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College and University Environmental Programs as a Policy Problem (Part 1): Integrating Knowledge, Education, and Action for a Better World?

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Abstract The environmental sciences/studies movement, with more than 1000 programs at colleges and universities in the United States and Canada, is unified by a common interest—ameliorating environmental problems through empirical enquiry and analytic judgment. Unfortunately, environmental programs have struggled in their efforts to integrate knowledge across disciplines and educate students to become sound problem solvers and leaders. We examine the environmental program movement as a policy problem, looking at overall goals, mapping trends in relation to those goals, identifying the underlying factors contributing to trends, and projecting the future. We argue that despite its shared common interest, the environmental program movement is disparate and fragmented by goal ambiguity, positivistic disciplinary approaches, and poorly rationalized curricula, pedagogies, and educational philosophies. We discuss these challenges and the nature of the changes that are needed in order to overcome them. In a subsequent article (Part 2) we propose specific strategies for improvement.

Keywords Environmental studies · Environmental sciences · Environmental education · Interdisciplinary education · Human dignity · Sustainability · Problem-solving skills · Leadership

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Introduction

There are currently more than a thousand degree-granting programs in environmental sciences or environmental studies at American and Canadian colleges and universities (Romero and Silveri 2006; Vincent and Focht 2009a; Sherren 2008), with new programs coming on line (Auer 2010). The University of Washington, for example, recently formed a new College of the Environment, touted as the largest environmental college in the world (Perry 2008). It has more than 185 faculty, 870 undergraduate and 535 graduate students, at least 450 course offerings, and 17 "interdisciplinary research and outreach centers" (University of Washington 2010). A primary objective of such environmental programs is to produce graduates who can help societies and governments solve pressing technical, management, and policy problems involving natural resources, environmental quality, and social justice. Collectively, we call these programs the "environmental program movement" (EPM). The evolution and expansion of the EPM, almost nonexistent forty years ago, is a promising trend.

Although there is considerable variation among and within environmental programs, there is also much common ground. In addition to a shared focus on the environment, core principles include interdisciplinarity, systems-oriented thinking, and awareness of the importance of both human and non-human dimensions of environmental problems (Vincent and Focht 2009a, b). Many environmental programs purport to offer a comprehensive perspective on human-environment relations, new methods of study, and mastery of approaches to address the negative impacts of human activities on the natural world. The EPM is part of what Harold Lasswell (1970, p. 3) called a "counter offensive," a new configurative outlook to remedy decades of differentiation and fragmentation of knowledge and its application.

The evolution of the EPM reflects renewed urgency about the age-old problem of clarifying the goals of human endeavor and understanding our relationship with nature (e.g., see Sivaramakrishnan and Vaccaro 2006). Of course, the EPM also strives to remedy specific environmental problems. The "fuzzy" or "wicked" nature of environmental problems was recognized early on by Rittel and Webber (1973), and many of these problems have grown in magnitude, urgency, and complexity (in both natural systems and decision making) in recent years. Elucidating and remediating such complex environmental problems tend to exceed the diagnostic and prescriptive powers of any single discipline or traditional method.

Interdisciplinarity and interdisciplinary problem solving, then, are crucial to the EPM, as exemplified by the mission of the School of Sustainability at Arizona State University (2009): "To bring together multiple disciplines and leaders to create and share knowledge, train a new generation of scholars and practitioners, and develop practical solutions to some of the most pressing environmental, economic, and social challenges of sustainability, especially as they relate to urban areas." Similarly, the Dean's Message at Duke University's Nicholas School of the Environment states:

> "Our expectation is that each and every graduate of the Nicholas School has the knowledge to understand the complexities and pluralities of today's environmental challenges; the practical skills to devise and implement effective solutions; the real-world acumen to use markets and public–private partnerships, as well as more traditional governmental tools, to achieve desired outcomes; the ability to think critically across disciplines; and the flexibility to work in teams or individually" (Chameides 2010).

Interdisciplinarity can been interpreted in a variety of ways (Kockelmans 1979; Lélé and Norgaard 2005), but for the problems that the EPM seeks to address it entails a configurative outlook that goes well beyond multidisciplinarity—it requires more than simply gathering together two or more disciplines in a single department, set of courses, or research project. True interdisciplinarity uses and integrates multiple theories, methods, and approaches. It requires a comprehensive framework for organizing knowledge, directing enquiry, and communicating with others. To be effective in analyzing and resolving complex problems, an interdisciplinary approach should provide the tools to clarify the observer's standpoint, define and orient to a problem, map the full social and decision-making context, and apply multiple methods to generate, evaluate and implement solutions (Clark 2002; Rutherford and others 2009).

Unfortunately, the record of the EPM in actually integrating knowledge across disciplines and producing graduates with the requisite skills to solve complex environmental problems is not particularly impressive. Over the years, many analysts have documented broad concerns about the EPM, both retrospectively and prospectively. These have included (but are not limited to) the need to move beyond weak multidisciplinarity toward true interdisciplinarity (Caldwell 1983), the effect of disciplinary Balkanization common to most colleges and universities (Brough 1992; Braddock and others 1994), the more general failings of higher education to foster interdisciplinarity and collaboration (Francis 1992; Orr 1996), the need to identify and utilize common or shared values as the basis for interdisciplinary research and problem solving (Lélé and Norgaard 2005), the perceived conflict between problem solving and critical theory in the EPM (Wapner 2008), and the relative devaluation of problem solving over

other forms of pedagogy and practice in the EPM (Ward 1991/1992; Pallant 1996/1997). The record of the EPM in addressing these concerns is weak, as is illustrated by the tension between two of the most prominent assessments of the EPM (Soulé and Press 1998; Maniates and Whissel 2000). In our view, the foregoing problems in the EPM have their roots in three major weaknesses:

(1) *Muddled goals*. Although the broad aims of the EPM are fairly well established and promoted, many individual programs have not deeply examined or clearly articulated the fundamental higher-order goals and values that underlie commitments to interdisciplinarity and environmental problem solving. Participants in these programs may not understand or agree on what the goals are or how they should be pursued.
(2) *Disciplinary hodgepodge*. The EPM is hyper-differentiated. The growing mix of disciplines, methods, and faculty contributes to fragmentation and competition in outlook and method and an inability to communicate with each other—a modern day Tower of Babel.
(3) *Curricular smorgasbord*. Environmental programs typically offer a broad array of traditional, disciplinary theories, epistemologies, and teaching methods. Too often, students are not given enough guidance about how to draw on, integrate, and apply the knowledge offered in these various courses to problems in the real world.

These interrelated and overlapping weaknesses constrain creativity and prevent the integrated, interdisciplinary work that is necessary to advance the common interest of the EPM in understanding and addressing complex environmental problems. The president of the Association for Environmental Studies and Sciences recently observed (Hempel 2009, p. 3):

> Complicating the knowledge-building task in the face of so much data is the "trained incapacity" of many in higher education to engage the interdisciplinary tools of integrative thinking that are required to understand the dynamics of coupled human and natural systems. As a result, we are in danger of becoming data rich and ecologically poor; equipped with a vast cyberinfrastructure that is better at serving our needs for specialized diagnosis than for holistic treatment.

In this article we use the interdisciplinary tools of the policy sciences to examine the EPM as a policy problem (see Lasswell and McDougal 1992; Clark 2002; Brunner and others 2005). We ask:

- What is the common problem that underlies the increasingly apparent disconnect between real world problems and the knowledge and skills currently offered by many environmental programs?
- What accounts for this gap between needs and current assets?
- What factors must be addressed in order to improve performance?

To answer these questions, we develop a working definition of the EPM problem, by clarifying the goals of the movement, mapping past and current trends in relationship to those goals, identifying causal factors underlying those trends, and projecting the future (Lasswell 1971a; Clark 2002). We discuss the challenges facing the EPM and the nature of the changes that will be required in order to overcome these challenges. In an accompanying article (Part 2) we draw on our analysis of the EPM problem to propose specific strategies for improvement.

This article and its companion are intended to stimulate debate about how best to organize, teach, and practice environmental science, management, and policy in the EPM. We acknowledge that some environmental programs have made real progress toward applied interdisciplinarity, and that there are laudable efforts in some multidisciplinary approaches to use more than one conceptual lens, and to bridge the divide between the natural and social sciences. Examples include ecological economics (Costanza 1989), panarchy theory (Holling 2001), conservation psychology (Saunders 2003), the human ecosystem approach (Machlis and others 1997), and the frameworks developed by Elinor Ostrom and others for analyzing linked socio-ecological systems (Ostrom 1999, 2007, 2009). However, much more needs to be done if the EPM is to realize its potential. We believe that there are great opportunities and thus cause for hope. Progress may be incremental rather than revolutionary, but with careful analysis and strategic intervention, successful innovations in individual programs can be instituted, evaluated and diffused to improve the EPM as a whole.

Our Methods and Standpoint

All of the authors of this article are involved in the EPM, although we differ in our personal experiences, disciplinary backgrounds, intellectual training, and professional practice. We are or have been researchers, public servants, instructors, and students, in a wide range of departments, programs, and institutions. Collectively, we have taught more than seventy courses on environmental sciences or environmental studies topics, including courses that focus specifically on interdisciplinary problem solving. We have worked in more than forty countries on diverse problems, ranging from those that mainly involve the technical

biophysical sciences, to complex organizational challenges and large-scale cross-jurisdictional policy problems. We have participated in strategic planning in our own and other programs and we have discussed our ideas with many colleagues, students, government officials and representatives of non-governmental organizations.

Our own goal is to improve the performance of the EPM in the face of a dire need for more effective programs. Our individual and collective value commitments include respect for people and the environment, dedication to interdisciplinary education and problem solving, and belief in civic responsibility, including the duty to speak out about matters of public concern (see Nussbaum 1997; Sandel 2009). This essay and its companion (Part 2) reflect our combined experiences and views, and although we are not of one mind about all the pressing problems in the EPM, we are in agreement about the fundamental concerns outlined here.

The Common Problem

In our view, the shared interest or purpose within the EPM is to ameliorate environmental problems through empirical inquiry and analytic judgment. This is a key distinguishing feature of the EPM. Unlike traditional academic programs that may be content to develop new knowledge simply for the sake of knowledge itself, the EPM strives to produce knowledge and skills that will contribute to better decision making, in order to address environmental problems. The basic reason for improving decisions is so that people might live lives of dignity in healthy, sustainable environments. This higher-order goal, which we elaborate upon in Part 2, encompasses both human and non-human ends. Given the interconnections of human and natural systems, human dignity and healthy environments are intertwined and mutually reinforcing. Human dignity, which involves the provision of basic human values (such as respect, health, well-being, freedom, rectitude and education; see Part 2), cannot be maintained without healthy environmental conditions. At the same time, it is not possible to protect and sustain healthy environments over the long term in circumstances where people are deprived of their dignity. The goal of human dignity in healthy environments may seem anthropocentric, but when human dignity is broadly construed to include values such as rectitude (acting in a morally correct way, doing the right thing), it encompasses environmental preservation and other moral and ethical aims.

The overarching goal of human dignity in healthy, sustainable environments is supported by the United Nations Universal Declaration of Human Rights (1948; and see Maine Law Review 2008), and a wide variety of other international, national, and local proclamations, constitutive documents and institutions, including: the Talloiries Declaration (a commitment by universities and colleges to promote sustainability (ULSF 2001; Sherren 2008)); the Council of Environmental Deans and Directors and its recent Environmental Studies Summits (e.g., National Environmental Studies and Sciences Summit 2008); the Association for Environmental Studies and Sciences (2009); the Association for the Advancement of Sustainability in Higher Education (2009); the mission statements of many programs in the EPM (e.g., the Nelson Institute for Environmental Studies at the University of Wisconsin 2009); and various government-sponsored programs (e.g., the Smart Communities Network of the National Center for Appropriate Technology 2009). It is a goal that has long been promoted for environmental education. For example, a 1969 report on "multidisciplinary" environmental programs for the U.S. President's Environmental Quality Council recommended that "their common purpose… should be problem-focused education and research directed toward people—their need and desire for a satisfying life in pleasant surroundings" (Steinhart and Cherniack 1969, p. 44). Ideally, faculty, administrators, and students in the EPM should pursue this goal through educational programs that use appropriate concepts, policy, organization, and methods.

Unity Versus Fragmentation

Despite the appearance of overall unity of purpose, significant differentiation and fragmentation exists in the EPM. Faculties, administrators, and students build separate programs and subprograms in response to local factors, special interests, and incentives associated with research funding and career advancement. As Brewer (1999, p. 328) notes, "The world has problems, but universities have departments."

Perhaps the most visible differentiation is the divergence between environmental sciences and environmental studies programs. Environmental sciences programs tend to be housed in specific academic departments, schools, or colleges, with an emphasis on the biophysical sciences and the epistemology of positivism.[1] Research and teaching in environmental sciences often focus on resource "cells"

[1] By positivism, we mean a philosophy that frames all matters of science as cause-and-effect relationships, constituted by variables whose identity and salience can be elucidated through empirical enquiry (Clark 2002, p. 92; Athearn 1994, p. 87). Furthermore, positivism promotes the view that all perceptions and cognitions mirror their contents, which are more or less a direct copy of the way the world is actually structured (Fogel 1993). The cognitive content of positivistic research is believed by proponents to be independent from the context in which the researcher lives and learns about the world.

(such as weather, soils, atmosphere, water, forests, range, or wildlife), and may include the systems operating within and across such cells, and the effects of environmental conditions on human well being. In contrast, environmental studies programs tend to feature more diverse disciplines and epistemologies, including social and natural scientists and post-positivists as well as positivists. Research and teaching typically attempt to address a wider range of environmental problems, including the organizational, institutional, planning and policy dimensions of these problems. Thus, environmental sciences programs are often anchored in the "sciences" part of the name, whereas environmental studies programs are oriented to the broader study of the environment and environmental problems. The boundaries between these types of programs are fuzzy rather than sharp, however, and individual programs may have characteristics of both.

Differentiation in the EPM exists beyond the contrast between environmental studies and environmental sciences. Research on the perspectives of environmental program managers conducted by Vincent and Focht (2009b) found "three distinct, but not opposing, perspectives" (p. 164) on environmental curriculum design. The "Environmental Citizen" perspective "focuses on training students to be environmentally aware citizens who can be effective environmental advocates in whatever career they choose" (p. 169). A broad curriculum is favored, including social and natural sciences and political and social dimensions of environmental problems. The "Environmental Problem-Solver" perspective emphasizes "educating environmental professionals to solve environmental problems," using "systems-focused approaches" and multiple disciplines (p. 171). Curricular breadth is again preferred over disciplinary specialization. The "Environmental Scientist" perspective "focuses on training specialists, especially scientists and engineers, who can devise practical solutions to environmental problems" (p. 172). Although interdisciplinarity is considered to be important, the Environmental Scientists "favor deep strength in a disciplinary area with branches reaching out to allied disciplines" (p. 172).

In addition to the variation among environmental programs, there is much differentiation and fragmentation within individual programs. Although programs may strive for a broad education across disciplines, many factors foster division, including the disciplinary identifications and epistemologies of faculty, and the incentive structures under which they operate.

Finding the right balance between unity and differentiation is essential to success for individual environmental programs and for the EPM as a whole. Too much differentiation can lead to incoherence, unproductive competition, less than effectively integrated education, and a poor foundation for teaching and learning the interdisciplinary skills of problem solving. At the same time, it is important not to overemphasize unity. Too much homogeneity contributes to "group think," tunnel vision, blind spots, errors, and failure (see Janis 1972; Miller 1982; Arvai and others 2004; Etheridge 1985; Ascher 2009). There is no need for all environmental programs to be exactly the same. Some amount of differentiation is to be expected and encouraged as programs and subprograms adapt to local circumstances, experiment with different approaches, or focus on different needs and different types of environmental problems.

We believe that the EPM and many of its individual programs have failed to find the appropriate balance between unity and differentiation. This is especially evident in difficulties with muddled goals, disciplinary hodgepodge, and lack of integrated curricular and pedagogical content.

Goal Muddle

Although the shared aim of improving decisions and ameliorating environmental problems provides some degree of unity to the EPM, there is less clarity or agreement about the higher-order goals behind this aim. Improving environmental decisions is subject to a variety of interpretations by faculty, administrators, and students who have different perspectives and disciplinary backgrounds and who devote their energies to different conceptions of the common good, causing confusion and disputes. Higher-order goals are the broadest and most basic, typically expressed in abstract terms. We argue above and in Part 2 that human dignity for all in healthy sustainable environments is the appropriate higher-order goal for the EPM and its programs, but within many programs this, or any other such higher-order goal, is not settled or widely agreed upon. Muddled goals can lead to an "anything goes" approach, wherein each faculty member tends to revert to his or her own personally imbedded goals, which often are technical, reflecting identification with a particular discipline. Such narrow goals may seem more concrete and tractable, but divergent lower-order goals divide faculty, administrators, and students, and can promote unproductive competition.

For example, a coastal wetland ecologist may have a goal of understanding human impacts on coastal watersheds, or more specifically, determining whether tidal marshes maintain their elevation in the face of sea level rise. Meanwhile, the goal of the silviculturalist or forest ecologist may be to carry out research on the biological and physical processes governing the regeneration of natural forests and to investigate the creation of agroforestry analogs. The environmental health faculty member's goal may be to address air pollution and human health through

research that seeks to make use of data from several disciplines. The natural resource management expert's goal may be to work on community forestry using multidisciplinary teams in developing countries. The anthropologist's goal may be to explore gender and relationships in agrarian systems. The expert in industrial environmental management may have the goal of applying innovation theory to the development of energy technology, studying industrial symbiosis and exchanges of waste, material, and energy within networks of businesses. Meanwhile, the economist's goal may be to research non-market values and to use cost-benefit or trade-off analysis to inform decisions about coral reefs, ecotourism, and outdoor recreation. These are all important objectives for individual disciplines, but they do not reflect or necessarily advance any shared, higher-order integrative goal for an environmental program.

We feel that there is too little discussion within the EPM about higher-order goals and their philosophic underpinnings (see Sivaramakrishnan and Vaccaro 2006; Nussbaum 1997; Sandel 2009). Lack of goal clarity, regardless of the reason, makes programs vulnerable to "drift" and easy capture by trendy issues, funding shifts, short-term imperatives, or transitory student demands (e.g., Bledsoe 2006). Without clear goals, approaches to problem solving can be dominated by disciplinary and technical ways of looking at values, knowledge, and skills. Faculty and administrators may fail even to understand the need for integrated efforts around a high-order goal. Moreover, without clear goals at all levels, valid performance appraisal is not possible. External accreditation standards that focus on ensuring the provision of a particular selection of courses and technical skills are no substitute for clear higher-order goals, with objectives and performance measures specifically tied to those goals.

Disciplinary Hodgepodge

We frequently see multidisciplinary environmental programs that consist of faculty members with strong expertise in specific disciplinary fields but who, in practice, mainly act independently of each other in their research and teaching. Although there may be many disciplines represented, the program has not developed a fully integrated approach or an accepted language of communication across this disciplinary hodgepodge. Norton (1991, p. ix) observed that "a common interdisciplinary language is the first step toward a unified theory of environmental stewardship." Nearly two decades later, we are still far from achieving this first step. Typically, faculty members are hired because of their success in studying, conducting research, and publishing within specific disciplinary niches, and there are substantial incentives within the academic world to stay within those niches. This makes it extremely difficult to embrace a shared goal and to practice integrated research and teaching. In a very small program, faculty members may partially overcome this by developing interpersonal relationships that foster unity and shared research, but this becomes far more difficult as the program grows.

The disciplinary hodgepodge of environmental programs is confounded by the recent emergence of many new academic disciplines and subdisciplines. As Weiler (2007, p. 149) notes, the "disciplines have fractured, multiplied, and coalesced like volcanic islands in a sea of turmoil." Students are promised interdisciplinarity, but are instead offered training in multiple individual disciplines. There is ample evidence, however, that they are seeking more. On orientation day in one relatively new Canadian program, many of the graduate students from the first two cohorts expressed very clearly that they chose that school over others because of its explicit promise of interdisciplinarity. What they meant by that term varied considerably by individual, but the essential message is that students are evidently searching for something more than multiple disciplines. This is true as well in the American schools and programs that we have encountered.

The faculty of a particular interdisciplinary environmental program might consist of a mix of disciplinary specialists, such as ecologists, economists, anthropologists, sociologists, political scientists, "generalized" policy people (with backgrounds in law, political science, economics or other specialties), and others, all focusing on a variety of local, national, or international concerns. The risk in this is that the program is diverse to the point that there is limited overlap in goals and educational concerns. A host of problems can be expected to arise. Communication and collaborative work are likely to be constrained—among other things, faculty from different disciplines may use different terms to refer to the same basic ideas. Joint research among faculty members across disciplines will be unusual (see Sherren 2008). When they do work together on larger research projects, each faculty member is likely to undertake a separate part of the project, and these independently developed parts may then be pasted together to form a combined report, or at best, the insights from two or three disciplines may be used to make recommendations (e.g., a report on forest ecology might include policy recommendations). Faculty members will tend to recruit and work with graduate students who align with their own specific disciplines or outlooks. Generally, faculty members will stay out of each other's way so that they can pursue their own interests in their own ways. However, divisive behind-the-scenes maneuvering may take place to enhance one's own discipline through more hires, greater support from administrators, and increased standing and resources.

A variety of constraints and perverse incentives make it difficult for even those faculty members who genuinely seek to work together to achieve interdisciplinarity in a program. For example, innovative junior faculty with new ideas and energy may be interested in moving programs toward interdisciplinarity, but they simply do not have the time, resources, or influence to effect significant change. The tenure process pushes junior faculty to focus on publishing as much as possible in the most prestigious journals, and they are more likely to be successful at this if they do narrow work within their own disciplines. Over time these potential innovators may become resigned to the status quo. Faculty performance in most universities is primarily judged in terms of conventional standards, such as the number of peer-reviewed papers published, rather than the amount of student progress and awareness that is achieved, or other more appropriate but difficult-to-measure indicators. Faculty promoters typically look for "superstars" who have advanced their fields, not "super-integrators" who have elevated the plane of education for all students. Another constraint, in this case felt early on in the implementation of a program, involves the negotiation of standards among faculty from different disciplines or different departments and colleges within a university. The faculty members involved come from different disciplinary traditions with conflicting expectations as to what the standards should be for student evaluation in courses, theses, and comprehensive examinations, fair teaching loads where cross-departmental appointments exist, and even tenure and promotion.

In summary, environmental programs tend to be a disciplinary hodgepodge made up of parts, rather than an integrated whole. A coherent picture of the whole may never be created or offered to students (see Chen 2008; Groopman 2007). As MacMynowski (2007) notes, some programs cannot get past this and pause, freezing at the brink of interdisciplinarity. This is the crux of the problem defined by Soulé and Press (1998, p. 397), who warn that the ill-defined nature of such a disciplinary mix leads to "both a paralysis of program planning and hyper-diverse, shallow curricula"—what they call "the environmental studies problem." The problem, though, is not limited to environmental studies programs, it is prevalent in the EPM.

Curricular Smorgasbord

Many environmental programs lack the integrated curricular and pedagogical content to generate and apply interdisciplinary knowledge to environmental problems. Instead, they offer a mix of disciplinary outlooks, epistemologies, and pedagogical approaches. Students faced with this curricular smorgasbord may be left largely to their own devices to sort through the many courses and figure things out as best they can. They may joke among themselves that they are more interdisciplinary than their professors, but they never really learn how to draw on and integrate material from the different disciplines they encounter. Without an overarching goal and interdisciplinary framework shared by faculty, curricula tend to be based on individual "default" disciplinary values, assumptions, pedagogy, and methods (see Schön 1983; Brunner and Ascher 1992). This gives rise to identifiable, fragmented parts of programs grounded in one or more specific disciplines, such as environmental science (ecological science, toxicology, etc.), policy analysis (economics, law, political science), environmental history (history), environmental ethics (philosophy), policy studies (political science, economics), social ecology (sociology), political ecology (anthropology), management sciences (organization and business), social justice (humanities), and many others (e.g., community-based approaches, environmental justice, environmental psychology). When curriculum and pedagogy are organized around these parts and then agglutinated into a program, the result continues to reflect considerable differentiation, rather than a framework or methodology for integration. Courses may even be added simply to recruit students, attempting to enhance the appeal of the curriculum by casting a larger net.

Diversity of courses is not necessarily a problem in itself, but the courses should be interrelated systematically. A diversity of courses is beneficial in that it reflects the wide range of knowledge and methods available from the different disciplines, but it is problematic to the degree that it precludes integration. For example, one environmental program we have observed developed its curriculum based on business models of problem solving and leadership, mainly teaching business skills (e.g., business planning, contingency theory, accounting). Another offers a skill set that focuses on technical, biophysical skills and positivistic epistemology, favoring select disciplines to the exclusion of other, broader course offerings. A third program has increased the number of courses it offers from about seventy to about one hundred fifty in approximately a decade, without increasing faculty proportionately. There does not appear to be a clear strategic plan for these course additions, other than in response to changes in student demands, administrators' interests, and available faculty.

When an environmental program reduces the educational experience and curriculum to an array of disciplinary courses, or the rare multidisciplinary, team-taught course, it overlooks the skills, knowledge, and methods needed for a more comprehensive, contextual, and integrated understanding of human interactions, and the critical thinking needed to address actual environmental and human problems. Such curricula do not serve students well.

Other Definitions of the Problem

There are, of course, other views about the status, effectiveness, and problems of the EPM. We briefly describe three of these competing problem definitions here for comparison. First, a *status quo* definition sees the current "chaos" in environmental programs—as one faculty member put it to us—as good for students because it exposes them to the real chaos found in actual practice. He suggested that students must learn to cope as well as they can on their own and that they should start learning from their own program's chaos. It may be true that students will face chaos when they graduate, but we believe that the EPM can and should provide them with systematic tools to deal with that chaos.

In contrast, a *disciplinary* definition of the problem recognizes that there is something wrong with the current EPM, but argues—the reverse of our views—that there is just too little "hard" science being offered. Students simply need to learn more within a specific discipline and become better scientists. Furthermore, decision makers and the public do not appreciate the contributions that more hard science could make. If science were better funded and scientific recommendations were followed, environmental problems could be solved more effectively. Thus, improving the EPM would mean adding more positivistic, disciplinary-based, and mainly biophysical, science.

A *bureaucratic* definition believes that the main problem with the EPM is inefficiency. This definition is sometimes promoted by administrators, who argue that important decision-making and financial matters in environmental programs should be centralized in a top-down controlled hierarchy. This should be accompanied by a shift in organizational culture (values and outlook), away from the collegial community culture typically associated with universities, to a more business-like and bureaucratic approach, in terms of reporting relations, standard operating procedures, information flows, and distribution of power. Under this arrangement the main focus of attention would be on operational efficiency from the point of view of the administrator.

All of these competing definitions of the problem fuel the differentiation and fragmentation of personal and professional identities, loyalties, and expectations present in the EPM. They reduce the sense of community and limit opportunities for collaboration, open deliberation and evolution into genuine interdisciplinarity.

Restating the Common Problem

It may be possible for the EPM to achieve its goals, but this will not happen if we leave environmental programs as they are, or if we focus simply on producing more hard science or additional investigation of theory, or if we increase the bureaucratization of programs. None of these strategies will ensure the balance of unity and differentiation that is needed for sound interdisciplinary research and teaching, and none will overcome the weaknesses of muddled goals, disciplinary hodgepodge, and curricular smorgasbord.

These challenges speak to the difficulty of finding common interest goals and a practical, integrated program that strongly serves society. The tension within programs, as we see it, is really about this balance of unity and differentiation, which plays out in the structure and operations of programs. At worst, the structure, philosophy, methods, and curriculum of a program may have little relationship to the major problems of our time. Without substantial change, environmental science/studies programs will be, as Soulé and Press (1998) conclude, ineffective in their primary mission, which they see as educating ecologically literate graduates, responsible citizens who are problem solvers and successful agents of change. If so, what is to be done?

Causes of the Problem

Our formulation of the common problem has direct bearing on clarification of the goals and organization of the EPM as a whole, and on the goals, educational content, and approaches of individual programs. It also affects our own professional roles and responsibilities and those of other participants in the EPM. In this section we offer an explanation of the causes and potential consequences of the current situation, beginning with an overall diagnosis and then examining specific conditioning factors.

Diagnosis

The uneven performance of the EPM stems from preventable errors, many of which can be traced to basic limitations on the capacity of participants to perceive the world. People tend to be inattentive to the real world contexts in which they operate (Kegan 1994; Charon 2007). They abstract from the complexity of reality, and in doing so misunderstand or overlook important features (Brunner 1991). For the EPM, this has too frequently led to the development of program goals that are ambiguous or mismatched to real world problems, and curricula that do not provide the necessary knowledge and skills to understand and address those problems fully in complex contexts, or to contribute in democratic ways to enduring solutions that serve common interests (see Steelman and DuMond 2009).

Three interrelated factors are implicated. The first involves bounded rationality, the second has to do with

epistemology, and the third concerns disciplinarity and its effects on program content and pedagogy.

Bounded Rationality

"Bounded rationality" is one of the basic problems of the human condition (see Simon 1957, 1983; March and Simon 1961; Schön 1983; Sullivan 1995). People operate through simplified models of the real world because they fail to appreciate or are cognitively unable to handle the true complexity they face. This constraint on rationality is unavoidable, as open systems are too complex for the human brain to comprehend fully or manage completely. Consequently, problem solvers, even academics, must reduce this complexity and create simplified models or frames in the search for solutions. Unfortunately, many people are largely unaware of their cognitive blind spots, assuming instead that they are fully rational and comprehensive in their understanding and analysis, even though the "rational actor" model of human behavior has been widely criticized (e.g., Green and Shapiro 1994). This misplaced faith in their own capacity for rationality, and its dominant manifestation in resource management—known as "scientific management"—have been critiqued by Brunner and others (Brunner 2002; Brunner and others 2005).

It is common, because of bounded rationality, individual psychodynamics (see Yalom 1980; Brunner and Willard 2003), and other factors, for people to convert a complex, ambiguous task into a set of theories and methods and an overall design that simply reflect who they are, what they value, and how they see the world and themselves (for a discussion of the problems arising from bounded rationality in cross-disciplinary work, see Lowe and others 2009; Phillipson and others 2009; Gibbons and others 2009). For academics, this may mean building an environmental program based on the epistemology, theories, and methods of the particular discipline or disciplines in which they were trained. Skill education is reduced in this way to a narrow set of technical problems and methods, framed in disciplinary or at best multidisciplinary terms. The program itself then operates to reinforce the assumptions of its creators. Such narrow programs can be overly rigid and invulnerable to critique, learning, and change. They become "self blocked" and resist examination of their own operating assumptions and performance (Etheridge 1985, 2004). Consequently, finding a principled and practical alternative remains elusive.

Within a given discipline, it may be adequate to reduce problems to a set of rational, simplified assumptions and methods in order to test theories. However, the complex environmental problems we now face cannot be resolved through broad theories of general application; they require contextual, interdisciplinary understanding. Different standards of judgment and quality must be used (see Steelman and Rivera 2006; Brunner and others 2005). Participants need to recognize that their rationality is bounded and work to uncover and address their blind spots. It is possible to counteract cognitive limitations to some extent through explicit strategies such as working in teams with others who have different perspectives, using multiple methods for gathering and analyzing data, and using a good interdisciplinary framework to organize information and orient to problem solving. Maniates and Whissel (2000, p. 512) discuss the relative strengths of programs in which faculty demonstrate collective self-awareness of the "hard choices" that their programs face, including how to address disciplinary depth versus breadth, disciplinary biases, challenges of problem definition, pedagogical philosophy, and other core issues. Jones and others (1999) make a similar point, also in the context of environmental higher education. But heightened self-awareness is not enough, and even where programs have made progress in overcoming bounded rationality much more needs to be done to meet the needs and complexity of the problems at hand.

Epistemology

The EPM problem also has epistemological origins, that is, in people's basic beliefs about knowledge, about what we can know, how we can know it, and how we can know that we know it (see Brunner 1991, 2006). The dominant epistemology in most environmental programs is positivism (see Feist 2006). As Schön (1983, p. vii) observes, positivism is the very essence of how science and rationality have been commonly understood in modern universities: "I have become convinced that universities are not devoted to the production and distribution of fundamental knowledge in general. They are institutions committed, for the most part, to a particular epistemology, a view of knowledge that fosters selective inattention to practical competence and professional artistry."

Many environmental programs, particularly environmental sciences programs, are organized around positivism. Even when it is recognized that people and context matter in understanding and addressing environmental problems, these features are often treated as merely additional variables to be examined and manipulated using positivistic methods. Schön (1983) explains how positivism contributes to the narrowness of university education. He points out that universities are committed to teaching positivism, first and foremost, rather than broad or integrated education. He also describes how practicing professionals often use a different epistemology—a pragmatic "theory-in-action" approach that is open to learning by doing and adapting with experience (see Brunner 2006). This approach, which is far more suitable for dealing with

the complexity and uncertainty of environmental problems, is rarely taught explicitly in the EPM.

The positivist epistemology also fosters misunderstanding about the relationship of science and policy making. As Pielke (2007) notes, two mistaken assumptions often underlie the call for more positivistic science in problem solving and policy making, which he calls the "linear science to policy" and the "public deficit of knowledge" assumptions. Positivism supports the belief that a lack of scientific knowledge is the pervasive problem in environmental decision making and that the more science that is produced, given to decision makers, and made available to the public, the better will be the resulting decisions and policy outcomes. Science is seen as the silver bullet—if we have more science, we have a better chance of hitting the magic combination, missing link, or jackpot factoid that will fix a problem. In addition, in the positivist worldview science is lessened by acknowledgement of an ethical referent, which is often conflated with some form of religiosity, and thus framed as anti-evolutionary. These assumptions about science and policy are incomplete in their attention to values, politics, and other contextual variables that actually influence decision making. Complex environmental and social problems are reduced to technical definitions and analytic acts, even though creating a technical definition is itself a political act. Operating under these assumptions forces students to adopt the roles of "pure scientist" (conducting pure research and attempting to avoid policy making completely), "science arbiter" (offering science-based answers to specific questions from policy makers but avoiding political debate), or "issue advocate" (using science to advocate a particular political position) (see Pielke 2007, p. 76; Foote and others 2009). These roles can be limiting and misleading.

In short, as Schön (1983) and many others have called for, we are in need of a new, genuinely interdisciplinary epistemology of science and practice. The new approach should embody the capacity for self reflection in order to manage bounded rationality, and it should use learning-in-action to deal with unique, uncertain, and conflicted situations. It should also orient pragmatically to problems, take into account the full sociopolitical and environmental context, and use multiple methods (Brunner 2006).

Disciplinarity

The third major factor contributing to the EPM problem has disciplinary origins as well. Disciplines offer great depth of knowledge and specialized methods and sometimes can be brought into close working relationship with one another to address problems (see Sullivan 1995; Kronman 2007). The disciplines have made tremendous contributions to our knowledge about components of the world, and can be expected to continue to make important contributions in the future. However, a collection of disciplinary faculty remains only an aggregation of people, isolated from one another in their values, epistemologies, knowledge, and methods. Moreover, as academic disciplines and subdisciplines become increasingly narrow and specialized, their research and teaching seems more and more removed from applied problems. Farr and others (2008), p. 29) describe the effects of such trends in the field of political science:

> "[It is] dominated by a narrow conception of the role of the scholarly professional. It is increasingly segmented and specialized. It is increasingly driven by methods and modes of theorizing that require abstracting away from vital features of politics and encourage seemingly endless debate about theoretically tractable but often empirically trivial questions. Most of all, political science today provides far too few stable opportunities for scholars who wish to engage directly or deeply with the substance or making of public policy."

Farr and others go on to note that "schools of public policy [are] mostly dominated by economists, where fundamental questions of power, politics, political institution-building, popular control, and practical leadership are neglected" (see also Green and Shapiro 1994; Shapiro 2005).

Disciplines are "islands" of ideas and practices with cultures of shared identity, purpose, and work; islands that may be more or less connected to other disciplinary islands in cooperative or conflicting ways. Furthermore, disciplinarians typically believe that their individual professional status and advancement lie within their own particular disciplines. Disciplinary identification and outlook contributes to fragmentation of perspectives and programs. Disciplinarians give their own chosen topic of study, and preferred methods for studying it, preeminence in attempting to show the way to improve humanity's lot—and they are rewarded for this approach with grants, promotion, and standing within their disciplines. The sense of identity, belonging, and acceptance associated with disciplinary groups is a powerful and fragmenting incentive that can give way to reinforced myopia and arrogance, intellectual one-upmanship and denigration of other groups.

The simple gathering together of multiple disciplines into an environmental program or team-taught course cannot be expected to produce the unity of purpose and genuinely interdisciplinary approach to environmental problems needed in the EPM (e.g., Moslemi and others 2009). For example, "interdisciplinary" may be interpreted as just two disciplines working together—ecologists with economists, groundwater hydrologists with surface water hydrologists, or psychologists with economists. Although

such collaborations are important and have led to substantial improvements in understanding, much more is needed. Consider integrated water management, which may require knowledge from physics, chemistry, geology, forest ecology, groundwater hydrology, surface water hydrology, political science, psychology, sociology, anthropology, archaeology, law, ethics, history, and other fields. Without some common or at least coherent framework to guide integration and communication across different disciplinary perspectives, those faculty who are really interested in interdisciplinarity may become frustrated as their expectations are unmet, undermining their willingness to continue collaboration and exploration. The present academic arena is not a fertile germination bed for new integrated approaches (e.g., Yale College 2001).

Other Factors

Three others factors merit mention: over reliance on convention, institutionally driven professional stressors, and the need to attract resources and students. First, environmental programs are frequently formed from existing academic departments, either through merger or through expansion of the mandate of a single department. As a result, new environmental programs are often "polyps" of preexisting programs. As the new programs are set up and faculty are seconded or recruited, traditional and conventional patterns of professional outlook and work are carried over (another form of bounded rationality). Faculty and administrators come with built-in paradigms, epistemologies, disciplinary loyalties, and much more, including expectations about reward and incentive systems, funding and accounting systems, and bureaucratic arrangements and preferences. At the same time, structural constraints within the university may discourage or prevent appointments of faculty from existing departments to interdisciplinary research groups or interdisciplinary programs because the existing departments would lose their entitlement to the faculty positions if their faculty were appointed elsewhere. Departments do not want to lose the money, prestige, and power associated with having a particular, preferably large, number of faculty positions. The problem here is convention, which must be overcome to find a good balance between unity and differentiation in new programs.

Second, an alternative to the scenario described above is a new program in which faculty are brought together by a shared goal of pragmatic interdisciplinary pedagogy in the interests of environmental problem solving. But this often occurs in the face of conventional administrative ideas about disciplinarity in higher education. Faculty may face a combination of ill-defined review criteria, competing administrative mandates, unenlightened institutional leadership, insufficient resource allocation, and undue pressure to perform, especially in the tenure review process (for discussion of some of these challenges, see Hall and others 2005; Pfirman and others 2005a, b; Pfirman and others, no date). There is also pressure from more traditional departments in the university to align with a "respectable" discipline rather than being involved in mushy interdisciplinary work, which they perceive to be unscientific. It is daunting for faculty to engage their professional pursuits under this sort of stress, particularly junior faculty who are inexperienced in navigating the institutional and professional hurdles (Brunner and Willard (2003) provide a model for addressing such professional insecurities).

Third**,** for environmental programs to survive as legitimate entities, they must attract students and resources, and their ability to do so is partly dependent on the image the program projects as well as its content. This requires that programs market or promote themselves in competitive ways. As Auer (2010) demonstrates, even the initial decision to adopt the name "environmental" and develop an environmental degree program may be driven by a "back story" of political and financial pressures. Every program attempts to present itself in the best possible light, but over-selling a program by distinguishing it from others as unique or state-of-the-art can be problematic. The risk is that the program does not and cannot perform as advertised. Resources, including personnel, equipment, and money, are also required for a successful program. Gaining these scarce resources is a full-time, seemingly endless chore. These considerations add pressure to the task of developing effective programs.

To sum up, the weaknesses of the EPM basically arise from limited rationality on the part of faculty and administrators, the experts and decision makers. Fragments of knowledge (epistemological, disciplinary, and contextual) are used to simplify the complicated problem of setting up a successful program, curriculum, and skill-based education. As a result, the environmental and policy questions under consideration—the problem-solving tasks at hand—may be reduced to a previously existing design and outlook. We are not suggesting that this is the result of a conscious agenda pushed by disciplinarians or other participants (although in rare cases this may be the case). In addition to their cognitive limitations, faculty have limited time and resources available to learn about and practice interdisciplinary concepts, which encourages them to fall back on the disciplinary approaches to which they are accustomed. The proverbial tail wags the dog, as available people, approaches, and resources determine what questions are asked and answered and what skills are used.

Future

Considering the problem of limited rationality and the way it manifests in goal muddle, disciplinary hodgepodge, and

curricular smorgasbord, what can we expect for the EPM in the future?

The trends and conditions that are facilitating the evolution to more effective programs and those that are hindering the transition are mixed. We describe a few key trends here. The first trend we see is an increasing number of faculty, administrators, and students who are coming to appreciate the downside of too little unity. This recognition is not new to the EPM (e.g., Norton 1991), but it appears to be increasing and has even been popularized (Wilson 1998), resulting in renewed attention to the debate about what sort of unity is needed and how the individual disciplines encompassed by the EPM are treated in unifying efforts (e.g., Berry 2001). The need for greater unity is felt and understood in diverse ways by individuals and is stimulating reconsideration of individual programs and the EPM overall (e.g., Seager 2008). The growing appraisal of environmental programs, reflection on them, and dialogue about them take many forms, including renewed discussion about key topics such as problem definition, the nature and content of interdisciplinary problem solving, social justice, appropriate core courses and degree tracks, capstone courses, tenure standards for interdisciplinary scholars, and more. For example, Project Kaleidoscope (2009), an organization supported by the National Science Foundation, with a mission to promote strong undergraduate programs in science, technology, engineering, and mathematics, has sponsored innovative appraisals of interdisciplinarity in the EPM (e.g., Hall and others 2005; Pfirman and others 2005a). We expect this helpful trend to continue, but appraisal and discussion at the level of individual programs and at the level of the EPM as a whole need to be better organized and amplified.

A second positive trend is that there appears to be a developing convergence of ideas, concepts, and methods with those that were formulated as "interdisciplinary problem solving" decades ago by Harold Lasswell and his collaborators (as described by Lasswell 1971a, b; Lasswell and McDougal 1992; Brunner 1996, 1997a, b). There are many examples of this contemporary convergence, including Bammer (2005, p. 6), who talks about the need to build a new specialization, which she calls "integration and implementation sciences." Seager (2008, p. 1) also calls for an academic focus on interdisciplinarity, which he calls a "sciences of sustainability." He notes that the present academic situation poses a serious obstacle to advancing and understanding of sustainability. Many other scholars are offering up new ways to think and work for greater integration (e.g., Jones and others 1999; Balsiger 2004; Lélé and Norgaard 2005; MacMynowski 2007), and there are growing calls for "mixed methods" to be used in problem solving (e.g., Johnson and Onweuguzie 2004). As we argue in Part 2, the "policy sciences" approach detailed by Lasswell (1951, 1962, 1970, 1971a,b) and others, offers the kind of interdisciplinarity these authors are seeking, and it has been applied successfully to problems in a variety of contexts.

A third trend we have observed, one that hinders the transition to more effective programs, is growing differentiation, as environmental programs hire new faculty who are specialists in disciplines unconnected to the history, core outlook, and collegiality of the existing program, and who may not have a strong commitment to interdisciplinarity or applied problem solving. This trend adds more disciplinary diversity and specific skills to existing programs, but it also brings fragmentation and conflict over program goals, standards, and curricula. At the same time, however, this trend is stimulating some people to reconsider the philosophy and purpose of environmental programs, which could potentially be helpful to the EPM.

Although some of these trends are encouraging, they do not suggest that the problems of the EPM will be resolved without substantial additional action. Unless the problems we discuss are addressed, we anticipate that shortfalls between the promises of cutting-edge approaches and interdisciplinarity made by the EPM and the actual performance of environmental programs will become more evident. The effects of violated expectations are not likely to be constructive for the programs, faculty, or students. Regardless of how the EPM's challenges are described, we need to do better given the present and foreseeable human condition and status of the environment.

Conclusions

The environmental sciences and environmental studies movement is made up of many university and college programs (which we call the environmental program movement, or EPM). The EPM is a major societal response to modern environmental problems, including rapid global change expected to be harmful to the human enterprise. Programs in the EPM should provide—and should educate students so that they are also able to provide—empirical and analytic inputs to improve decision making and ameliorate environmental problems. Currently, however, most programs are made up of diverse disciplines, each with its own theories, body of knowledge, standards of problem solving and conventional role in the policy process. There is too much differentiation and fragmentation within the EPM, evident in the muddled goals, hodgepodge of disciplines, and curricular smorgasbord found in many environmental programs. Finding a better balance between unity and differentiation is the chief challenge. In Part 2 we discuss specific strategies designed to overcome the weaknesses we have identified.

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