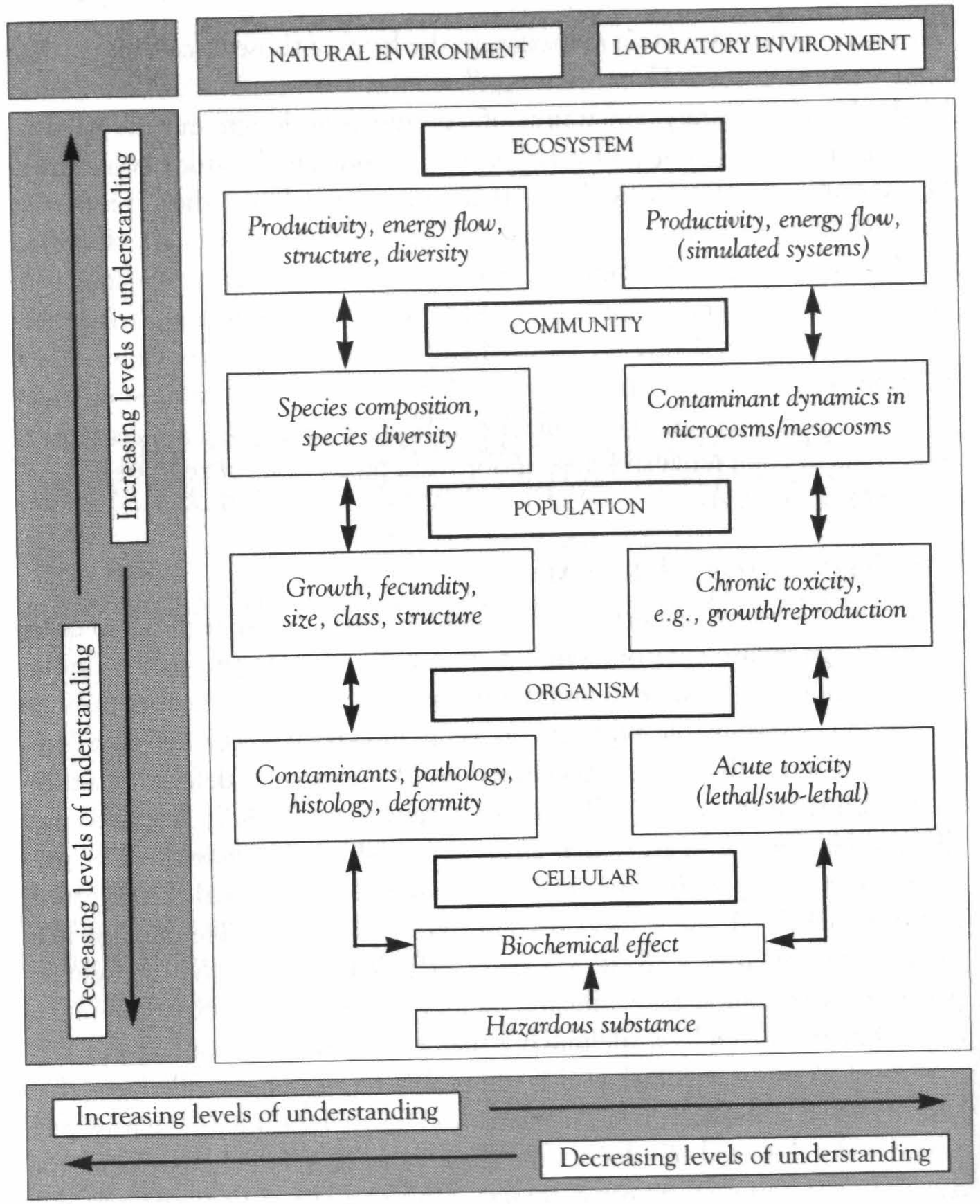

FIGURE 2.1. Diagramatic representation of the relationship between the level of biological organization of a system, both natural and artificial, and its amenability to description and understanding.

either in absolute terms or relative to the benefits accrued. In broad terms, risks are determined from a combination of the intrinsic hazards presented by a chemical or activity and measurements or estimates of exposure to that agent. Such approaches assume that it is possible to know enough about the hazards of, and exposure to, a particular chemical or activity to enable calculation of the risks in a reliable manner.

In practice, risk assessments tend to employ simplistic and subjective assumptions about ecosystem structure and the flows of energy and matter that characterize them. Frequently they lack the breadth and quality of data necessary to facilitate prediction of impacts. Uncertainties and indeterminacies arising from ecosystem complexity are rarely made explicit. Failure to recognize and account for such unknowns can have severe consequences.

It is often assumed that "sound science" will ultimately provide the central basis for environmental legislation. Clearly there is an ongoing need for pure and applied knowledge to facilitate improved understanding of ecosystem function and contaminant behavior (Ducrotoy and Elliot, 1997), but such knowledge will always be incomplete and, in itself, can form only part of responsible policy and management systems. Scientific analyses and deductions undoubtedly serve policy makers with valuable information, and this can be used to identify hazards and to prioritize and guide decisions of a more precautionary nature (Funtowicz and Ravetz, 1994). Fundamentally, however, such assessments cannot replace the decision-making process itself (Power and McCarty 1997; Wynne 1992).

The Need for Precaution

Recognition of existing and, indeed, inherent limitations to scientific knowledge, coupled with the ongoing necessity to take action, wherever possible, to prevent damage before it has occurred, even in the absence of proven causality, led to the formulation of an alternative approach to environmental protection, which is fundamentally precautionary in nature. The Precautionary Principle, or the Principle of Precautionary Action, undoubtedly has its origins in the German federal government's approach to environmental protection, the *Vosorgeprinzip*, developed in the early 1980s (DoE, 1995; FRG, 1986; McIntyre and Mosedale, 1997). This guiding principle had at its core the recognition that, in order to meet the responsibility of protecting the natural foundations of life for future generations, irreversible damage must be prevented.

The Precautionary Principle not only permits action to be taken in the absence of conclusive evidence of cause–effect relationships, but also stresses that action in anticipation of harm is essential to ensure that it does not occur (Bodansky, 1991). The adoption of such an approach implies a shift in emphasis in favor of a bias toward safety (McIntyre and Mosedale, 1997), ensuring that any errors of judgment made will lead to excess, rather than inadequate, protection.

The principle has perhaps gained its highest profile within the field of marine environmental protection, especially with respect to inputs of haz-

ardous chemicals, although it is equally applicable to other fields of environmental legislation. Ultimately it has application at the science–policy interface not only in relation to the control of the release of harmful chemicals to environmental media, but also to the release of biological agents (including genetically modified organisms), the management of resource exploitation (e.g., fisheries), and, indeed, any field in which human activity might have substantial, far-reaching, or even irreversible impacts.

Incorporation of the Precautionary Principle into International Environmental Law

Since its initial formulation, two trends have been apparent in the development of the principle. First, the principle has gained increasing acceptance as a fundamental guiding paradigm within national and international legislative frameworks. It now forms a fundamental component of numerous legislative agreements on the protection of the environment, as discussed below. At the same time, however, the principle has veered away from a strong mandate for precautionary action toward a universal sentiment with little guidance on practical implementation. The principle has been defined in a number of different ways and is increasingly cited without explicit definition. As a result, there is a danger that the initial intentions of the principle may become increasingly diluted or effectively lost during the implementation of some of the legislation in which it is incorporated. There is, therefore, an urgent need to look again at the principle of precautionary action and what it means in terms of practical application.

While the earliest origins of the *Vosorgeprinzip* remain unclear (DoE, 1995; Gray and Bewers, 1996), its most complete definition is probably that given in a German federal government report on the protection of air quality (DoE, 1995). This definition essentially comprises four elements, that damage should, as a priority, be avoided; that scientific research plays an essential role in identifying threats; that action to prevent harm is essential, even in absence of conclusive evidence of causality; and that all technological developments should meet the requirement for progressive reduction of environmental burden. Of these elements, the requirement for action in the absence of analytical or predictive certainty has become the most widely used condensation of the principle.

For example, the Ministerial Declaration, which arose from the First International Conference on the Protection of the North Sea, held in Bremen in 1984, incorporated the statement that North Sea States must not wait for proof of harmful effects before taking action. This commitment was made more explicit in the Ministerial Declarations from the 1987 and 1990

North Sea conferences (MINDEC, 1987, 1990). Although by no means its earliest use, the explicit inclusion of elements of the principle within the 1987 North Sea Ministerial Declaration (MINDEC, 1987) represented a highly significant endorsement, which, undoubtedly, subsequently facilitated its adoption by other regional seas and global marine fora. Notable among these are the Oslo and Paris Commissions (protecting the North East Atlantic) (OSPAR, 1992, 1998), Barcelona Convention (Mediterranean) (UNEP, 1996), and the London Convention on dumping of wastes at sea (LC, 1972, 1996).

It has also gained wider application in legislation designed to prevent environmental degradation, notably the 1987 Montreal Protocol regulating ozone depleting substances, the 1992 Climate Change Convention, the Rio Declaration on Environment and Development (1992), and the 1995 United Nations Agreement on High Seas Fishing (UN, 1995). McIntyre and Mosedale (1997) provided a more comprehensive review.

Toward Implementation of the Precautionary Principle

Although the principle has been widely recognized and incorporated into international treaties and conventions, its implementation has been more limited. One of the prerequisites for effective implementation, following agreement and ratification of a particular treaty, is the definitive interpretation of the principle in terms of practical measures. Without such interpretation, the principle would likely remain as a token theoretical ideal that may be acknowledged and subsequently ignored. The degree to which the principle has been interpreted in relation to programs and measures varies greatly between agreements. Perhaps the most transparent and definitive commitments to implementation relate to international agreements for the protection of the North Sea and the North East Atlantic maritime area.

North Sea Ministerial Declarations

The Ministerial Declaration arising from the Second North Sea Conference (MINDEC, 1987) recognized that, in order to safeguard the marine ecosystem, it would be necessary to reduce polluting emissions. Particular focus was placed on substances that possessed the hazard marker properties of persistence, toxicity, and liability to bioaccumulate:

> especially when there is reason to assume that certain damage or harmful effects on the living resources of the sea are likely to be caused by such substances, even when there is no scientific evidence to prove a causal link between emissions and effects (the principle of precautionary action) (MINDEC, 1987).

This interpretation was further strengthened by the Third and Fourth Ministerial Declarations (MINDEC, 1990, 1995), the latter committing to continuous reduction of such inputs with a target of their cessation within one generation. In the sense that this commitment addresses a very broad group of chemicals on the basis of their inherent hazardous properties, without the requirement for individual assessment of causality, it is truly precautionary in nature. Precisely how effectively such measures will translate to precautionary action remains to be seen.

Oslo and Paris Commissions and the OSPAR Convention

The 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR, 1992) adopted similar provisions, although the specific timeline for implementation (the "one generation goal") was only adopted at the OSPAR Ministerial meeting in Sintra, Portugal, in July 1998 (OSPAR, 1998). Again, the commitment has been made to make every endeavor to achieve "zero discharge" (cf. discharges, emissions, and losses) for all hazardous substances to the OSPAR maritime region by 2020, with the aim of achieving concentrations close to zero in the environment for synthetic substances and close to background for naturally occurring substances. The convention participants envisioned that implementation would be a staged process, with action on a priority list of chemicals of particular concern within a more limited timeframe. It is also acknowledged that the involvement of industry and other international organizations will form a vital part of effective implementation programs to meet the stated objectives (OSPAR, 1998).

The London Convention and Its 1996 Protocol

The language of the London Convention (1972), a global forum under the auspices of the International Maritime Organization (IMO) that regulates the dumping of wastes at sea, includes a general requirement to take all practicable steps to prevent pollution from dumping operations. The 1996 Protocol to the Convention (LC, 1996) makes explicit reference to the precautionary approach as a general obligation (Article 3), with a practical, though generic, requirement for preventative measures to be taken whenever harm is likely to result from the dumping of wastes, even when conclusive evidence of causality is unavailable. Although such preventative measures are not elaborated further under Article 3, the obligation is also made that action does not simply shift the potential for pollution from one environmental compartment to another.

The current prohibitions on the dumping of both radioactive and industrial waste by contracting parties, resulting from amendments in 1993 to the 1972 convention, could be viewed as essentially precautionary in intent because, again, action is required in the absence of specific assessments of cause and effect. The 1996 protocol, effectively even more restrictive, adopts a reverse list approach within which only a limited number of specified types of waste may be considered for dumping, subject to detailed waste characterization and assessment. For each of the listed wastes (currently including dredge material, fish offal, sewage sludge, inert geological material, vessels, human-made structures at sea, and bulky items comprising iron and steel by small island nations), characterization of the nature and content of the waste is required according to generic guidelines (LC, 1997). Specific guidances for each waste category currently remain under development.

Although such evaluations are essentially case-by-case assessments of hazard and likely impact, the generic guidelines stress the importance of the recognition and consideration of uncertainties in the prediction of impacts in a precautionary manner. One direct interpretation of a precautionary approach in this regard is the provision that

> if a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.

The 1996 protocol remains open for signature. Early ratification is clearly essential in order to move the convention to a more precautionary basis and would be highly significant with respect to the global nature of the treaty.

The Rio Declaration on Environment and Development

The Rio Declaration (1992) provided an opportunity for the Precautionary Principle to gain wider currency in international agreements and national legislation. Nevertheless, the definition of the principle within the declaration is relatively vague, giving little indication as to how it should be applied in practice. The declaration reads:

> Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (RioDEC, 1992).

This results in part, of course, from the need to reach a consensus declaration among a diverse group of countries. Moreover, the Rio definition introduces to the principle the provision that measures should be cost-effective, which could imply that precautionary action might be subject to

cost-benefit analysis; that is, an additional evaluation step in which the advantages and disadvantages of such action are weighed up, primarily in financial terms. In simple terms, it is feasible that if the financial costs of taking necessary precautionary action are deemed too great, such action may be ruled out. This concern is by no means unwarranted. Indeed, the 1994 U.K. strategy for sustainable development uses a definition of the principle on the basis of the Rio definition, making explicit the proviso that precautionary measures should be taken only if

> . . . the likely balance of costs and benefits justifies it (DoE, 1995).

Such conditions are becoming more prevalent in the various definitions and interpretations of the precautionary approach and threaten to undermine the fundamental purpose for which the principle itself was developed by subsuming it simply as one "tool" within a risk-based approach. This is discussed further below and, more extensively, by Santillo et al. (1998).

The EC Treaty 1993: Establishing the European Community

While historically and still primarily an economic entity, the EC Treaty (EC 1993) summarizes the European Community approach to the environment under Article 130. Interestingly, while the treaty bases environmental legislation on the Precautionary Principle, it sees the Principle of Preventative Action as an additional and separate obligation. No further definitions are given, and it remains unclear precisely how the Precautionary Principle would be implemented other than through effective, preventative action. Moreover, in practice there would appear to be little room for truly precautionary measures to be implemented within existing directives on environmental issues. Cost-benefit analysis again plays a central role, as does the overriding commitment to the economic and social development of the community and its regions and the maintenance of the single European market. In the regulation of chemicals, the community has clearly adopted a risk-based approach, and the absence of precaution is particularly apparent with respect to current permissive legislation on nonassessed chemicals. The processes by which the production, marketing, and use of chemicals are regulated in the EU and in several member states are currently undergoing review.

United Nations Agreement on High-Seas Fishing

Recognition of the failure of existing management initiatives to ensure sustainable exploitation in numerous fisheries around the world (e.g., North Sea—Cook et al., 1997; Serchuk et al., 1996—Canadian cod stocks; Myers and Mertz, 1998) initiated the development of a more precautionary approach to the exploitation of fish stocks (Stephenson and Lane, 1995). Such approaches differ fundamentally from those aimed at controlling or eliminating pollution, as those relating to fisheries work from the assumption that some level of continued exploitation is ultimately sustainable. They also differ in a number of fundamental ways from traditional approaches to fishery management, primarily in their recognition of the underlying importance of species conservation and the mechanisms they incorporate to address uncertainties and indeterminacies (Dayton, 1998).

The 1995 United Nations Agreement on the Conservation and Management of Straddling Stocks and Highly Migratory Fish Stocks (UN, 1995) includes specific reference to the need to ensure long-term sustainability through adoption of a precautionary approach. The agreement goes on to describe, in general terms at least, how such an approach would be applied, including improved science-based decision making, development of techniques to address and account for uncertainties in stock size and productivity, and the implementation of methods to reduce by-catch of nontarget species (i.e., unwanted catch of other organisms, including seabirds and sharks, resulting from fishing efforts directed at the target species).

The agreement has yet to be ratified and implemented, despite the urgency imposed by the very poor state of many fisheries on a global basis. Meanwhile, the development of thinking within the precautionary approach to fisheries continues. Recently, Myers and Mertz (1998) suggested allowing each fish cohort, or year group, to spawn at least once before they are subject to commercial fishing as an additional practical and more precautionary measure to safeguard long-term sustainability. Nevertheless, the interpretation of the principles in this field still lag considerably behind their application to the control of chemical contaminants.

Science and the Precautionary Principle

It has been argued (Bewers, 1995; Gray, 1990) that the Precautionary Principle is, in essence, unscientific as it promotes preventative action even in the absence of proof of causality. Risk-based approaches are commonly presented as the science-based alternative. Such views do not appear to recognize that the principle is founded on the use of comprehensive, co-ordinated research in order to guide precautionary action. The fundamental difference between risk and precautionary approaches is not that one uses science while the other does not, but simply the way in which scientific evidence is employed for decision making at the science–policy interface. The precautionary

approach is, to a degree, less prescriptive in its evaluation of the need for action, in that it does not rely on a need explicitly to define and quantify risks, but rather on the more general application of scientific research as a means for the early detection of dangers to human or wildlife health or to the environment as a whole. The commitments within the North Sea and OSPAR processes, for example, clearly have a firm basis in science, as they rely on scientific research to identify those properties and, thereby, substances or groups of substances that are of concern. Nevertheless, in the requirement to address all substances with those properties, the legislation is also clearly precautionary in nature. It is in this manner that science can continue to play a central role in the formulation and implementation of effective environmental legislation without the need for a risk-based approach.

The Precautionary Principle is, in its own right, a crucial scientific tool to mitigate threats to the environment (Johnston and Simmonds, 1990, 1991). Clearly it is not intended as a substitute for a scientific approach but rather as an overarching principle to guide decision making in the absence of analytical or predictive certainty. It provides a mechanism to compensate for inherent uncertainty and indeterminacy in natural systems and a central paradigm for responsible, timely, and definitive preventative action.

Gray and Bewers (1996) suggested that, in the context of the North Sea Ministerial agreements, the Precautionary Principle should be implemented through the employment of pessimistic assumptions in standard risk-assessment procedures. Such an approach captures neither the spirit nor the provisions intended for the principle and threatens to undermine its utility by subjecting it to the self-same limitations of risk assessment and management procedures. Their arguments are challenged in more detail by Santillo et al. (1998).

In short, the Precautionary Principle cannot and should not be subsumed under a risk assessment mechanism, as is also currently implied within guidance for risk assessment and management in the United Kingdom (DoE, 1995), to be invoked only when an risk assessment is judged to have failed (Brown, 1998). Neither should risk assessment be seen as a means of implementing the Precautionary Principle, as one tool in the full suite of risk assessment methodologies. Contrary to Brown (1998), the Precautionary Principle should operate at all times in recognition of the fact that assessments of hazards, exposure, and risk, despite their apparent objectivity, can never alone ensure an adequate level of environmental protection. Indeed, if the principle is not operational at all times, its effectiveness is greatly diminished.

Implementation into the Future

If the Precautionary Principle is to act as a truly effective means of ensuring that serious and irreversible environmental damage is avoided, continued development of its interpretation and implementation within international treaties and conventions is essential, in addition, of course, to the timely ratification of the treaties themselves. As noted by McIntyre and Mosedale (1997), the principle is now very much a norm of customary international environmental law, but it is essential that its incorporation as such results in more than "lip service" to precautionary measures. As one example, the obligation for North East Atlantic States to meet the "one generation goal" with respect to discharges, emissions, and losses of hazardous substances will require urgent implementation of precautionary action.

In order to facilitate the translation of the principle from theory to practice, it may be necessary to revisit and reaffirm the necessity for, and initial intentions of, the precautionary paradigm (see also Santillo et al. 1998). The Precautionary Principle or, more definitively, the Principle of Precautionary Action, could be defined in terms of the four elements below, based largely on the early formulations of the principle in German federal law (FRG, 1986).

Implementation of the Principle of Precautionary Action demands that:

1. Serious or irreversible damage to ecosystems must be avoided in advance, both by preventing harm and by avoiding the potential for harm;
2. High-quality scientific research is employed as a key mechanism for the early detection of actual or potential impacts;
3. Action to protect ecosystems is *necessary*, not simply possible, even in the presence of uncertainty, ignorance, and irreducible indeterminacy; and
4. All future technical, social, and economic developments implement a progressive reduction in environmental burden.

Such an interpretation would reaffirm the principle as a mandate for anticipatory action of a preventative nature.

Bodansky (1991) argued that the choice faced by environmental regulators will always be between one risk and another and that the precautionary withdrawal of one process may simply lead to the transfer of the problem to other media. In this regard, it is essential to recognize that the Precautionary Principle is not intended to be applied in a simple one-sided approach to decision making, without consideration of the potential hazards of alternatives. For action to be truly precautionary, it must also ensure that the fundamental objective of the reduction of overall environmental burden is

strictly observed. If this requirement is not observed, then the goal of environmental legislation would not be guaranteed.

In order to meet this objective, it must be recognized that a decision, for example, to prevent the use or discharge of a certain chemical may require a fundamental reevaluation of societal need for that product and may not always imply simple substitution with an alternative. For example, if the commitments within the North Sea Ministerial process (MINDEC, 1995) and, more recently, under OSPAR (1998) are to be met, particularly to achieve zero discharge, emissions, and losses of hazardous substances to the North Sea and North East Atlantic regions respectively, changes to industrial practice, process, and even products will undoubtedly be necessary.

Conclusion

During the ten to fifteen years since its early formulation and development, the Precautionary Principle has, therefore, been progressively incorporated as a guiding paradigm in treaties and conventions designed to protect the environment. At the same time, however, there has been relatively little focus on the development of mechanisms by which precaution may be effectively implemented.

The initial development of the Precautionary Principle stemmed from the necessity for a mechanism to address uncertainties and limitations to scientific knowledge at the science–policy interface. It is of fundamental importance, therefore, that the principle should not be weakened to a point at which it is seen merely as an ideal to be noted but ignored. Furthermore, attempts to make the principle subject to cost-benefit analysis or to reduce its status to one of a suite of tools within risk-based approaches must be strongly resisted. Such changes threaten to prevent the principle from serving the essential role for which it was designed.

The North Sea Ministerial process and the OSPAR Convention provide some of the strongest bases yet for the practical implementation of the Precautionary Principle as it applies to the protection of the marine environment, particularly with regard to hazardous substances. It is now essential to ensure that the principle is strictly observed during the further development of these agreements, and particularly during the development and application of practical programs and measures to address threats to the marine environment. Moreover, it is important that similar provisions are extended to provide similar levels of protection to other compartments of the environment. It is only through adopting mechanisms that enable and, indeed, require precautionary action that we will be capable of ensuring that environmental damage and threats to human health can, wherever possible, be avoided in advance.

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Chapter 3

THE PRECAUTIONARY APPROACH TO CHEMICALS MANAGEMENT: A SWEDISH PERSPECTIVE

Bo Wahlström

The Precautionary Principle has always held a strong position in the Nordic countries and Germany. The origins of the principle in environmental legislation may be traced back to the late 1960s. This chapter explores several examples of the application of the Precautionary Principle in Sweden, as well as examples when it should have been used. This chapter discusses the future of chemicals policy in Sweden as well as the concept of chemical sunsetting. The chapter concludes by noting the need for generic approaches toward unwanted chemicals as well as the need to pay attention to chemicals in products. Criteria such as persistence and bioaccumulation should be used to identify those chemicals that should be phased out in the future. In the long term, perspective global agreements on unwanted chemicals are also needed.

Historical Background of the Precautionary Principle in Sweden

The written history of the Precautionary Principle in Swedish legislation can be traced back to the Government Commission on Environmental Management, established in 1969, which delivered its report to the Swedish government in the Spring 1972. On the basis of the report, the government

For all those who work on behalf of the
environment, public health, and sustainable agriculture.
And to all those beings that suffer from environmental damage,
may the Precautionary Principle bring a better world.

Protecting Public Health & the Environment

Implementing the Precautionary Principle

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