



The Precautionary Principle and Scientific Research Are Not Antithetical

The Precautionary Principle is intended to protect human health and the environment. To serve these goals effectively, precautionary action must be coupled with concurrent research to decide whether the action taken is in fact protective.

The essence of the Precautionary Principle is that society should not wait until it knows all of the answers before attempting to protect against significant harm. The Principle is succinctly stated in the 1989 Rio Declaration (1):

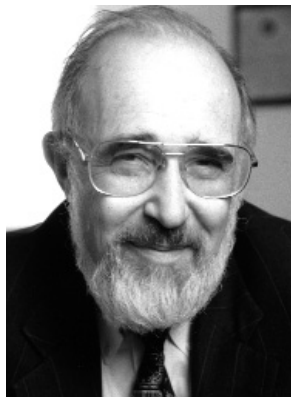
Nations shall use the precautionary approach to protect the environment. Where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone cost-effective measures to prevent environmental degradation.

The Precautionary Principle has been increasingly included in national legislation and international treaties as an appropriate foundation for environmental decision making (2–6). Unfortunately, supporters of precautionary actions have often generalized their position to one that appears antagonistic to science, despite the fact that science has usually provided the initial information about the threat. This antagonism to scientific research among those advocating action often reflects their justified frustration at the slowness of the scientific process, the weakness of scientific methodology, the uncertainty of risk assessments, and their opponents' overuse of the argument that additional research is needed before any action can be taken. Advocating action without waiting for definitive science has been interpreted by some as a reason to stop research. But the opposite should be the case: acting on the Precautionary Principle should automatically trigger research.

Invoking the Precautionary Principle is inherently an admission that we may be making a costly mistake. By definition, action founded on incomplete scientific information has some finite risk of being unnecessary or even harmful. If reasonable scientific certainty existed, invoking the Precautionary Principle would not be needed. Further, it is axiomatic that the precautionary action imposes a significant economic or social cost on at least some segment of society; if there were not a significant cost, the precautionary action would be taken without the need to invoke a special principle to justify the action. Taking action in the circumstances of uncertain benefits and significant cost can be responsible only if followed up with appropriate research to determine if the action does in fact deal effectively with the "threat of serious or irreversible damage" that led to its adoption.

The precautionary action may also provide the best opportunity to narrow uncertainty about environmental cause and effect. This uncertainty, which is a requirement for considering action under the Precautionary Principle, often reflects inherent scientific limitations in extrapolating laboratory findings to the real world or in disentangling the many confounding factors involved in epidemiologic or ecologic studies. The closest that we can come to overcoming these limitations is to take advantage of situations in which there is a controlled perturbation of the level of exposure in the real world. Arbitrarily changing exposure levels through precautionary regulatory actions

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while measuring the levels of unwanted effects in society approximates controlled laboratory conditions. Unfortunately, regulators have a long history of avoiding research that would determine whether a current regulatory action is justified. Such shortsightedness is perhaps justified when the decision is supported by reasonable scientific certainty. However, the essence of

the Precautionary Principle is to take action despite uncertainty, so there is a much greater need to determine if the action is effective in achieving its goals. Further, such research would be directly relevant to cause-and-effect issues of substantial concern to the general public rather than seeming esoteric.

There will be times when society acts on the Precautionary Principle that it will not be possible to rapidly ascertain whether the action has been warranted or effective, for example, because of inadequate power for any feasible epidemiology study. However, the potential for concurrent study of the efficacy of a proposed precautionary action should be automatically explored rather than, as now, left to chance. When shorter term evaluation is not feasible, longer term approaches to understand the underlying issues should be undertaken.

Research should also accompany precautionary actions to provide assurance that the real cause is being addressed. The uncertainty inherent in a precautionary action means that we could be overlooking the appropriate preventive action in favor of an erroneous approach. The sooner we know that we are making a mistake, the quicker we can devote resources to address the real cause of the unwanted effects.

Even the simple confirmation of a causal relationship between the removal of an environmental threat and the amelioration of adverse effects could be of great value. It would provide a firm foundation to more effectively intervene in the future or on which to base mechanistic understanding that would prevent recurrence of similar threats. In contrast, if after the precautionary action is taken, substantial uncertainty remains as to whether it was justified, it will be more difficult to build upon the decision.

Our society should be very willing to invoke the Precautionary Principle to protect public health and the environment, particularly when the scientific uncertainty includes a potentially disastrous worst-case scenario. However, simply stated, the more precautionary we are, the more often we will have acted unnecessarily. Responsible precaution requires that we accompany proposals for precautionary actions with a research agenda to decide if the actions, once taken, are justified. The Precautionary Principle works soundly only when those who invoke it accept that the precautionary action encompasses and automatically triggers research designed to concurrently determine the wisdom of the precautionary action.

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