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Contemporary Conceptions of Environmental Risk: Implications for Resource Management and Policy

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Recent theoretical development in environmental sociology has focused on the concept of "risk." Macro- and middle-range theoretical conceptualizations relevant to understanding environmental risk and resource depletion have emerged from Europe and the United States. We review five theoretical approaches to the environment–society relationship and identify convergent characteristics relevant for resource management in the modern world. These characteristics suggest goals for resource management should include expanded discursive systems, a more informed public and building institutional trust.

KEY WORDS: environmental risk; resource management; pollution; policy.

INTRODUCTION

In classical sociological theory, the biophysical environment was a peripheral rather than a core concept for addressing analytical models of society and human behavior. Because of sociology's competition with biology and psychology, the biophysical environment was relegated to the margins of sociological inquiry (Benton 1994). If sociology were to stand as a separate discipline with distinctive subject matter, it had to be cordoned off from biology and the natural realm (Durkheim [1897] 1970). Extracting the "social" from its environmental context was reinforced by the technological transformations of the day. Classical theorists witnessed the relative escape

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of modern societies from ecological constraints and the development of the human capacity to transform an independent biophysical world. (Goldblatt 1996). At the time, it was assumed that the biophysical environment could absorb pollution associated with modernization and provide an inexhaustible supply of natural resources.

This historical context has been radically altered. The emergence and proliferation of human-generated environmental risks and the depletion of natural resources critical for human survival are central problems of the twenty-first century. In other words, "far from transcending ecological constraints, modern societies [are] rapidly acquiring new ones of their own making" (Goldblatt 1996, p. 5). Given the growing awareness of problems associated with environmental pollution and resource depletion, many researchers and practitioners have attempted to understand the impact of environmental risks on individuals, communities, and ecosystems. The modern world has been increasingly sensitized to "risk" as "the organizing concept that gives meaning and direction to environmental regulation" and policy (Jasanoff 1999, p. 135). Theoretical approaches in environmental sociology provide emerging models that are relevant to resource management and policy directives.

In this paper, we initially discuss traditional risk assessment and the need for a revised theoretical framework. We describe two macro-level theories which framed global environmental political discourse over the last decade. Then we review three middle-range theories that focus on the local biophysical environment as a sociocultural variable. Finally, we identify several trends likely to inform future efforts to manage environmental risks and natural resources.

ENVIRONMENTAL RISKS: RESOURCE DEPLETION AND POLLUTION

Modern industrial and agriculture production processes negatively impact the environment in two ways. First, withdrawals from the environment cause resource depletion when nonrenewable resources are overused and renewable resources are used faster than they are replenished by natural processes (Meadows *et al.* 1992). Second, additions to the environment take the form of pollution when toxic chemicals (typically, the negative by-products of production processes) are released at rates too fast for earth's natural processes to absorb and break them down (Meadows *et al.* 1992). Historically, these impacts on the environment (resource depletion and pollution) have been treated separately. However, examples of their interconnectedness abound.

Indeed, many of the environmental problems of the twenty-first century pose tremendous challenges due to the interconnected and confounding characteristics of resource depletion and pollution. Agencies responsible for managing water resources are acutely aware of the challenges posed by the concomitant problems of water quantity (resource depletion) and water quality (pollution). The burning of fossil fuels resulting in the release of greenhouse gases (pollution) coupled with deforestation (resource depletion) has resulted in the controversial problem of global climate change. Even with the continued anthropocentric focus on human health, some form of risk assessment must address the impacts of resource depletion and pollution. These are interconnected and ultimately impact human health and the biosphere. As such, we contend that theories primarily focusing on natural resource depletion and/or pollution of the environment can be categorized as theories of environmental risk.

TRADITIONAL RISK ASSESSMENT

Traditional risk assessment focuses on the direct impact of toxic chemicals on human health, not on the health of wildlife species, ecosystems, or ecological services. The process of risk assessment followed a four-step methodology. The first step, hazard identification, begins with identifying concentrations of chemicals and biological contaminants that may pose human health risks. Dose-response assessment is the second step, which includes an estimation of how much exposure to a contaminant is necessary for adverse health effects and how human response may vary as a function of different contaminant levels. The third step, exposure assessment, consists of identifying potentially exposed individuals, the medium(s) through which exposure actually and potentially occurred, and an estimate of the duration of exposure. The fourth step is called risk characterization, which involves integrating the assessments derived from the first three steps. The objective of this final step is to determine whether adverse health effects will result from exposures to specific contaminants (Harvey *et al.* 1995; National Academy of Sciences/National Research Council (NAS/NRC) 1983,1994).

This methodology provides a statistical determination of the probability of harm to humans from a specific natural or human action. Traditional risk assessments are conducted by knowledge experts who operate within a clearly specified domain and utilize a rational actor approach to risk (Clarke 1999; Freudenburg 1988; Jasanoff 1999). The outcome of this process is effective planning for situations of relatively low or moderate uncertainty. However, under conditions of high uncertainty, this nonreflexive realist approach results in an empty promise of control, or more simply, a discourse that says "trust me" (Clarke 1999). Increasingly, the exalted status and truth claims of

traditional risk assessment have been a point of contention, as different theoretical approaches have emerged for identifying and constructing risks and managing uncertainty in the modern world. As such, social scientists have accepted the challenge to broaden the traditional risk assessment framework.

ALTERNATIVE RISK ASSESSMENT MODELS

The traditional approach to risk assessment has been expanded on two fronts, the social constructivist and the ecological risk assessment approaches. The first emanates from a sociology of knowledge perspective, viewing environmental policy as a socially constructed issue through continuous discourse among organizations which seek to transform dissent into consent (Eder 1999; Hannigan, 1995). As Jasanoff (1999, p. 139) notes,

> Consensus on such "facts" as the risks of formaldehyde or DDT arises not from demonstrated deaths, disability or environmental damage, but from repeated confrontations among disparate scientific observations, their interpretations by experts and stakeholders, and the ingrained moral and social commitments of decision-making institutions.

Slovic (1997, p. 22) adds that "much of the public's reactions to risk can be attributed to a sensitivity to technical, social, and psychological qualities of hazards that are not well-modeled in technical risk assessments." The social constructivist perspective understands that interpretations of modern risk are "highly mediated" and "extremely open to social definition and interpretation" (Szerszynski 1999, p. 240). In fact, the image of risk in the modern world has shifted from a positive, enlightenment view to a more critical, reflexive posture. This trend has given rise to "risk movements," which reframe mathematical risk calculations in terms of "the preservation and extension of community" (Halfman 1999, p. 179).

Modern social theory, particularly recent developments in Western Europe and the United Kingdom, has illuminated theoretical themes in environmental sociology. Although, originally taking an atheoretical orientation, environmental sociology has begun to challenge the traditional view of the natural environment as an independent, objective reality. With the emergence of environmental degradation "as a barometer for the distribution of technological risks" came a shift to a more direct theoretical concern with the consequences of environmental degradation and the subsequent consequences for resource management (Picou and Gill 2000, p. 144).

A social constructionist position argues that science itself provides "manufactured explanations of the world that should have no privileged claim on authenticity" (Cohen 2000b, p. 14). In its most extreme forms, "strict constructionist" approaches have been harshly criticized (Best 1993).

Nonetheless, recent macro- and middle-range theoretical explorations of the environment–society relationship provide a number of contextual constructivist themes relevant to resource management. The relevant themes include the need for expanded participation and discourse, a critique of traditional science, and a focus on public trust and skepticism. These themes are implicitly reflected in the NRC's recent critique of risk assessment and call for risk characterization—a broader, socially based conception of risk—in future assessments (Sterns and Fineberg 1996).

The second expansion of this traditional approach is called ecological risk assessment. This approach is gaining legitimacy and expanding assessment to include threats not only to human health, but also to the health of wildlife species and ecosystems. Ecological risk assessment is a "systematic means of assessing the state of ecological resources and determining remediative priorities for the myriad of potential problems human action has caused" (Power and Adams 1997, p. 803). This expansion has moved beyond the reactionary nature of traditional risk assessment, as it has been used in a "proactive manner to prevent the unacceptable ecological effects associated with the production, use, and disposal of chemicals" (Van Leeuvwen 1997, p. 813).

In sum, traditional risk assessment as an expert-driven, four-step process of determining the objective risks to human health has been expanded in at least two significant ways. First, examining how environmental risks are socially constructed and communicated has become legitimate areas of inquiry. Second, the narrow focus on human health has been expanded to include an assessment of the threats posed by resource depletion and pollution on the health of humans, wildlife species, and ecosystems. This expansion of traditional risk assessment serves as a point of departure for reviewing and developing theoretical models in environmental sociology. In the next section we will discuss two global theoretical perspectives that view the environment as a core sociological concept.

GLOBAL THEORETICAL PERSPECTIVES

Two global theoretical models of postindustrial development have recently emerged in Germany that are relevant to environmental sociology. Rooted in the work of Ulrich Beck and Anthony Giddens, risk society theory shifts concern from the logic of wealth distribution to the logic of the distribution of risk. This is the orienting characteristic of the modern world in which new technological risks and hazards pose a challenge that can only be overcome through subpolitical reorganization of environmental politics and the democratization of technical knowledge (Beck 1992). The second global theoretical perspective, ecological modernization theory, emerged out

of the writings of Joseph Huber, Barry Commoner, and Udo Simonis. Ecological modernization embraces sustainable development as the means for establishing harmonious relationships between economic development and environmental stewardship. In contrast to the risk society theory, ecological modernization elevates the role of science and technology as a solution to ecological crises (Commoner 1990; Mol and Spaargaren 1993; Simonis 1988). We will briefly outline these two global theoretical perspectives.

RISK SOCIETY THEORY

For Beck, through the modernization of modernity or the demise of industrial society, modernity is transformed and characterized by two narratives—the risk narrative and the individualization narrative. The risk narrative suggests that social conflict and inequality will emerge from the distribution of technological risks which were created by the very successes of industrial society. These modern social threats differ from previous risks because they (1) are undetectable by human sensory perception, (2) transcend generations and (3) preclude causal attribution and compensation for victims (Beck 1992, 1996). Knowledge of risk in the modern world is, at best, a second-hand, nonexperience (Beck 1992). Modern risks set the stage for societal self-annihilation. Beck exposes the destructive side of progress, contending that technological hazards will have dire consequences for the future.

For Beck, society's response to technological catastrophes involves the process of reflexive modernization expressed through the individualization narrative (Beck 1992). Reflexive modernization means

> the disintegration of the certainties of industrial society as well as the compulsion to find and invent new certainties for oneself and others without them. But it also means new interdependencies, even global ones. Individualization and globalization are in fact two sides of the same process of reflexive modernization. (Beck 1996, p. 14)

Beck views structural change in the modern world as the process by which individuals are "set free from the certainties and modes of living of the industrial epoch—just as they were 'freed' from the arms of the church into society in the age of the reformation" (Beck 1992, p. 14). Choice and calculation become more viable for people in the modern world as the restructuring of social conflict along risk cleavages coincides with the reorganization of social forms to include new subpolitical groups which shape society from below.

As subpolitics weakens the implementation power of the state, the "authoritarian decision and action state gives way to the negotiation state, which arranges stages and conversations and directs the show" (Beck 1996, p. 39). This social transformation to the risk society involves the unbinding of science through a broader subpolitical critique by citizen science (Irwin

1995). Nongovernment organizations (NGOs) proliferate responding to the inability of industrial society's institutions to insure and compensate victims of modern risks. Increasingly, modern institutions appear organized by the narrative of irresponsibility and must engage in a discourse over society's capacity to deal with the side effects of modern technology, especially toxic pollution and ionizing radiation (Beck 1992).

This discourse also signals a change in the nature of trust in the modern world. Trust in traditional industrial society reflected an unexamined and habitual confidence in science and technology. As we move to risk society, trust now becomes bestowed trust which has to be won, or earned, by modern governments, organizations, and groups from "autonomous, reflexive individuals" (Giddens 1990, 1991; Szerszynski 1999). This view assumes an adversarial society, mobilized through risk anxiety and dominated by subpolitical discourse on science, technology, and environmental risks. Risk society theory assumes a discourse, subject to conflict and anxiety (Freudenburg 1997).

Ecological Modernization Theory

Ecological modernization theory is a macro-theoretical model of ecological degradation. It emerged as a response to the failures of the initial wave of environmental management of the 1970s and early 1980s (Cohen 1997). During this phase pollutants were dispersed over time and space, rather than reduced. Furthermore, industrial responsibility for ecological harm provided an irresolvable discourse on causality, impact, and responsibility that resulted in, at best, ambiguous claims and counterclaims (Cohen 1997). Out of this impasse came ecological modernization theory, a model of resource and risk management that claims to transcend these various conflicts and interests. The "dissolution of conventional antagonisms between economic progress and responsible environmental management" is based on "reframing" environmental discourse (Cohen 1998a).

> In other words, [ecological modernization] reframes the terms of discourse by interpreting pollution reduction as a means of enhancing economic competitiveness rather than as an externality requiring the installation and maintenance of expensive remedial technologies. (Cohen 1997b, p. 6).

Cohen (1997a,b, 1998) has summarized the theory of ecological modernization in terms of six general principles:

1. *Super industrialization*, a process that will correct the design flaws of industrial technology, involves a change to cleaner, less resource-intensive technologies and production processes that will reduce the necessity for expensive, add-on, remedial technologies. The

correlation between economic development and environmental degradation will be significantly reduced, thereby propelling modern industry onto a new developmental trajectory (Cohen 1997a,b, 1998).

2. The implementation of *strict (yet flexible) government regulations* acknowledges the ineffectiveness of past corporate volunteerism. Such regulation should promote first-mover advantages, economically viable green products, and innovative production systems (Cohen 1998).
3. *Integrated pollution management* strategies will overcome problems associated with the transfer of pollutants within the biophysical environment. Such strategies would be part of the redesign of regulatory procedures and production processes.
4. *Anticipatory planning practices* would enable industry to be more timely and responsive to their generated health and environmental hazards. Based on the German notion of *vorsorgeprinzip*, or the precaution principle, this tenet argues that the lack of scientific certitude is insufficient reason to postpone the taking of prudent measures for reducing environmental risk (Cohen 1997b).
5. *Organizational internalization of environment responsibility* is based on the Dutch principle of *verinnerlijking* which "requires all public and private entities to integrate a concern for environmental quality into all of their activities as a means of overcoming the standard approach of treating ecological considerations as add-on considerations" (Cohen 1997b, p. 7). Stand alone organizational components for assuring ecological responsibility should be dissolved and reembedded throughout all decision points in production systems.
6. The development of *constructive relationships* through a broader organizational network for decision making would minimize existing ecological antagonisms and conflict over environmental policy. The resulting discourse among industry, government, NGOs, and the public should be grounded in good faith and the free exchange of information (Cohen 1997b).

Ecological modernization theory, as an alternative to risk society theory, has gained some acceptance by national governments and industry. For example, the Organization for Economic Cooperation and Development (OECD) and the European Union have endorsed selected principles (Gouldson and Murphy 1996; OECD 1996). A consortium of major multinational corporations, the World Business Council for Sustainable Development (now a subsidiary of the International Chamber of Commerce), has advocated an eco-efficiency approach for improving organizational performance (Cohen 1998b; Porter and Vand der Linde 1995).

The main contradiction between the two global theoretical perspectives centers on the potential role of modern technology for either overcoming environmental crises (ecological modernization) or exacerbating extant environmental problems (risk society). This duality has been addressed by Cohen (1997a), who proposes a two-dimensional typology of societal development and risk emergence. This typology suggests that in the transition from premodern to modern to ecologically modern societies, the cycle of ecological degradation and economic advance cannot continue indefinitely (Cohen 1997a). A shift in the social construction of the environment from an expendable resource to a valued amenity sets the stage for risk society conflict and/or ecological modernization corrections to design flaws. Risk society is not necessarily an objectively more hazardous society; rather, it is a society preoccupied with the threats of technological failure and environmental catastrophes. Evidence of this preoccupation is manifest in debates over toxic pollution, toxic waste siting, toxic technological disasters, and the responsibility and compensation for the lethal consequences of such events (Beck 1992; Edelstein 1988; Erikson 1994; Picou 1996; Picou and Rosebrook 1993).

MIDDLE-RANGE THEORIES

Three middle-range theories of social response to environmental degradation have been recently put forth by American environmental sociologists. Arising out of studies of localized environmental degradation in the United States, the ecological–symbolic framework focuses on the abrupt severance of the relationship between people and their immediate biophysical surroundings (Couch and Kroll-Smith 1985; Edelstein 1988; Erikson 1994; Kroll-Smith and Couch 1993a). Resource-dependency theory utilizes a similar social constructivist narrative, but identifies subsistence cultures of indigenous people and economic systems of resource harvesters as the focal point of theoretical concern (Gill 1994; Gill and Picou 2001; Picou and Gill 1996; Oliver-Smith 1996). Ecosystem management theory argues for a holistic, adaptive model of resource management that integrates scientific knowledge of ecological processes with local sociopolitical values and knowledge (Cortner and Moote 1999).

Ecological-Symbolic Theory

Toxic contamination severs the exchange relationships between human communities and their biophysical environment (Kroll-Smith and Couch 1993a,b). The intrusion of invisible toxic risks through contamination alters

one's lifescape, or personal security within the immediate biophysical envelope, producing social disruption and the erosion of institutional trust among victims (Edelstein 1988; Erikson 1994; Freudenburg 1993, 1997; Freudenburg and Jones 1991). Toxic contamination, either objectively measured or subjectively constructed, is seen as a "new species of trouble" which "contaminate(s) rather than damage; pollute, befoul, and taint rather than just create wreckage" and "scare human beings in new and special ways" (Erikson 1994, p. 144). The uncertainty and anomie resulting from environmental contamination "is further compounded when physicians using sophisticated equipment are unable to confirm cases of exposure" (Picou and Gill 2000, p. 148).

The ecological–symbolic approach, as a social constructivist framework, views continuous claims-making and litigation as part of a corrosive community response to the failure of traditional institutional support systems for diagnosis and compensation of damages from contamination (Freudenburg 1997; Hannigan 1995; Hirsch 1997). Popular epidemiology and other public challenges to both government and corporate scientific experts, in the form of alternative expert opinions, have emerged within the contentious context of litigation in the United States (Brown 1987, 1992, 1997; Brown and Mikkelsen 1989; Kroll-Smith and Couch 1993a). The severe social and psychological impacts that result when the socially mediated exchange relationships between people and the biophysical environment are disrupted is documented by numerous case studies, including research on Three Mile Island and the *Exxon Valdez* oil spill (Arata *et al.* 2000; Baum 1987; Baum and Fleming 1993; Green 1996; Picou *et al.* 1997).

Resource-Dependency Theory

Although similar to ecological–symbolic theory in that it is predicated, once again, on social constructivist assumptions of culture–environment linkages, resource-dependency theory focuses on cultural and economic linkages, rather than lifescape or personal security assumptions (Gill and Picou 1998; Oliver-Smith 1996). As such, this approach broadens the parameters of resource management to include traditional knowledge and culture of indigenous groups within the framework of impact assessment (Gill and Picou 2001). In contradistinction to the discourse of opposing scientific experts, resource-dependency theory identifies alternative epistemological positions as legitimate participants in a mutual beneficial discourse network.

The ecological–symbolic approach focuses on health risks, whereas resource-dependency theory focuses on threats to natural resources which undermine renewable resource communities' economic and cultural connections to the biophysical environment (Picou and Gill 1996). Resource

contamination threatens economic stability and quality of life. In short, resource-dependency theory extends the scope of resource management to include traditional ethnic knowledge and commercial harvesters as stakeholders in an expanded discourse on environmental degradation and resource depletion.

Ecosystem Management Approach

The traditional paradigm of natural resource management, with its reliance on scientific reductionism and discipline-specific analyses, is unable to capture the broader "systemic" and "transdisciplinary" nature of environmental problems (Meine 1995). The health of ecosystems, biodiversity, and endangered species are all threatened by resource depletion, habitat destruction, and environmental pollution. The call for more interdisciplinary approaches to address contemporary environmental problems became commonplace by the late 1980s and, by the early 1990s, traditional natural resource management gradually entered into a crisis of legitimacy (Clark *et al.* 1999; Holling *et al.* 1998).

In response to this crisis, ecosystem management emerged as the new management strategy. By 1994, 18 federal agencies in the United States adopted some form of ecosystem management as a guiding policy (Cortner and Moote 1999). Grumbine (1994) provides a definition stating that "ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and value framework toward the general goal of protecting native ecosystem integrity over the long term" (p. 28). On a policy level, ecosystem management is viewed as a strategy to promote sustainability (Franklin 1997; Golden 1998; McCormick 1997), recognizes resource management decisions as socially constructed goals and objectives that vary across space and over time (Haeuber 1996; Wallace *et al.* 1996), and adheres to a collaborative decision-making model, one that brings together all relevant stakeholders—such as government agencies, tribal organizations, industry, and citizens (Clark *et al.* 1999; Haeuber 1996; Wallace *et al.* 1996).

Ecosystems, the focus of management, exist at multiple scales with no particular scale inherently more strategically meaningful from a management perspective than another (Haeuber 1996). Ecosystem processes are nonlinear and unfold over a varied range of spatial and temporal scales (Clark *et al.* 1999; Haeuber 1996; Wallace *et al.* 1996). Recognizing the complexity of ecosystems, ecosystem management is a strategy that accepts scientific uncertainty (Grumbine 1997), "treats policies as hypotheses, and management as experiments" (Holling *et al.* 1998, p. 358), and requires implementation by adaptable, decentralized organizations (English *et al.* 1999; Nelson 1995).

IMPLICATIONS FOR ENVIRONMENTAL POLICY

In this section, we discuss themes derived from our review of the five theories and identify some concerns relevant for formation and implementation of environmental policy.

Expanded Participation and Discourse

All five perspectives suggest that modern societies are striving to enhance rational decision-making by altering the nature of and expanding participation in environmental discourse. For example, technical assessments of risk are too narrow, as input from an expanded field of stakeholders is now required (Stern and Fineberg 1996). However, can a fuzzy concept like "discourse" be made relevant to agencies responsible for managing natural resources or enforcing environmental regulations?

Social discourse can refer to a number of communicative events, including the coordination of behavior through interaction. Social discourse can develop into an emergent social form which becomes embedded in social structure (Eder 1999). The risk society and ecological modernization theories explicitly recognize that discursive social arrangements have accompanied the rise of modern political institutions. The rise of social democracy, parliamentary forms of government, the judicial system, and science were all characterized by complex and elaborate discourse systems over the last 250 years (Eder 1999). Critique and enlightenment require public space and the invitation to participate. Old vertical command systems are replaced by expanding horizontally organized systems of discourse (Eder 1999). Thus, discourse systems are also a characteristic of the modern world.

In addition, ecological modernization, resource-dependency, and ecosystem management theories view discourse as functional, as a mechanism to go beyond adversarial gridlock between competing interests. Environmental discourse does not necessarily insure a specific future outcome, but discursive systems are binding through commitments, which, in turn, facilitate an expressive function through appropriate decision-making systems. Resource-dependency theory contends that an expanded participatory framework should also include Traditional Ethnic Knowledge (TEK) of indigenous populations. The risk society and ecological–symbolic theories suggest that the emergence of subpolitical groups and the mobilization of citizens reflects an organic, grassroots response to the inability of industrial society's institutions to protect victims from modern risks and resource depletion. Given this theme, resource management in the modern world will require the involvement of new combinations of government, corporate,

voluntary, and regulatory organizations in policy decisions at all stages of deliberation.

Critique of Traditional Science

All five theoretical perspectives recognize that traditional science, a foundation of modernity, is partially responsible for many of the environmental problems we face today. Traditional science—based on a reductionistic, linear, mechanistic, closed-system model of the empirical world—is unable to capture the broader systemic, transdisciplinary, and dynamic nature of ecological processes and many contemporary environmental problems. Historically, the public generally supported scientists' claims of expertise and viewed science as a superior knowledge system with canons of proof producing findings untainted by personality, politics, and commercialism. Legitimate human knowledge was built largely on trust in expert systems located in institutions.

Today, critics of traditional science argue that scientists are (and were) not objective, research may be politicized, and large-scale research organizations have become financially tied to commercial interests. Public skepticism of science appears to be increasing with alternative explanations grounded in TEK and other nonscientific epistemologies gaining public endorsement (Holton 1993). Additionally, confidence in institutions responsible for risk regulation and management eroded steadily over the past several decades (Dunlap and Mertig 1992; Lipset and Schneider 1983). A number of studies provide evidence of a relationship between low levels of trust in institutions and high levels of expressed environmental concern (Freudenburg 1993; Hoban and Woodrum 1992; Marshall 1995; Slovic 1992).

While agreeing with this critique of traditional science, each theory views the role of science somewhat differently. Ecological–symbolic and risk society theories contend that stakeholders utilize discursive strategies as a means to counter the "truth claims" of scientists representing interests other than their own. The risk society theory explicitly addresses the role of science, as Beck's concept of the "unbinding of science" indicates that science is demystified and open to skepticism (Beck 1992). Furthermore, evidence suggests that the method of (traditional) science is not being forsaken, but rather the method and language of science are being dislodged from the institution itself by people negatively impacted by risks (Beck 1992; Brown 1987, 1992, 1997; Kroll-Smith and Floyd 1997).

Resource-dependency and ecosystem management theories endorse discursive strategies as a consensus-building tool that values multiple epistemologies, with no single epistemology viewed as more legitimate than

another. Science is viewed as one epistemology among many. As such, stakeholders are encouraged to form groups, or coalitions, to proactively manage resources in ways that minimize the potential impact of environmental risks. Of all the theories, ecological modernization views science in the most positive light. Since science is necessary for the creation of "cleaner, more efficient, and less resource intensive technologies," nations on the path of ecological modernization must reaffirm its commitment to scientific rationality (Cohen 1997, p. 109).

Public Trust and Skepticism

Given the themes of expanded and more functional discursive processes and less reliance on scientific "experts," public trust of agencies responsible for resource management, enforcing regulations, and mobilizing citizen involvement is critical. Public trust in responsible institutions involves a consideration of a broader notion of relevant information as well as the significance of relational dimensions of trust. As Wynne (1996, p. 58) has stated,

> public risk perceptions rationally involve some element of judgment both of the quality of relevant social institutions, and of their relevance, in other words of the roles of different social agents including one's own relationship to them...

All five theories address issues of public trust and skepticism regarding science, organizational mission, and institutional dependency. The ecological–symbolic and resource-dependency theories identify a loss of institutional trust as a primary response to technological disasters (Freudenburg 1993, 1997; Picou and Gill 2000). Risk society theory projects increasing public skepticism and growing distrust of the institutional management of modern risks, while, alternatively, ecological modernization theory invites increasing trust and public confidence in science, technology, and resource management. Successful discourse (i.e., consensus-building) on environmental risk and resource management policy requires a high degree of confidence in science, and strong institutional trust bonds by participating parties. The emerging participatory processes in environmental decision-making reflect an attempt by natural resource management agencies to regain citizen trust and institutional legitimacy (Marshall 2001; Rosener 1982; Thomas 1990; Tuler and Webler 1999).

DIFFERENTIATING AMONG THEORIES OF RISK

Thus far, we have identified three characteristics common to all five theories of risk. However, there are two characteristics that enable us to

differentiate among the five theories of environmental risk. The first characteristic is whether the theory advocates changing the system itself or changes within the system and the second is the generalizability of each theory.

Change-the-System or Within-System-Change?

The change-the-system perspective contends that, sans systemic change, promoting economic growth and environmental protection is futile because of the inherent, structural contradictions between the two. At the macro-level, the risk society theory and other prevailing theoretical critiques of modernity embrace this perspective (e.g., Cable and Cable 1995; Catton 1980; Dunlap and Van Liere 1984; Marshall 1999; O'Connor 1973; Schnaiberg 1980; Schnaiberg and Gould 1994). Some extend this critique by contending that the emergence of global capitalism has exacerbated and further entrenched existing contradictions (Marshall 1999). At the middle-range level, ecological–symbolic theory implicitly agrees with this perspective, as it sees technological disasters as the negative by-product of unchecked economic growth, the misguided faith in technology, exploitative production processes, and the failure of institutions.

The within-system-change perspective argues that it is possible to have economic growth and environmental protection. The concept that best captures this perspective is sustainable development. At the macro-level, ecological modernization theorists champion this perspective, arguing that the escape from the ecological crises of modernity is through technological innovation, institutional adaptation, and superindustrialization. In this sense, ecological modernization theory is conservative and optimistic.

For the middle-range theories, environmental discourse regarding natural resources, pollution, and economic development has been adversarial, often stalled by the competing interests of economic growth and environmental protection advocates. Overcoming this gridlock, according to the ecosystem management theorists, can be achieved through authentic environmental discourse and collaborative decision-making. Grassroots, collaborative discourse enables sustainable development through the integration of local knowledge and experience, multiple community values (environmental, economic, and other values), and data collected by social and biophysical scientists. Not surprisingly, theories taking the "within-system-change" perspective (ecological modernization in Europe and ecosystem management in the United States) have been embraced in principle and practice by policymakers. These theories can be implemented as policy without addressing the politically contentious issue of the structure of the existing political economic system.

Generalizability

The second characteristic asks the following question: What range of events, scenarios, or contexts does each theory help us understand? Ecological modernization and risk society theories, based entirely on the industrial experience of a few nation-states in Western Europe (Blowers 1997), appear to be most applicable to advanced "welfare states" where the material needs of most of its citizens are met *via* wealth redistribution through taxation and social security. As such, both theories specify at least one precondition necessary for the emergence of an ecological modern society or a risk society—the material needs of some portion of the population must be met at some unspecified level. With pressure from transnational corporations on nation-states to adopt neoliberal policies, welfare policies are quickly being eliminated in those few core countries that were relatively successful in meeting the material needs of its citizens (Marshall 1999).

Assuming current trends hold, it would not be wise to generalize from theories based on the contours of advanced welfare states to other advanced Westernized nation-states. It would be even less appropriate to generalize to developing nation-states. While the concern about and attention given to global environmental risks (the bane of the risk society) is warranted, we must not lose sight of the profound, often class-specific, impact that local resource depletion and pollution problems have on individuals and communities (Marshall 1999). Middle-range theories appear to be better suited to examine environment–community relationships.

Most middle-range theories were formulated in an attempt to make sense out of data collected in the field. While each of the middle-range theories addresses the environment–community relationship, the dynamic of this relationship varies. For instance, ecological–symbolic theory was developed to better understand the relationships between disasters, the disruption of the environment–community relationship, and social construction of the disaster. This theory is generalizable to any disaster event that abruptly alters the environment–community relationship.

Resource-dependency theory addresses a special type of environment–community relationship, one in which natural resources are important not only for economic reasons, but also on a cultural level. This approach is applicable to any resource-dependent community and holds much promise for research on the remaining resource-dependent indigenous communities across the globe. Ecological–symbolic and resource-dependency theories study the environment–community relationship in the aftermath of a disaster event. Research indicates that citizens mobilize quickly in reaction to environmental problems that are perceived as a threat to individuals, communities, and culturally significant species or resources.

Ecosystem management is unique as a middle-range theory since it strives to manage resources proactively in order to minimize the threat of environmental risks. In fact, ecosystem management as a practice encourages citizens to better understand the environment–community relationship as a means of mobilizing their interest in participating in a long-term, collective effort to protect the local environment and encourage sustainable development. Of the three middle-range theories discussed, ecosystem management is probably the most generalizable.

CONCLUSION

The five theories discussed in this paper were not developed in an ivory tower detached from the real world, but rather reflect the changing relationship between societies, communities, and the biophysical environment. The most effective way of addressing the problems of resource depletion and pollution is for theory to continue to inform practice and vice versa. Theories of environmental risk provide a broader framework that enables field researchers and policymakers to note patterns across case studies and generalize to new issues. Evidence from field research and an assessment of the effectiveness of environmental policy encourage researchers to update, modify, and, in some cases, abandon existing theories of environmental risk. As the human dimensions of the production and distribution of environmental risks become ever more palpable, social scientists must continue to inform conceptions of risk and the process of risk assessment.

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