

# Ecological Risk Assessment: *Use, Abuse, and Alternatives*

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## Introduction

Debates over the role of ecological risk assessment should start with agreement on a definition. Much of the confusion and divisiveness over risk assessment applied to ecological problems is caused by using the same terms but attributing different meanings to them. Indeed, in the classical applications of risk analysis (automobile, life, and health insurance, industrial failures, natural disasters, accident prevention, etc), the definition, if not the practice, of risk assessment is different from that typically used in ecological risk assessment. The concept of ecological risk assessment I refer to here is best defined along the lines of “. . . a way of examining risks so that they may be better avoided, reduced, or otherwise managed.” (Wilson and Crouch, 1987); “. . . a process to evaluate the likelihood of undesirable effects on ecological receptors from exposure to one or more stressors . . . .” (Regens, 1995); and “. . . a series of questions directed to the available data to analyze the expected risk.” (Patton, 1995). There are many other risk assessment concepts, but these are beyond the discussion here: human health risk assessment, comparative risk assessment, engineering risk assessment, environmental risk assessment, risk communication, risk regulation, risk reduction, risk allocation or justice issues, and a suite of decision making paradigms.

Opinions on the use of ecological risk assessment in public policy analysis are diverse; they range from positive: “. . . scientifically credible evaluation of the ecological effects of human activities” (Suter, 1993) to skeptical: “. . . one more hurdle on the road to a permit” (Webster and Connett, 1990) to dismissive: “. . . risk assessment is a sham . . .” (Merrell, 1995). The “middle ground” is populated by a disjointed array of opinions because the debate over the proper role of ecological risk assessment defies the simplistic categorization of right vs. left, conservative vs. liberal, technocratic vs. democratic, and “green” vs. “balanced use.” Neither the debate nor the tool is new, but the intensity of the debate has increased as ecological risk assessment has become the policy tool of choice in some organizations (Lipton *et al.*, 1993; Lackey, 1994, 1995; Regens, 1995).

Some critics contend that risk assessment is “. . . deeply flawed and subject to abuse” (Montague, 1995). Its use to help resolve public policy on human health issues is equivalent to “premeditated murder” (Merrell, 1995). Some people *will* die or suffer disease by a policy decision *when* society makes a decision as to *how many* deaths will be tolerated for the benefits obtained. When used in making policy on ecological issues, the users of risk assessment have accepted a form of “ecological triage” -- administratively deciding which individuals, populations, or species will live and which will die (Montague, 1995).

Another type of criticism is the contention that ecological risk assessment as currently practiced is nothing more than “incorporating ecology into the paradigm of human health risk assessment, laying on an underlying, unsophisticated, ecological veneer” (Karr, 1995). While not morally repugnant to such critics, many current applications of ecological risk assessment are inappropriate. Further, such a position questions the assertion that ecological “health” is analogous to human “health” and, thus, that the approaches and tools of human health risk

assessment can be easily adapted to ecological problems (Menzie, 1995).

Ecological risk assessment is not without strong supporters (Suter, 1993). Generally, supporters tend to come from regulatory agencies (and their political and scientific advisors) and much of the “regulated community” (and their political supporters and scientific advisors). Some governmental agencies are strongly supportive, to the point of implementing policies and guidelines (Patton, 1995). Much of the scientific and engineering infrastructure has embraced the approach. “How to” training courses and symposia are plentiful. Books and technical papers explain in detail the technical intricacies of conducting ecological risk assessments (Suter, 1993; Molak, 1996).

Other advocates of ecological risk assessment, although far from effusive, acknowledge a useful role: “Risk assessment is a very flawed tool, but, given the current process of policy formulation, it has a legitimate role to play.” (Funke, 1995). In an ideal application, ecological risk assessment “. . . should be a purely technical analysis driven by scientifically acquired data, and free from social bias” (Fairbrother, *et al.*, 1995).

What is the appropriate use of ecological risk assessment? When is its use inappropriate? How is it misused? What are the alternatives? Is it underused, and would its increased use bring rationality to public policy? I will argue here that ecological risk assessment (1) has a legitimate, appropriate, but limited role in science, policy analysis, and policy implementation; (2) is often misused, and in some circumstances abused, both naively or intentionally; and (3) is not the only approach and others ought to be seriously evaluated.

### Appropriate Use

Risk assessment has been used effectively in many fields as an aid in decision making. It is used to estimate the likelihood of an event (i.e., automobile fatality, flood, nuclear accident, etc), clearly recognized as “adverse.” Its typical use in decision making with regard to ecological issues is similar: estimating the likelihood of a certain, defined event occurring (e.g., what are likely mortality consequences to biota of the use of a particular chemical?). The key requirement is that the “consequence” is “adverse” by definition, which enables the analyst to conduct the risk assessment (Bartell, *et al.*, 1992; Lackey, 1994, 1997). In classical risk assessment this assumption of what is adverse is easy to justify: a nuclear accident is universally accepted as adverse, as is an automobile crash, a skiing accident, a debilitating heart attack, or an airplane crash. The analog in ecological risk assessment is less clear.

To be technically tractable and credible, the risk “problem” must be defined in fairly narrow terms. Even defined in “fairly narrow terms,” the analysis may be technically quite complex and require sophisticated scientific information. Most often the narrowing is done by a legislative policy mandate [e.g., Comprehensive Environmental Response, Compensation, and Liability Act and how it is implemented (Lipton *et al.*, 1993; Friant *et al.*, 1995)]. The risk

problem then becomes relatively simple analytically [e.g., one or a few chemicals are the stressor causing effects on a few biological components; the effects, if present, are “adverse” by definition (Regens, 1995)]. Such simplification, of course, begs the question of whether this analysis leads to “good” policy options, but it does give the analyst a toe hold on what is “desired” or “adverse” (Friant *et al.*, 1995). Another way to state this perspective is that “risk assessments assume a definition of health conditions.” (Funke, 1995).

Although beyond the scope of the debate here, an obvious potential role of risk assessment is to help allocate scarce resources. Risks need to be managed in our personal lives, companies, and government. How does one compare risks? Potentially, risk assessment offers an approach by *comparing* risks rather than *measuring* individual risks. Such an approach was used by the EPA Science Advisory Board (U.S. Environmental Protection Agency, 1990). The four ecological problems with highest risk were habitat alteration, decrease in biological diversity, stratospheric ozone depletion, and global climate change. Risks such as herbicides, pesticides, toxic chemicals, and acid deposition were medium risk problems. Oil spills, groundwater pollution, radionuclides, acid runoff, and thermal pollution were relatively low risk problems. Therefore, a logical use of risk assessment would be as one tool to help allocate research and regulatory efforts from lower risk problems to higher risk problems. Risk is only one factor in allocating resources, so ecological risk assessment should be only one element in the decision making process.

Whether ecological risk assessment is used to address relatively narrow, technical questions [e.g., toxicological effects of a chemical on a particular biotic component (Friant *et al.*, 1995)] or to allocate scarce government resources (i.e., comparative risk assessment), it is critical to recognize that risk assessment is merely a *tool* in the decision making process. At best, and if used properly, it is a tool that can assist in presenting the likely consequences of various decision alternatives (Woodhouse, 1995).

## Abuse

Concerns about abuse in ecological risk assessment often revolve around the contention that the tool can be used to “support” a predetermined policy position (Merrell, 1995). The metaphor often used to illustrate this concern is that of the “tortured prisoner.” A tortured prisoner will confess to any crime; the confessions are only limited by the creativity and persistence of the prison guards. Such is the allegation about risk assessment and its practitioners: given enough creativity, virtually any policy position can be “supported” by risk assessment. The most common allegation is that the policy questions are formulated in a way that will produce virtually any result, and that the result has the aura of scientific acceptability (Montague, 1995). Those who know the most about how to manipulate the procedures control the discourse -- which questions are asked, and how they are answered (Funke, 1995; O’Brien, 1995).

Another potential abuse is that technocrats and politicians will define risk “problems” in ways that can be “solved” technically, but have little real relevance to the public policy issue. The metaphor often used is the risk assessor looking for his lost keys under the street lamp. Although the keys were most likely lost far from the street light, the risk assessor laments that he has little chance of finding the keys in the dark so why waste time looking there. Although this makes a humorous story, ecology is complex and our understanding is limited, therefore there is a strong tendency to define problems in ways that we can “handle” scientifically, even though the formulation may be policy irrelevant (O’Brien, 1995).

A potential abuse of ecological risk assessment is to apply the same analytical tool to every problem: if your only “tool” is a hammer, every “problem” must be a nail. If every ecological policy problem is viewed from a risk perspective, then it is not surprising that technocrats will try a force fit. The useful role of ecological risk assessment is to help solve fairly narrow, well defined technical questions, not to answer larger, more complex public policy questions.

One of the most serious types of misuse by technocrats is to substitute their values and priorities for those of the public or their elected representatives (Webster and Connett, 1990; Menzie, 1995). In philosophical terms this is illustrated by shifting the scientific “is” to the political “ought.” In science there are no “oughts.” Animals, plants, and ecosystems are neither good nor bad, better or worse, or healthy or sick unless a *value* criterion is applied. “Risk” has no definition in ecology unless someone defines what is adverse (or healthy). Whether the introduction of wheat, horses, or zebra mussels to North America is good or bad depends on the value criteria applied -- not the personal opinions of scientists and risk assessors.

## Alternatives

One obvious alternative to ecological risk assessment is a modification to drop the idea of “risk.” Some have referred to this as “benefits” analysis where the desired benefits are selected by the political process (Principe, 1995). Others refer to “consequence analysis” which simply assesses ecological consequences without defining good or bad, adverse, ecological health, or risk (Lackey, 1996). Eliminating the concept of “risk” in ecological policy problems reduces the number of value-based choices scientists and assessors must make; thus more choices are reserved for democratic processes through accountable decision makers. In some cases it may be that analysts are actually conducting something closer to ecological “consequence” analysis than ecological “risk” analysis.

Another, related approach is “ecological alternatives assessment” (O’Brien, 1995; Pagel, 1995). Alternatives assessment steps back even further from risk assessment and focuses on the questions being asked. Critical public policy questions would not be buried in technical analysis. As with other analytical tools, whoever controls the questions asked in risk

assessment constrains the policy options under consideration (Funke, 1995).

The old concept of benefit/cost analysis, which suffered, justifiably, many of the same criticisms now leveled against ecological risk assessment (Schrecker, 1991), is potentially a viable alternative to ecological risk assessment. Benefit/cost analysis is much closer to a decision making framework than is risk assessment, one of several inputs to benefit/cost analysis. However, it is an illusion that public policy questions can be reduced to a single metric of value (money), but the basic concept of tradeoffs has appeal. Although fraught with analytical difficulty, benefit/cost analysis is closer to the kind of information decision makers actually need from technocrats, but it is subject to the same distortion by improper use of personal values as is ecological risk assessment.

## Conclusion

Over the past few decades there has been a diverse array of “tools” and “paradigms” offered as *the* solution to solve public policy and decision making problems. Is ecological risk assessment just another “tool of the year” that will follow the fate of computer-based modeling, geographic information analysis, management by objectives, total quality management, management reengineering, Delphi, and organizational reinvention? Each burst on the scene and was advocated by some with near religious zeal, only to fall at various rates from favor in lieu of another, newer tool. Though each eventually assumed a useful role as a tool appropriate for some problems under some circumstances but not an overall panacea (Lackey, 1996, 1997).

Ecological risk assessment is a tool that might help resolve some kinds of public policy questions, although policy questions must be fairly narrowly defined and explicitly described to be analytically tractable. This does not mean that they are simple problems, merely analytically tractable. Its most common use will continue to be with questions where the definition of ecological “adversity” is provided by legislation, policy, or arbitrarily assumed by the analyst. Its potential for addressing more complex, and relevant, ecological policy questions has yet to be fully evaluated.

A serious allegation is that ecological risk assessment (along with many other technocratic tools) provides a route to subvert the democratic process (e.g., how does the public decide which ecological changes are adverse and which are beneficial?). The very nature of the process requires the analyst to make many value based decisions -- hence the charge that the process is elitist by its very nature (O’Brien, 1995). In fact, the decision to use risk assessment is a heavily value laden decision. Technical expertise cannot substitute for values and priorities in ecological risk assessment; these are issues of policy, not science.

Ecological systems are complicated and the ecological consequences of decisions are often difficult for the ecologist to grasp, much less those without this expertise. Further,

analysts and scientists involved in ecological risk assessment are using a tool that most of the public does not comprehend; thus the danger of misuse through miscommunication, unintentional or otherwise, is great. There is no scientific or ecological imperative in risk assessment; it is only a tool to help those charged with making decisions evaluate options.

Those of us involved in ecological research and assessment should remember that risk assessment is the latest of a large number of tools and approaches that played on the scientific and management stage with great fanfare. These tools and approaches have each evolved into the role: "useful in certain, clearly defined circumstances." Ecological risk assessment is undergoing a similar transformation.

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Dr. Robert T. Lackey, senior fisheries biologist at the U.S. Environmental Protection Agency's research laboratory in Corvallis, Oregon, is also courtesy professor of fisheries science and adjunct professor of political science at Oregon State University. Since his first fisheries job more than four decades ago mucking out raceways in a trout hatchery, he has dealt with a range of natural resource issues from positions in government and academia. His professional work has involved many areas of natural resource management and he has written 100 scientific and technical journal articles. His current professional focus is providing policy-relevant science to help inform ongoing salmon policy discussions. Dr. Lackey also has long been active in natural resources education, having taught at five North American universities. He continues to regularly teach a graduate course in ecological policy at Oregon State University and was a 1999-2000 Fulbright Scholar at the University of Northern British Columbia. A Canadian by birth, Dr. Lackey holds a Doctor of Philosophy degree in Fisheries and Wildlife Science from Colorado State University, where he was selected as the 2001 Honored Alumnus from the College of Natural Resources. He is a Certified Fisheries Scientist and a Fellow in the American Institute of Fishery Research Biologists.

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