A Course on Species and Ecosystem Conservation: An Interdisciplinary Approach

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ABSTRACT
Many ways exist to learn interdisciplinary problem solving (e.g., field trips, on one's own, workshops, and courses). This paper describes "Species and Ecosystem Conservation: An Interdisciplinary Approach," a course taught at Yale University's School of Forestry & Environmental Studies. It is a graduate, three-hour, one semester course which offers a comprehensive approach to interdisciplinary problem solving, illustrations on how to use it, and an opportunity for students to apply it and present results. The course, which emphasizes problem structuring, applies interdisciplinary problem-solving concepts to species and ecosystem conservation, as well as to contemporary professional practice. In the last 11 years, over 200 students from 30 countries have found the course to be highly relevant for them and applicable to their professional goals. A similar course could be taught elsewhere or abstracted into a several day workshop. This paper is structured in three sections: (1) an overview of the Yale course, (2) an outline of how to apply and present an interdisciplinary approach, and (3) student evaluations of the course. The course's rationale and goals are explained, and its content, organization, and main themes are described. An outline for writing and presenting interdisciplinary case analyses is offered.

LEARNING INTERDISCIPLINARY PROBLEM SOLVING

This course offers students the opportunity to learn a comprehensive approach for interdisciplinary problem solving, apply it for the first time, and present results to the class. There are many ways to learn interdisciplinary problem solving, such as workshops (Clark *et al.* in press), field trips (Clark and Ashton 1999), and on one's own or in study with a trained practitioner (Clark 1997a). However, a three-credit, one semester course that meets once or twice a week for about three hours is an excellent vehicle for introduction to the subject.

COURSE RATIONALE

The present problem of species and ecosystem loss and the limited effectiveness of professionals in addressing this problem successfully rests on a *common problem*. The common problem is that, typically, conventional professionals, and other participants and analysts, simplify a problem and misconstrue or overlook some important part of the context, only to discover their error in retrospect when results come in which are quite different from what they expected! The case material covered in this course clearly shows how participants in problem solving fall victim to their own limited (disciplinary, epistemological, organizational, or ideological) problem-solving conceptions and skills. The professional challenge is to acquire facility in the use of an interdisciplinary conceptual framework that helps you to see more of the relevant context more reliably than would otherwise be achieved by using conventional, positivistic, and narrow disciplinary viewpoints. This framework is made up of *problem orientation*, the *social process model*, and the *decision process model* as

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the basic tools for "mapping" any policy context. The course teaches the framework.

The course is part of a professional and policy movement, which in turn is part of a worldwide effort to address the increasingly complex environmental problems of our time (Brunner and Ascher 1992). The goal of this movement is to improve species and ecosystem conservation, professional practice, and diverse policy decisions through interdisciplinary scientific inquiry. This movement is often *mis*understood as a search for rational, objective, and specific solutions (using positivistic or experimental science) to specific environmental problems that would otherwise be solved "politically." In actual practice, enduring solutions to these kinds of problems cannot be found by reducing them to either single disciplinary perspectives or positivistic approaches.

This class, taught at the university level, fulfills the need to integrate theory and practice in an interdisciplinary professional school. Virtually every discipline in the conventional academic spectrum can contribute to improving professionalism and environmental decisions—today's problems require truly interdisciplinary approaches. However, no environmental policy problem, in particular the loss of species and ecosystems, falls entirely within the boundaries of any one discipline. Unfortunately, when most disciplines encounter environmental policy problems, they usually subordinate the problem to their disciplinary perspective, which proves to be theoretically and methodologically limited, and often inadequate.

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The first interdisciplinary-like, policy-oriented programs in United States universities began about 35 years ago, although the movement was initiated over 50 years ago (Brunner 1991). Since that time, the interdisciplinary policy movement has fragmented into many approaches because of disciplinary biases and the fact that the basic goal of these programs is often ambiguous and therefore open to different interpretations.

The interdisciplinary problem-solving approach of the *policy sciences* is the oldest distinctive tradition in this professional and policy movement (Brunner 1997a). The conceptual and theoretical tools to apply this interdisciplinary approach were formulated by Harold Lasswell, a "sociologist/political scientist" at Yale Law School (see, for example, Lasswell 1971). Since then, they have been continuously refined through practice by Ronald Brunner (University of Colorado), Garry Brewer (University of California), William Ascher (Claremont McKenna College), Andrew Willard (Yale University), and many others. Brunner, Brewer, and Ascher were all students of Lasswell's at Yale University in the 1960s and 1970s.

The interdisciplinary policy approach of the policy sciences recommends human dignity (achieved through a commonwealth of democracy) as the overriding standard for improving policy decisions. Positivism, which has traditionally dominated nearly all disciplines, is beginning to be recognized as an insufficient basis for effective problem solving. Many examples of this are evident in the course readings and elsewhere in practice today. The policy

sciences uses an "anthropologically-based" approach that is problem-oriented, contextual, and multi-method. This professional and policy movement can be used as a standard for other problem-solving approaches.

COURSE GOALS

The overarching goal of the course is to learn how to think more efficiently, effectively, and responsibly about any area of conservation (or any policy area) using the best conceptual and applied interdisciplinary tools available (Brunner 1997b, c). This in turn helps professionals to be effective practically on the job. The course helps the student to:

1. Define a specific policy-relevant species and ecosystem conservation problem and develop alternatives that are rational, practical, and justified responses to the problem (while clarifying personal standpoint on the matter).
2. Critique any literature or program (e.g., management plan, policy prescription, field effort) in conservation decision making and come to understand it in terms of a more comprehensive, functional view of the practical and theoretical context.
3. Understand the professional responsibilities and roles of the interdisciplinary, policy-oriented practitioner in today's complex world.

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These three objectives of the course—practical, theoretical, and professional—are interrelated and mutually reinforcing. Progress on any one of them encourages progress towards the other two. It bears noting that this course can improve competence in *basic professional practice*. However, mastery of the interdisciplinary approach to problem solving requires intelligence, integrity, hard work, practice, and persistence over many years.

Making interconnections among the general conceptual tools of interdisciplinary problem solving and the particular conservation problem of interest is the main challenge of the course and students' later professional work. The tools are abstract and general enough to be useful to any conservation problem. But each conservation problem is unique in its concrete details. So an interdisciplinary conservation professional must move back and forth between the general and the particular situation. This is not easy because *it requires professional judgment and interpretation throughout.* That is, the professional must learn how to think systematically and critically. However difficult this task is for a student, the effort pays off practically, as he or she comes to "see" more of the problem-relevant context over time. It also pays off as the student gains confidence in his or her understanding of the case's details. Finally, it pays off as the student learns to recognize patterns (small and large) that have been "invisible" before. All the while, the student is developing skills in the use of these intellectual tools through application to specific problems. While this interdisciplinary approach is key to making improvements in species and

ecosystem conservation and to responsible professional practice, it is also invaluable to problem solving in other policy arenas.

MAIN THEMES

A list of key themes that a student needs to understand through this course can be found in the Appendix to this paper. They are part of the foundation of the course. This lists contains 20 themes grouped under problem orientation (species and ecosystem loss), professionalism, pre- and post-positivist theory in interdisciplinary problem solving, and contemporary professional practice. These four groups are a guide to questions and considerations a student will need to be aware of during the semester. This list is also a "decision tool" to help a student determine whether or not to take this course. Students are encouraged to be aware that this course is likely to contradict what they have learned or assumed in their education and experience to this point.

THE COURSE AND INTERDISCIPLINARY PROBLEM SOLVING

The course as described in the school catalogue is given below. Also a brief introduction to the principal dimensions of the interdisciplinary approach is given, with questions to ask in any problem-solving setting. This is followed by discussion of the course's organization.

COURSE DESCRIPTION—PROBLEM FOCUS

Conserving species and ecosystems (biodiversity) is an important social goal. The historic trend is that species and ecosystems are being lost at unprecedented and accelerating rates. This major problem has profound significance for the present and all future human generations. Professionals (and citizens) now living are the last generation that can prevent the extinction of large numbers of species and the disruption of critical ecosystem processes. To address this problem, professionals must apply conservation (ecological and social) sciences and, at the same time, know explicitly about integrative, interdisciplinary problem solving and how to apply it skillfully. This course systematically uses a proven interdisciplinary approach derived from the policy sciences to address the species and ecosystem loss problem. The role of the individual professional and his/her effectiveness in problem solving is examined also. The course includes theory, techniques, and case studies. This includes looking at the organizational and policy contexts of biodiversity work.

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a group of three or four people and present them (1+ hr)(1/3 of grade).

The prerequisites are few. Students should have taken one or more classes in conservation biology and related areas (e.g., population, community, or landscape ecology), in social ecology (e.g., human dimensions of wildlife conservation, science and politics of environmental regulation), and in the policy sciences and related areas (e.g., natural resource policy, environmental law and policy). Extensive and diverse work experience (local to international) is highly desirable.

To facilitate lively discussion, enrollment is limited to 25 students. Reading assignments include a reading packet (theory and cases, available on request) and a book—*Averting extinction: Reconstructing endangered species recovery* (Clark 1997b). Readings change each year. The course's evaluation policy includes an evaluation form handed out during the last week of class. Throughout the course, students are encouraged to make constructive comments on how to improve the course, at any time, in writing or in person.

Interdisciplinary problem solving requires that the problem solver successfully orient to the problem at hand, be contextual (in terms of the social and decision process involved), and use diverse methods. The conceptual framework introduced above and discussed below can guide this work and serve as a checklist and means to integrate results for judgement and action.

COURSE ORGANIZATION

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The course begins with a brief overview in the first meeting (week 1). Part I: Basic Elements in Interdisciplinary Problem Solving (weeks 2-5) introduces elements in interdisciplinary problem solving. It provides details on the policy problem (species and ecosystem losses and the effects on humans) and its context, the challenges of professional practice, and the policy process as a means of understanding and participating to improve professional and societal responses. Part II: The Decision Process: Species and Ecosystem Conservation in the Common Interest (weeks 5-10) focuses on the conservation decision process and employs the basic interdisciplinary elements. Numerous examples and cases are used. This part identifies some basic weaknesses in decision processes and discusses ways to avoid them. Part III: Student Applications (weeks 11-13) offers students an opportunity to demonstrate their knowledge and skill in interdisciplinary problem solving. Part IV: Course Review and Final Discussion (week 14) ends the course. The organization as presented in the 1999 course, based on two meetings of 80 minutes each per week over a 14-week semester, is available on request.

INTERDISCIPLINARY PROBLEM SOLVING

Species and ecosystem management is actually an ongoing process of humans making decisions, not about plant and animal behavior, but about our own actions (Clark and Brewer 2000). Should we limit what we do or change our practices? Should we conserve species? Or collect and hunt them? Should we

encourage species to exist in viable populations? Should we leave them alone? How should we set ecosystem management goals? Should we adopt a new policy for managing species and ecosystems? The management process is about people and what we value, how we interact, and especially how we set up and carry out practices to limit our impacts on the environment, including detrimental effects on species. Because the outcome determines what happens to a public resource, the management process is—or should be—open and public.

A focus on the "decision process" is key. Some of the activities that lead up to a decision include gathering, processing, and disseminating information about the issue. Relevant information includes data on people's values and beliefs, the behavior of organizations, institutional practices, and the species and ecosystems. This stage of the decision process also calls for open discussion, debate, and lobbying about the meaning of the data and what should be done with the information. Next, based on all the information and debate, a decision is made resulting in a prescription (plan, law, program, etc.), which should be realistic and detailed enough so that everyone knows what to expect. Finally, the follow-up activities include implementing the decision (administration and enforcement), evaluating the program (done by those formally involved as well as by outsiders), and eventually terminating old ways of doing things and moving on to new ways. Evaluations—formal and informal, public, comparative, and continuous—are particularly important in providing feedback for midcourse "corrections." Appraisals are the basis of learning.

Many people despair that decision making is a messy, politicized, irrational process. But recognized standards for good decision processes do exist, and everyone involved should try to make the overall process meet these standards. The decision-making process should be, first of all, rational, integrated, and comprehensive.

Because managing species and ecosystems involves many different people, agencies, and organizations, each with potentially different information, interests, roles, analytic and political challenges, and perspectives, we need to be careful about how we organize ourselves to carry out this decision-making process. A good process will not happen on its own, nor will it come about by recycling standard operating procedures, bureaucratic arrangements, existing conflict, and old ideas. Rarely do people discuss the difficulties and limitations of struggling to decide significant, complex public issues. Yet these interactions make all the difference in whether the decision process—in this case, how species and ecosystems will be managed—will succeed or fail.

Many people despair that decision making is a messy, politicized, irrational process. But recognized standards for good decision processes do exist, and everyone involved should try to make the overall process meet these standards. The decision-making process should be, first of all, rational, integrated, and comprehensive. At the same time it should be selective, targeted, and focused. The biophysical and social information considered in decision making should be reliable; if not, some measure or description of uncertainty (or risk) is needed. Decision making should be open and accessible to those with something to contribute or something at stake. The process should also be open to scrutiny. It should be inclusive, as "selective omission" often serves personal or special interests and causes unproductive conflict. Timeliness is also essential. The lag between finding a problem and fixing it should be as short as possible,

and obsolete or unworkable practices and policies should be corrected promptly. Decision processes should also be honest, flexible, and efficient. Overall, decision making should make things better, not worse.

The ideals we should strive for in choosing our problem-solving methods are *rationality, integrativeness*, and *comprehensiveness*. The three-part framework outlined below taken from Clark and Brewer (2000), invented decades ago to address complex problems, is an alternative to the conventional, ordinary problem solving so often applied to natural resource management and policy problems. This simple framework—substantiated by extensive research and practical applications—enables users to manage enormous amounts of ecological complexity and psychosocial conflict. It helps people understand and describe situations, outcomes, events, and processes in their real-life contexts, and it reveals options for action to people with authority or those with the desire and ability to make a difference.

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This framework will not provide quick answers. It constitutes a set of operational principles, a means to organize knowledge for thought and research and to integrate it to solve problems (Figure 1). Its categories serve as a "checklist" of variables to address in any conservation project, thus enabling users to construct a realistic map of the social context and decision process and to use it to define and solve problems. It is rational, integrated, and comprehensive.

Before applying the framework, however, it is essential that we examine and clarify our own standpoints concerning the conservation problem and its context under investigation. All people have biases that limit rationality, and these biases should be appreciated to the extent possible and taken into account by the professional when doing his or her work. True professionalism demands that participants in problem solving commit themselves to two standpoints: (1) to be as unbiased and as free as possible from parochial interests, cultural biases, ideologies, disciplinary rigidities, and fixed bureaucratic loyalties; and (2) to seek the common good, which, as mentioned above, is described by the policy sciences as human dignity achieved through a commonwealth of democracy.

After committing to the appropriate standpoints, we can use the framework to address a problem. The three activities that constitute effective problem solving, and which are often described as being *problem-oriented, contextual, and multi-method* (Clark and Brewer 2000), are as follows:

1. **Explore the problem fully.** The way in which we characterize the conservation management problem will largely determine how we respond to it. Too frequently in environmental issues, people commence "biological solutions" before they define "conservation problems." If we miscast or under-represent what is involved, we virtually guarantee the misallocation of resources and increase chances of failure. To effectively characterize a problem, five procedures must be used:

Figure 1 Interdisciplinary guidelines for addressing conservation policy and management issues. See text for explanations.

#1 IS IT REASONABLE? Problem Orientation	#2 IS IT POSSIBLE? Social & Decision Process[1]	#3 IS IT JUSTIFIED? Social Process[1]
Value task (goals) Historic task (trends) Scientific task (conditions) Futuring task (projecting) Practical task (alternatives)	Participants[2] Perspectives Situation Base values Strategies Outcomes Initiation Estimation Selection Implementation Evaluation Termination Effects	Participants[2] Identification Expectations Demands Participants' Myths[3] Doctrine Formula Symbol
#4 WHAT IS MY STANDPOINT? Standpoint Clarification		
In terms of personality, epistemological, disciplinary, organizational, and parochial biases. Biases limit rationality.		
#5 HOW WILL I INTEGRATE WHAT I KNOW? Knowledge Integration		
Synthesize knowledge from #1-4 to improve understanding and judgement for action.		

[1] A social process is people pursuing values (i.e., power, wealth, knowledge, skill, respect, well-being, affection, rectitude) through institutions using resources. Human social process includes participants, their perspectives, situation, base values, strategies, outcomes, and effects.

[2] People are likely to act in self-interested ways to complete acts that are perceived to leave themselves better off than if they had completed them differently (mazimization postulate).

[3] Myth is comprised of doctrine (philosophy, basic beliefs), formula (constitution, laws), and symbols (lore heroes, flags, grizzly bears). Myths are constantly being readjusted through social and decision process.

Goals: What goals or ends, both biological and social, does the community want? Are the values behind the goals clear? These may be refined over the course of the analysis.

Trends: Looking back at the history of the situation, what are the key trends? Have events and processes moved toward or away from the specified goals?

Conditions: What factors, relationships, and conditions created these trends, including the complex interplay of factors that affected prior decisions? What models, qualitative and quantitative, might be useful at this stage to explain trends?

Projections: Based on trends and conditions, what is likely to happen in the future? It is important to project several scenarios and evaluate which is most likely. Is this likely future the one that will achieve our goals?

Alternatives: If trends do not seem to be moving toward the goals, then a problem exists and alternatives must be considered. What other policies, rules, norms, institutional structures, and procedures might help us to achieve our goals? Evaluate each in terms of the goals. Select one or more and implement them.

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2. **Ensure an adequate decision process.** Species and ecosystem management is concerned with establishing *who* will make decisions about *how* we use resources. Participants must successfully influence this process if we expect to save species and their habitats. Remember the standards for good decision processes described earlier.

Pre-decision

Initiation: Initial sensing that a problem exists. Who first determines that there might be a problem? Who and how should the problematic situation be examined? Who should undertake the initial work? When, how? Can or should the issue be tentatively put on the agenda for further study? Should investigation begin on the size, importance, and other features of the problem? Who is affected? Who should follow up?

Estimation: What information—biological and social—do we need to make good decisions about the problem, in this case of species and ecosystem management? Do we have it? What is missing? How do we get it? How will it be integrated and used? Does everyone have the information they want? Who is advocating which courses of action and for what reasons? Is there adequate opportunity for debate? Who might be served by which courses of action and who might be harmed?

Decision

Selection: Will the new policy be adequate to solve the problems we have identified? Will it be efficient, effective, and equitable? What are its goals?

Post-decision

Implementation: How will we "invoke," implement, or enforce the new rules? Who will do it, where, when, and how? Is it authoritative? Are adequate assets available to carry it out? Is it clear under what circumstances we will invoke the new rules, i.e., do people know what to expect? How will the new rules be administered? By whom? What sanctions will apply if people violate the new rules?

Evaluation: By what standards will we evaluate whether the new policies have succeeded? Who will do the evaluations? Who will get and act on the evaluations? How will their actions be appraised?

Termination: How will we know when to end this policy and move on to something more fitting? Who will decide? How can we start the process over again smoothly?

3. **Understand the context.** The human social context is too easily overlooked, ignored, or viewed as a constraint to the central biological task of species and ecosystem management and policy, when, in fact, it is central to understanding the problem and finding a permanent solution. "Map" the social process as realistically as possible.

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Participants: Which individuals and organizations are participating? Who wants to participate or should participate?

Perspectives: What demands are participants making? What expectations do they have? On whose behalf are demands made, i.e., what groups or beliefs do people identify themselves with?

Situations: What is the "ecology" of the situation—geographic features, for instance? Are there any crises? Which institutions are or should be involved? Is the situation organized or not, and is it well organized?

Values: What "assets" do participants have in terms of power, wealth, skill, knowledge (enlightenment), affection, well-being, respect, and rectitude?

Strategies: How are these assets being used? Are people's strategies educational, diplomatic, economic, or militant? Are these used persuasively or coercively?

Outcomes: What are the results of each decision activity? Who benefits and who is harmed in terms of which values or assets?

Effects: What institutions and practices are promoted and which are set back?

Attending to these three aspects of problem solving maximizes the likelihood that, as we tackle the problem of species and ecosystem conservation, the process will be procedurally and substantively rational, politically practical, and morally justified. Finally, the professional must integrate all the information derived from the above activities into an overall picture of the whole and render a judgment. This judgment is the basis for solving the problem at hand.

APPLYING AND PRESENTING THE APPROACH

Once a student has been introduced to this interdisciplinary approach, he or she is ready to apply it for the first time to a case of his or her choosing and make an oral presentation using visual aids. Analysis of case material is challenging. Moving between the concepts of interdisciplinary problem solving and the case repeatedly brings out the utility of the theory and links case analysis. Presenting the case in a clear, understandable fashion to an audience is also demanding. Students, depending on group size, generally take from 15 to 40 minutes per case presentation.

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OUTLINE FOR WRITING

Clearly writing the analysis requires drafting, editing, and redrafting. Students are asked to follow an outline and limit their writing effort to 15 pages (Table 1). The outline is comprised of an introduction, description of the problem, analysis of the problem, recommendations to solve the problem, and conclusions. Clark and Willard (2000) explain this outline, detailing why it is constructed in the way that it is. Clark *et al.* (2000) give ten cases using this outline in diverse situations. Student-authors in Part II of this volume used this outline as well. The paper length was chosen so as not to overwhelm a student with a large writing and analytic task. Also, a relatively short manuscript is something that might be presented to an elected official, program manager, or agency official. Shorter "policy briefs" of a page or two are even better for this audience. Thus, these papers are also an exercise in professional communication.

TEMPLATE FOR ORAL PRESENTATIONS

The oral presentation follows the written account. To facilitate presentations, students are asked to follow a similar "template" to that of the paper (Table 1). As each case is different, and creativity in presentation is necessary, students vary the template as needed. Cases are presented using overhead transparencies and other visual aids (e.g., slides, maps). Overheads are generally prepared using PowerPoint (examples in Part II). Each overhead contains text and/or pictures, and students generally use from five to 10 overheads each. A typical

Table 1 Recommended outline to follow in making written and oral presentations.

SPECIES AND ECOSYSTEM CONSERVATION: AN INTERDISCIPLINARY APPROACH
(There are many possible variations)

ABSTRACT (1 short paragraph. Less than 150 words)

INTRODUCTION (1 pg.)
- A. 1st paragraph (be problem oriented = goals, problems, alternative(s)). "The policy problem is..."
- B. 2nd paragraph (very short purposes of paper (3 purposes)).
- C. 3rd paragraph (clarify your standpoint in reference to the problem).
- D. 4th paragraph (describe the method you used).

I. **PROBLEM** (Description of the problem, 3-4 pgs.)—The what?
- A. Specify contextually (=social process) and in some detail the species/ecosystem problem that is the subject of your study.
- B. Specify problem in terms of decision process.
- C. Clarify goals in reference to the problem of concern.

II. **ANALYSIS OF THE PROBLEM** (Trends, conditions, projections, 3-4 pgs.)—The why and what's likely to happen?
- A. Description of trends in the decision process that have had an impact on the problem of concern, including identification of particular impacts and their relation to the achievement of goals.
- B. Identification and examination of the factors that have shaped the trends and impacts described in II. A.
- C. Projection of future trends in decision and accompanying impacts, with an emphasis on exploring the relationship between projected impacts and the achievement of goals.

III. **RECOMMENDATIONS** (Alternative promoted, 3-4 pgs.)—What to do? Justify your recommendation.
- A. Alternative(s) for resolving the problem given projections described in II. B. and C. above.
- B. Evaluation of the alternative strategies proposed for their potential contribution towards reaching the goals.
- C. Selection and justification of particular strategy to resolve the problem.

CONCLUSIONS (1 pg.)
- A. Very brief re-statement of goals, problem.
- B. Recommendation and justification to solve problem as defined.

ACKNOWLEDGMENTS

LITERATURE CITED

presentation might be introduced by a slide showing title and theme. A second slide would contain a brief statement of the policy problem, purpose of analysis, analyst's standpoint, and methods. Next, a table or figure showing the social process might be presented. A map of decision process follows this. Goals, based on the analysis to this point, are given. Next, an overhead showing trends, conditions, and projections in the problem is shown. A statement of recommendations to solve the problem and justification for the recommendation follows. The last transparency is the conclusion, restating the goal, problem, recommended alternative, and justification.

EVALUATING PRESENTATIONS

Students are asked to evaluate each other's presentation recording their appraisal on a standardized form (Table 2). This form follows the recommended outline for paper presentation, which in turn contains all elements of

Table 2 Evaluation form for student presentations.

SPECIES AND ECOSYSTEM CONSERVATION:
AN INTERDISCIPLINARY APPROACH
Appraisal of Presentations
This exercise is to help ppresenters improve (be constructive)
(1=excellent, 2=good, 3=needs work)

I.	INTRODUCTION			
1.	Was the policy problem stated clearly and simply?	1	2	3
2.	Were the purposes of the presentation stated clearly and simply?	1	2	3
3.	Was the presenter's standpoint clarified?	1	2	3
4.	Were the presenters methods clear?	1	2	3
II.	PROBLEM			
1.	Was the problem's context (=social process) adequately detailed?	1	2	3
2.	Was the problem's status relative to the decision process clear?	1	2	3
3.	Were goals sought in reference to the problem clarified?	1	2	3
III.	ANALYSIS			
1.	Were relevant trends (history) adequately described?	1	2	3
2.	Were conditions (=factors) that shaped trends adequately described?	1	2	3
3.	Were future trends (=projections) adequately described?	1	2	3
IV.	RECOMMENDATIONS			
1.	Were alternatives to resolve the problem adequately described?	1	2	3
2.	Were alternatives adequately evaluated?	1	2	3
3.	Was the selected alternative (=strategy) or complex of strategies appropriate to achieve goals and solve the problem?	1	2	3
V.	OTHER CRITERIA			
1.	How would you rate the overall quality of the presentation?	1	2	3
2.	How would you rate the use of overheads and other visuals?	1	2	3
3.	What is your recommendation to improve presentation and analytic style? Use reverse side to detail your recommendations.			

interdisciplinary problem solving. Following each presentation, the presenter is given the evaluations as a basis for revising and submitting his or her paper for a course grade.

EVALUATING THE COURSE

Students are requested to evaluate the course formally on the final day. The Yale School of Forestry & Environmental Studies provides a standard form that students use in all courses to appraise their semester's experiences. Additionally as a specific course assignment, students are asked to list and describe in a paragraph the three "take-home" lessons of the course from their perspective. Results of the 38 student evaluations in the 1999 class are summarized above.

1999 STUDENT EVALUATIONS

When asked to rate the relevance/value of the assignments and projects to the course subject, 96% said they were highly relevant and 4% said they were

pertinent. The course workload was considered heavy by 78% and manageable by 22%. In 1999, the course was taught in two sessions, one with 22 students and the other with 16. Taken together, 50% felt the class size was just right, 40% a bit too large, and 10% too large. When asked if the goals and objectives of this course were made clear at the beginning of the course, 98% said yes. One hundred percent said these goals were met by the course. Finally, when asked if the course fit into their overall course of study, 79% said there was an excellent fit, 15% said it was a very good fit, and 5% felt it was a satisfactory fit.

Students' general comments were solicited about the course. They included the following. "Fewer readings. More discussion. The course probably taught me more than any other at Yale did. I had an excellent experience. I only wished I had taken it last year. I learned a very valuable tool I will use a lot. This was by far the most useful and thought provoking class that I have taken to date at Yale. The presentations and guest speakers were a great learning experience. This class helped me to lucidly understand the issues that are my *(sic)* master's thesis. I recommend it to everyone, even those not involved in conservation of endangered species and ecosystems per se. It applies to any problem-solving context. A great course that I would not hesitate to take again and again."

The policy sciences approach to problem solving is an enormously useful tool in both defining problems and concomitantly finding solutions, not only to species and ecosystem problems, but to any complex issue involving human beings and their social, political, economic, and cultural systems. How one defines a problem inevitably dictates the solutions chosen to remedy the problem as defined.

1999 TAKE-HOME LESSONS

The final assignment asked students to describe the three take-home lessons from the course. A sampling of take-home lessons follows. "An explicit, methodological analysis of a policy situation grants the individual, group, or organization increased power to understand and influence that situation. The majority of policy is based in politics, not science. Development of new educational approaches and new professionals is critical to the future success of environmental policymaking. Conservation involves decisions by different people. It is important to understand the social process or context involved. The policy sciences approach to problem solving is an enormously useful tool in both defining problems and concomitantly finding solutions, not only to species and ecosystem problems, but to any complex issue involving human beings and their social, political, economic, and cultural systems. How one defines a problem inevitably dictates the solutions chosen to remedy the problem as defined. How complex species and ecosystem conservation really is (*sic*). Define a problem using problem orientation, understand the social process by mapping participant values and their interactions, and work in a group to clarify ideas and refine concepts for presentation and publication. The most important thing is the idea of a person's standpoint. The basic interdisciplinary nature of conservation issues and using it to approach problem solving (*sic*). It became obvious to me that mapping and understanding a problem and the social context, as well as the decision process is fundamental to finding a solution to the problem. The class has improved my self-confidence."

EVALUATIONS FROM PREVIOUS YEARS

The 1999 evaluations and take-home lessons are similar to all previous years. The following comment by one student in 1997 is typical. "I studied anthropology as an undergraduate in the UK. My career developed in my native country [not the U.S.] as the coordinator of an environmental management program, which eventually led me to the international level. I was unexpectedly influenced by the policy sciences [interdisciplinary problem solving] at Yale. It was stimulating stuff. It gave me an incredible scope and opportunity to work as a policy-oriented professional [building on my past experience and contacts]. I came to Yale, without recognizing it, as an infant policy scientist [interdisciplinary problem solver]. I leave it as a maturer *(sic)* one, one who recognizes my skills and strengths, and through that recognition, will be able to develop and apply them in a more systematic and, ultimately, productive manner toward the realization of my own professional goals. I feel, at last, happy in the knowledge that my interdisciplinarity is my strength. The course was a seminal experience for me!"

CONCLUSIONS

Learning interdisciplinary problem-solving concepts and skills and applying them to species and ecosystem conservation problems is a task that can be productively accomplished in a three and a half month graduate course, of which the Yale University School of Forestry & Environmental Studies course is but one example. The course is structured to introduce interdisciplinarity, key concepts, an analytic framework, and sample applications. These ideas are best learned and taught with the support of diverse readings, exercises, and open discussion. Students generally evaluated the course to be of great significance to their professional education, intellectual maturation, and development of critical thinking and applied skills.

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APPENDIX

MAIN THEMES OF THE COURSE "SPECIES AND ECOSYSTEM CONSERVATION: AN INTERDISCIPLINARY APPROACH"[1]

Problem Orientation (Species and Ecosystem Loss)

1. Species and ecosystems are being pushed to extinction at unprecedented rates worldwide. Species and ecosystems are the "basic" small- and large-scale "units" of nature, respectively.
2. Causes for species and ecosystem losses include a complex mix of direct and indirect human activities. This is therefore a human problem. This problem has intermixed biological, social, economic, and political dimensions.
3. Extinction rates are variously estimated at 100+ species extinctions per day and increasing. Destruction rates of native ecosystems are considered high, but are not quantified precisely.
4. Life support systems for all living forms depend on the health of species and ecosystems (i.e., nature). Thus the loss of species and ecosystems is expected to have harmful, uncertain, and long lasting effects on all humans and societies.
5. To avoid or ameliorate the harmful affects of species and ecosystem losses, nature should be maintained so that species exist in viable populations and ecosystems retain their structure, processes, and resiliency. Maintaining these species and ecosystems would permit the human enterprise to perpetuate itself sustainably.

Professionalism

6. Conservationists and natural resource professionals are part of a tradition comprised of many parts that differ in origin, outlook, and practical impact, but share the common (although sometimes ambiguous) aspiration to contribute to improved conservation management and policy.
7. There is a growing worldwide movement, in response to the increasingly complex problems of the contemporary world, including species and ecosystem losses, to which professionals from many disciplinary backgrounds are moving. Conservation and natural resource professionals are typical. However, this cohort of professionals is currently a minority in the overall social and decision processes in society.
8. The interdisciplinary approach to improving management and policy holds that most preventable errors of professional practice stem from the professional's own perspective: Typically, some important part of a problem's context is misconstrued too narrowly or overlooked altogether. As a result, the concept of the "problem" thus constructed and acted upon is inadequate.
9. The philosophy of knowledge known as positivism (experimental science), which dominates most scientific and problem-solving endeavors today, predisposes such errors because of its non-contextual view that postulates universal laws of behavior, its over-reliance on quantitative and formal methods, and its avoidance, in principle, of normative issues. These are problems in professional perspective and they can be corrected.
10. In contrast, the interdisciplinary problem-solving approach is based on the postulate that behavior is selective from the actor's own subjective viewpoint (perception matters). Multiple methods are required to understand problems. It recommends that the overriding aim of policy and inquiry should be human dignity (a commonwealth of democracy), wherein science is conceived in the broad sense to bring about human freedom. This requires a focus on normative (value) issues.

11. Progress of the interdisciplinary problem-solving movement to improve professional and policy responses to society's problems depends upon distinguishing the main elements of the overall movement and appraising their performance relative to one another and to the common goal of improving professionalism and policy decisions. Importantly, do not assume (in positivistic terms), that it means "to improve policy decisions through scientific inquiry" (wherein science is conceived in the narrow positivistic sense).

Pre- and Post-Positivist Theory in Interdisciplinary Problem Solving

12. Pre- and post-positivist theory, as used in interdisciplinary problem solving, abstracts similarities from many different contexts of human experience over history. It does not and cannot detail any specific context unambiguously, completely, or permanently.
13. Normative (values) and empirical (verified) theory are both grounded in diverse human experiences. Normative theory abstracts value preferences while empirical theory abstracts patterns of behavior without expressing value preferences. These two theoretical approaches are integrated in the interdisciplinary problem-solving approach.
14. The function of theory, from a post-positivist standpoint, is to direct attention to the relevant aspects of any particular "problem's" context. The function is not to prescribe what should be found there, nor to predict what will be found there, but to aid in assessing and in understanding what is found there.
15. Most recent claims of theoretical progress in problem solving in many disciplines and "multidisciplinary" efforts are actually refinements or innovations in the vocabulary of the policy sciences interdisciplinary problem-solving approach (they are partial re-inventions or convergences). Because authors of this vocabulary are usually unaware of the policy sciences, they think their new terms are true, first-time innovations.

Contemporary Professional Practice

16. Human behavior is not determined in the sense of Newtonian mechanics (mechanistic cause and effect). A person's pattern of behavior can be understood to be the coordination of individual acts, each based on a person's own subjective construction of the self-in-specific-context. Human behavior is about "making meaning" in life (e.g., a sense of self in social context).
17. Human value preferences are too often taken as given or fixed in contemporary professional problem solving, misused as rationalizations for hidden interests in promotional politics, and reduced to wealth and power considerations in the overall society. This is an oversimplification with significant harmful consequences.
18. For conservation problems fraught with uncertainty and ambiguity (as most interesting problems are), rationality is more procedural than substantive. In such circumstances, decision processes should focus on appraisal, and stopping errors in management and policy.
19. Political symbols (spoken, visual, and exemplars) are significant elements and tools shaping social process in groups and society and in meaning making, but they are under-estimated and under-studied relative to the substantial (e.g., biological) factors by participants in problem solving.
20. The politics of our time (trends) are distinguished by the rise of modernizing intellectuals, including scientists. Their power base is skill, their technique is symbol manipulation, and their net impact on human dignity is still in doubt! Whether they can significantly address the species and ecosystem loss problem and improve decision making is questionable.

[1] This list was partially derived from Ronald Brunner, Center for Public Policy Research, University of Colorado, Boulder, with his permission and modified for this course.