Scenario Planning: a Tool for Conservation in an Uncertain World

GARRY D. PETERSON,*‡ GRAEME S. CUMMING,† AND STEPHEN R. CARPENTER*
*Center for Limnology, 680 N. Park Street, University of Wisconsin, Madison, WI 53706–1492, U.S.A.
†Wildlife Ecology and Conservation, Newins-Ziegler 303, Box 110430, University of Florida, Gainesville, FL 32611, U.S.A.

Abstract: *Conservation decisions about how, when, and where to act are typically based on our expectations for the future. When the world is highly unpredictable and we are working from a limited range of expectations, however, our expectations will frequently be proved wrong. Scenario planning offers a framework for developing more resilient conservation policies when faced with uncontrollable, irreducible uncertainty. A scenario in this context is an account of a plausible future. Scenario planning consists of using a few contrasting scenarios to explore the uncertainty surrounding the future consequences of a decision. Ideally, scenarios should be constructed by a diverse group of people for a single, stated purpose. Scenario planning can incorporate a variety of quantitative and qualitative information in the decision-making process. Often, consideration of this diverse information in a systemic way leads to better decisions. Furthermore, the participation of a diverse group of people in a systemic process of collecting, discussing, and analyzing scenarios builds shared understanding. The robustness provided by the consideration of multiple possible futures has served several groups well; we present examples from business, government, and conservation planning that illustrate the value of scenario planning. For conservation, major benefits of using scenario planning are (1) increased understanding of key uncertainties, (2) incorporation of alternative perspectives into conservation planning, and (3) greater resilience of decisions to surprise.*

Planificación de un Escenario: una Herramienta para la Conservación en un Mundo Incierto

Resumen: *Las decisiones de conservación sobre cómo, cuándo y dónde actuar, por lo general, se basan nuestras expectativas para el futuro. Sin embargo, cuando el mundo es altamente impredecible y tenemos un espectro limitado de expectativas, éstas frecuentemente acaban siendo equivocadas. La planificación de escenarios ofrece un marco de trabajo para el desarrollo de políticas de conservación más resistentes cuando enfrentan a la incertidumbre incontrolable e irreductible. Un escenario, en este contexto, es el relato de un futuro plausible. La planificación del escenario consiste en usar algunos escenarios contrastantes para explorar la incertidumbre que rodea las consecuencias futuras de una decisión. Idealmente, los escenarios deberán ser construidos por un grupo diverso de personas con un propósito único y declarado. La planificación del escenario puede incorporar una diversidad de información cuantitativa y cualitativa en el proceso de toma de decisiones. A menudo, tomar en cuenta esta información diversa en forma sistémica puede llevar a mejores decisiones. Además, la participación de un grupo diverso de personas en un proceso sistémico de recolección, discusión y análisis de escenarios da lugar a un conocimiento compartido. La robustez provista por la consideración de múltiples futuros posibles ha servido bien a diferentes grupos; presentamos ejemplos de empresas, autoridades y conservación que ejemplifican el valor de la planificación de escenarios. Para la conservación, los mayores beneficios de usar la planificación de escenarios son (1) un mayor conocimiento de las incertidumbres de importancia clave, (2) la incorporación de perspectivas alternativas en la planificación de la conservación, (3) mayor resistencia de las decisiones a situaciones imprevistas.*

‡*email gdpeterson@facstaff.wisc.edu*
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Introduction

Traditional planning is frequently based upon the belief that the application of professional expertise to achieve well-defined goals will ensure efficient and effective management. However, such plans often fail to consider the variety of local conditions or the propensity for novel situations to create extraordinary surprises (Scott 1998). This blindness to variety and surprise, which is often accompanied by a false certainty about the efficacy of management, can lead to costly failures (Holling & Meffe 1996). We propose that scenario planning, a technique for making decisions in the face of uncontrollable, irreducible uncertainty, offers conservationists a method for developing more resilient conservation policies.

Scenario planning is a systemic method for thinking creatively about possible complex and uncertain futures. The central idea of scenario planning is to consider a variety of possible futures that include many of the important uncertainties in the system rather than to focus on the accurate prediction of a single outcome. Our aim is to summarize existing methods for developing and using scenario planning and to place these methods in a conservation context. We explain why traditional scientific tools are often inadequate for conservation planning, and we describe what scenarios are, when they are most useful, and how they are typically constructed. Finally, to illustrate the use of scenario planning we present examples from business, government, and conservation planning.

The Probable and the Possible

The Probable: Predictions, Forecasts, and Projections

Prediction means different things to different technical disciplines and to different people (Sarewitz et al. 2000). A reasonable definition of an ecological prediction is the probability distribution of specified ecological variables at a specified time in the future, conditional on current conditions, specified assumptions about drivers, measured probability distributions of model parameters, and the measured probability that the model itself is correct (Clark et al. 2001). A prediction is understood to be the best possible estimate of future conditions. The less sensitive the prediction is to drivers the better (MacCracken 2001). Whereas scientists understand that predictions are conditional probabilistic statements, nonscientists often understand them as things that will happen no matter what they do (Sarewitz et al. 2000; MacCracken 2001).

In contrast to a prediction, a forecast is the best estimate from a particular method, model, or individual. The public and decision-makers generally understand that a forecast may or may not turn out to be true (MacCracken 2001). Environmental scientists further distinguish projections, which may be heavily dependent on assumptions about drivers and may have unknown, imprecise, or unspecified probabilities. Projections lead to "if this, then that" statements (MacCracken 2001).

Predictions and forecasts are closely tied to the notion of optimal decision making (Lindley 1985). Optimal decisions maximize the expected net benefits (or minimize expected net losses), where the expectation is integrated over the full probability distribution of the predicted benefits minus losses over a specified time horizon. Optimal control and hedging represent active and passive approaches to optimal decision making. Because conservation biologists can seldom control the changes in society, technology and the environment that most affect the survival of species, optimal control is seldom a realistic approach. Hedging strategies can be effective in situations of low uncertainty. Unfortunately, in many ecological situations uncertainty is substantial and irreducible and arises from the problems of ecological prediction. Consequently, the framework of optimal decision making cannot be used to evaluate alternative ecological decisions (Ludwig 2002).

Ecological predictions have three fundamental, interacting problems: uncertainty, contingency, and reflexivity (Carpenter 2002). In most cases, the uncertainty of ecological predictions is not rigorously evaluated. In particular, the problem of model uncertainty is often ignored in ecology, even though statistical methods are available to address the issue (Clark et al. 2001). When the uncertainty of forecasts is rigorously evaluated it is usually found that the forecast is quite uncertain, meaning that it assigns roughly equal probability to an enormous range of extremely different outcomes. Ecological predictions are contingent on drivers that are difficult to predict, such as human behavior. The reflexivity of human behavior further constrains the possibility of ecological predictions (Funtowicz & Ravetz 1993). That is, if predictions are made and taken seriously, people will change their actions in response to the predictions, making accurate forecasts difficult (Brock & Hommes 1997; Carpenter et al. 1999).

Uncertainty can be confusing and demoralizing. It can lead to inaction or "paralysis by analysis" rather than decisiveness and action. However, uncertainty can be viewed as an opportunity (Ney & Thompson 2000). It can lead to the acknowledgement of the need for humility because all participants are ignorant of what the future will bring. Uncertainty can encourage tolerance because the plans and beliefs of others may turn out to be more effective and correct than your own. And uncertainty can inspire action because the future is not already determined but is being created by the plans and actions of people.

Scenario planning is somewhat similar to adaptive management (Walters 1986), an approach to management that takes uncertainty into account. Both examine alternative models of how the world might work and seek to develop policies that are robust to this uncertainty. What distinguishes them is that management experiments are built into the models. When experimental manipulation is possible, traditional scientific approaches are effective at answering questions (Medawar 1984). Scenario planning is most useful when there is a high level of uncertainty about the system of interest and system manipulations are difficult or impossible.

The Possible: Scenarios

Scenarios were initially developed by Herbert Kahn in response to the difficulty of creating accurate forecasts (Kahn & Wiener 1967; May 1996). Kahn worked at the RAND Corporation, an independent research institute with close ties to the U.S. military. He produced forecasts based on several constructed scenarios of the future that differed in a few key assumptions (Kahn & Wiener 1967). This approach to scenario planning was later elaborated upon at SRI International (May 1996), a U.S. research institute, and at Shell Oil (Wack 1985*a*, 1985*b*, Schwartz 1991; Van der Heijden 1996).

A *scenario* describes a possible situation, but the term has been used in a variety of ways. One common use of *scenario* refers to the expected continuation of the current situation—for example in the statement that "under the current scenario, we anticipate that the species will become extinct in the next 10 years." Another common use of *scenario* derives from systems models. The results of integrated computer simulation models depend on assumptions about the extrinsic drivers, parameters, and structure of the model. Variations in the assumptions used to create such models are often described as scenarios (Meadows et al. 1992). For example, the differences between the climatic scenarios of the Intergovernmental Panel on Climate Change (IPCC) are determined by differences in assumptions about demography and social, economic, technical, and environmental development (Nakicenovic & Swart 2000). Scenarios in this sense have been used in conservation for investigating the outcomes of different ecological management regimes (Klenner et al. 2000), to consider questions such as how malaria might spread in a warmer world (Rogers & Randolph 2000), or to select conservation sites based on projected changes in human settlement (White et al. 1997). Although these approaches describe future situations as scenarios, scenario planning invests much more effort in constructing integrated and provocative alternative futures.

We define a scenario as a structured account of a possible future. Scenarios describe futures that could be rather than futures that will be (van der Heijden 1996; Raskin et al. 1998). In essence, scenarios are alternative, dynamic stories that capture key ingredients of our uncertainty about the future of a study system. Scenarios are constructed to provide insight into drivers of change, reveal the implications of current trajectories, and illuminate options for action.

Unlike forecasts, scenarios stress irreducible uncertainties that are not controllable by the people making the decisions. Although trends, expert predictions, visions of the future, and models are all parts of scenario-building exercises, they should not be mistaken for scenarios themselves. Scenarios may encompass realistic projections of current trends, qualitative predictions, and quantitative models, but much of their value lies in incorporating both qualitative and quantitative understandings of the system and in stimulating people to evaluate and reassess their beliefs about the system (Greeuw et al. 2000). Useful scenarios incorporate imaginative speculation and a wide range of possibilities; those based only on what we currently know about the system have limited power because they do not help scenario users plan for the unpredictable.

Scenario Planning

There are many different approaches to scenario planning, but most of those presented here are derived from the qualitative approach of Shell/SRI International and share many features (Wack 1985*a*; Millett 1988; Schoemaker 1991; Bunn & Salo 1993; Schoemaker 1995; May 1996; van der Heijden 1996; Bossel 1998; Ringland 1998; Wollenberg et al. 2000). These approaches differ in emphasis because of variation in the goals of those who have created them.

Our approach to scenario planning is similar to these approaches but is also influenced by experience with adaptive environmental assessment and management (Holling 1978). We see scenario planning as consisting of six interacting stages that a small group of research scientists, managers, policymakers, and other stakeholders explore through a series of workshops. It begins with identification of a central issue or problem. This problem is then used as a focusing device for assessment of the system; assessment is combined with the key problem to identify key alternatives. Alternatives are then developed into actual scenarios. Scenarios are tested in a variety of ways before they are used to screen policy. Although this overview presents scenario planning as a linear process, it is often more iterative: system assessment leads to redefinition of the central question, and testing can reveal blind spots that require more assessment.

(1) Identification of a Focal Issue

Scenario planning aims to enhance our ability to respond quickly and effectively to a wide range of futures, avoiding potential traps and benefiting from potential opportunities. Because the real world is highly complex and the future contains an infinite number of possibilities, scenario planning must be focused to be effective. Examining the future in light of a specific question (e.g., how ecosystem services could change in Australian rangelands over the next two decades) separates the relevant aspects of the future that are knowable from those that are unknowable. Consideration of policy response options (e.g., what can be controlled within a region) distinguishes aspects of the future that are controllable or that can be influenced by the scenario maker from those that that are beyond control.

The focal issue should emerge from negotiation among participants in the planning process. For example, the initial question might be how to maintain a functional longleaf pine forest in a protected area for the next 20 years, or how to make an existing reserve network more robust. Frequently, problems are defined in a narrow way that represents the interests of a dominant group of stakeholders. Involving a diverse group of stakeholders can help to define an issue broadly (Ney & Thompson 2000). A more precise definition can be crafted after the system of interest is further assessed. The selection of a focal issue or question implicitly defines a system of interest.

(2) Assessment

The focal issue should be used to organize an assessment of the people, institutions, ecosystems, and linkages among them that define a system. It is also important to identify external changes, either ecological or social, that influence the dynamics of a system. These could include processes as diverse as migration, the spread of invasive species, climate change, or changes in tax laws. A key aspect of assessment is identifying which uncertainties will have a large impact on the focal issue. For example, climatic change may be a key uncertainty in the planning of a park system. A subset of these uncertainties will be used to help define scenarios.

One of the most valuable uses of the assessment processes is to confront the initial question or focal issue with the complexity of the world. Does the question address the underlying issue or only its symptoms? For example, managers could decide that determining the optimal configuration of parks is too narrow a question and focus instead on how their park management could produce a regional landscape that supports biodiversity. An assessment should consider the different world views of the key actors because these views often significantly shape a group's understanding of a system's dynamics (Ney & Thompson 2000).

(3) Identification of Alternatives

Following determination of what is known and unknown about the internal and external forces that shape the system's dynamics, the goal of scenario planners is to identify alternative ways that the system could evolve. These alternatives should be both plausible and relevant to the original question. Plausible alternatives should each represent a path shaped by the interaction of existing dynamics and possible future events.

An analysis of the role of uncertainties in the assessment can be used to organize alternatives. Although some uncertainties arise from the unknown future behavior of actors within the system, other uncertainties are based on the unknown dynamics of nature and unknown changes in system drivers. For example, the future of housing development within a watershed may be unknown but can be influenced by local policies. However, the future rainfall of that watershed is uncertain and cannot be influenced by local policies. Scenario planning usually focuses on uncontrollable uncertainties because the attempts of stakeholders to address controllable problems should be included within a scenario's dynamics.

A set of alternatives can be defined by choosing two or three uncertain or uncontrollable driving forces. For example, if two important uncertainties in a region are population growth and settlement pattern, they could be used to define alternatives such as increased migration to cities, increased migration to rural areas, and general population decline. The uncertainties chosen to define the alternatives should have differences that are directly related to the defining question or issue. They should imaginatively but plausibly push the boundaries of commonplace assumptions about the future. This set of alternatives provides a framework around which scenarios can be constructed.

(4) Building Scenarios

A set of scenarios is built based on the understanding accumulated during the assessment process to flesh out a few of the alternatives defined by the key uncertainties. A set of scenarios should usefully expand and challenge current thinking about the system. The appropriate number of scenarios is generally considered to be three or four; two scenarios usually do not expand thinking enough, whereas more than four may confuse users and limit their ability to explore uncertainty (Wack 1985*b*; Schwartz 1991; van der Heijden 1996).

Scenarios convert the key alternatives into dynamic stories by adding a credible series of external forces and actors' responses. Scenarios should become brief narratives that link historical and present events with hypothetical future events. Within these storylines the internal assumptions of the scenario and the differences between stories must be clearly visible. To be plausible, each scenario should be clearly anchored in the past, with the future emerging from the past and present in a seamless way. There are a variety of approaches to assembling scenario stories, including the use of tables or cubes to display critical uncertainties (Schoemaker 1991) and a search for archetypal plots, such as "winners and losers" or "victims become heroes" (Schwartz 1991). Whatever approach is taken, each story should track the key indicator variables that have been selected based on the initial question (e.g., percent of intact old-growth forest, soil erosion). To help communicate and discuss scenarios, it is useful to give each scenario a name that evokes its main features. Successful scenarios are vivid and different, can be told easily, and plausibly capture future transformation.

(5) Testing Scenarios

Once the scenarios have been developed, they should be tested for consistency. The dynamics of scenarios must be plausible; neither nature nor the actors involved in the scenario should behave in implausible ways. Inconsistencies will quickly emerge as major obstacles to their usefulness for developing policy. Consistency can be tested by quantification, against stakeholder behavior, through expert opinion, and against other scenarios.

Quantifying the changes expected in the system allows the plausibility of the scenarios to be tested in a number of ways. Simulation models can be used to test the dynamics of a scenario, but models are not the primary tool for scenario development. The most important part of a scenario's plausibility is likely to be the behavior of actors. Many modeling exercises have been criticized, correctly, by economists for assuming that people are far more passive than they actually are (Westley et al. 2002). The changes expected to occur within a scenario should be examined from the perspective of each key actor within it. If an actor is likely to respond to the scenario in some way that is not part of the scenario, that assumed inaction or action decreases the plausibility of the scenario. Varying degrees of sophistication can be used in testing the plausibility of actor behavior. A rough test would involve the scenario team adopting the world view of all actors to explore their behavior in a scenario. A stronger test would be to involve various groups of actors and stakeholders in the scenario process to ensure that actor behavior is plausible (Ney & Thompson 2000). For example, whereas a scenario may describe people moving away in response to an ecological change, discussions with local residents may reveal that such emigration is actually quite unlikely. Testing usually reveals problems with scenarios. Consequently, scenarios need to go through several iterations of refinement and testing before they can be used to evaluate policies.

(6) Policy Screening

Once a set of scenarios has been developed, it can be used to test, analyze, and create policies. The simplest use of the scenarios is to assess how existing polices would fare in different scenarios. Such an approach can identify weak policies and those that are more robust to uncertainty about the future. A slightly more sophisticated approach is to identify the properties of policies or actions that perform well in all the scenarios. For example, a park planning effort may use policies that examine different development trajectories. Scenarios could be used to help identify land-management strategies that produce parks that are resilient in response to change. In this process, it is important to identify traps and opportunities and aspects of the current situation that could influence these scenario features. This process may suggest novel policies, areas for research, and issues to monitor.

Scenario planning that involves stakeholders can provide a forum for policy creation and evaluation. Stakeholders who become involved in the scenario-planning process are likely to find that some scenarios represent a future that they would like to inhabit, whereas others are highly undesirable. This process of reflection can stimulate people to think more broadly about the future and the forces that are creating it and to realize how their own actions can move the system toward a particular kind of future. In this way, scenario planning allows people to step away from entrenched positions and identify positive futures that they can work at creating. Policy screening often identifies new questions, new variables, and new types of unknowns. These concerns can stimulate either another iteration of the scenario-planning process or another form of action.

A successful scenario-planning effort should enhance the ability of people to cope with and take advantage of future change. Decisions can be made, policies changed, and management plans implemented to steer the system toward a more desirable future. New research or monitoring activities may be initiated to increase understanding of key uncertainties, and they may stimulate the formation of new coalitions of stakeholder groups.

Examples of Scenario Exercises

Scenarios have been used in a variety of ways, but they have not been used much in conservation. Applications of scenario planning can be organized by their use of qualitative or quantitative methods and their approach toward uncertainty. Most scenarios incorporate both qualitative and quantitative details, and the relative mix of these two aspects distinguishes different scenario exercises. Some scenarios are intended to facilitate the management of uncertainty, whereas others are used to discover it. We present three examples of how scenarios have been used to approach problems that were beyond the reach of traditional predictive methods.

Shell Oil

In the early 1970s, Shell Oil used scenario policy planning to evaluate long-term decisions. Its profitable navigation of the 1970s oil crisis has become a classic story of the usefulness of scenario planning (Wack 1985*a*; Schwartz 1991; Van der Heijden 1996).

In 1970, world oil prices were low and were expected to remain so. Shell scenario planners considered a rise in prices to be possible, contrary to both market expectations and those of Shell executives. Because they were unsure of how this rise would occur, traditional forecasting approaches were inappropriate. Strategic planners at Shell used scenarios to integrate investigations of the global oil markets. They identified a number of tensions and limits to production in oil-producing countries and concluded that, at some volume of oil production, oil was more valuable kept in the ground than sold. This suggested a number of possible changes in the status quo. One of these scenarios envisioned a world in which a coalition of oil exporting countries was able to limit production, causing oil prices to rise. This scenario was considered radical, but it was plausible—perhaps even more plausible than scenarios that did not include a disruption. The scenario planning exercise led Shell to adjust its business management practices to hedge against the potential for high oil prices by increasing the efficiency of its refining and shipping operations. These changes in business practices, combined with its ability to respond to changes in oil prices, allowed Shell to adapt to a world of expensive oil much faster than its competitors.

Similarly, in the early 1980s, another scenario exercise at Shell explored the plausibility of a world in which the price of oil declined due to new non-OPEC discoveries and conservation. Shell again adopted a business strategy at odds with the consensus opinion in the oil industry, and, once again, Shell was able to outperform its competitors. During this period, Shell moved from being one of the smallest multinational oil companies to being the second largest (Wack 1985*a*, 1985*b*; Schwartz 1991). The organizational changes that helped Shell succeed would not have taken place without recognition of the uncertainty of the future and consideration of alternative scenarios.

Monte Fleur, South Africa

A different kind of scenario-planning exercise took place in Monte Fleur, South Africa, in the early 1990s (Kahane 1992). Prior to the transition to majority rule, a diverse group of leaders from South Africa's business, political, and civil society met in a series of 3-day workshops to examine the forces that were shaping the country and how these forces could be directed to help create a successful South Africa. The exercise was facilitated by members of the strategic planning group at Shell Oil, with the aim of creating a shared understanding of the dangers and potential opportunities that lurked in the transition.

The workshop participants developed four scenarios that were widely publicized in South Africa (Kahane 1992): (1) Ostrich, in which negotiations to end apartheid fail and minority rule continues; (2) Lame Duck, in which the negotiated transition to majority rule is slow, complicated, and indecisive; (3) Icarus, in which the transition is successful, but the new government enacts unsustainable, populist economic policies leading to an economic crisis; and (4) Flight of the Flamingos, in which gradual improvement in the social and economic status of South Africans occurs as diverse groups work together.

The creation of the scenarios appeared to enrich the negotiation process by creating a shared awareness of some of the potential traps (e.g., excessive spending, an overly narrow focus on the details of transition, and insufficient change), and it improved the quality of the transition to democracy. Several of the senior ministers in the post-apartheid African National Congress government were involved in the Monte Fleur scenario process, and Kahane (1998) suggests that the scenario-planning process made South Africa's transition to democracy significantly smoother.

Northern Highland Lake District, Wisconsin

A more ecologically oriented set of scenarios was recently devised to explore the future of ecosystem services in the Northern Highlands Lake District of Wisconsin (U.S.A.) (Peterson et al. 2003). This region, which covers 5000 km^2, is becoming increasingly developed as a result of tourism and the construction of second homes. This development has occurred primarily around the region's many lakes. Three scenarios were developed to explore the future consequences of settlement and ecological vulnerability over the next two decades.

In the "Walleye Commons" scenario, the loss of ecosystem services important to tourism reduced the attractiveness of the region. Changes in climate reduced the attractiveness of the region for winter sports, and the spread of a variety of water-borne diseases decreased opportunities for recreation. This decline in tourism led to a steep decline in property values and a gradual process of out-migration. However, low property prices presented an opportunity for Native American and conservation groups, who were able to expand areas of reservation and protected land, respectively. Property abandonment and a decreased tax base led to an increase in erosion and water pollution. In 2025, fish populations were robust but less valuable. Water quality was fair, with occasional local disease and turbidity problems.

In the scenario "Northwoods.com," the region's ecosystems were able to cope with population growth. The investments of recent migrants to northern Wisconsin and policy changes led to the establishment of a variety of satellite offices in larger towns in the region. These businesses and their workers were attracted by the low cost of living and the availability of many outdoor recreation opportunities, but the expansion of towns produced water-quality problems along the Wisconsin River and decreased fishing quality. In response to these problems, town residents developed a town-centered system of regional environmental regulation. Some rural residents profited from these policies, whereas others were angered as the cost of water, wells, and fishing increased. In 2025, water quality and fishing near towns were relatively poor but were improving. Due to strict regulation, water and fish populations in rural lakes were high in quality, but many rural residents felt that town residents had expropriated their ecosystems.

In the "Lake Mosaic" scenario, the number of lakefront second homes continued to increase, leaving few lakes undeveloped. Initial differences among lakes and their residents were amplified as new arrivals chose locations that matched their interests. This process led to a social and ecological divergence among lakes oriented more toward motor sports and lakes that were quiet and less modified. Lake residents often organized themselves into increasingly powerful associations. Some lake associations restricted access to lakes and their fish populations, whereas other associations removed woody debris, expanded lake access, and created artificial beaches. The focus on individual lakes led to conflict over issues that involved connections among lakes, such as road building, boating, fishing, and water quality. These conflicts left interlake issues largely unregulated, which allowed the expansion of many features of suburban development, such as strip malls, that residents did not like. Although many residents were unhappy with these regional changes, most believed their lakes were well managed. In 2025, water quality was generally good, except in some of the larger, shallower lakes near towns. Fishing quality was poor across the entire region, however, with the exception of some lakes that had been effectively privatized.

These scenarios illustrate that, due to the northern Wisconsin landscape, the future of ecosystem services is likely to be heterogeneous. They were designed to start a conversation among people in northern Wisconsin about alternative futures and to begin a process of evaluating policies in terms of how they shape the ability of the northern highlands lake district to respond to potential risks and to benefit from possible opportunities.

Implications of Scenario Examples

These three scenario exercises differ in their approaches to uncertainty and in how they were constructed. In the Shell Oil case, scenario planning was used to allow a well-defined actor (Shell) with a clear goal (to maximize shareholder value) to develop strategy for an uncertain future. In contrast, Monte Fleur brought a group of disconnected people with divergent goals together to create a shared understanding of the uncertainties surrounding the transition to democracy. In northern Wisconsin, a team of scientists created an initial set of scenarios to begin a scenario-planning process among a broad group of stakeholders. As we hope these examples make clear, scenario planning can be modified in a multitude of ways to fit a particular context. We believe it can be a versatile "soft" tool for conservation biology.

There are not many examples of scenario planning that directly relate to biodiversity conservation. The Stockholm Environment Institute's global scenarios project (Hammond 1998; Raskin et al. 1998) developed both global and regional scenarios based on extensive data and quantitative simulation models. In other situations, scenarios have been based on stories of the future generated by small groups of rural villagers (Wollenberg et al. 2000). The European Commission has funded a set of regional scenario studies that are nested within a larger European development scenario study. This project combines quantitative computer modeling with intensive stakeholder workshops (Rotmans et al. 2000). In the Netherlands, various forms of scenario planning involving planners, stakeholders, and scientists have been conducted for a variety of rural development issues (Schoute et al. 1995). However, the focus of all these scenarios is on social rather than ecological dynamics.

Despite their differences, the scenario exercises we have presented share many features. In particular, each considered a range of possible futures whose dynamics were analyzed in some detail. Desirable and undesirable outcomes were described, and insights were gained into the kinds of mechanisms that might produce them. In each instance, the purpose of the exercise was broader than achieving a single, narrowly defined solution. At the conclusion of most of these exercises, people took action using available levers—such as policy, organizational priorities, and education—to shape their own future.

Conclusion

Conservation biology continually confronts situations in which decisions must be made in the face of uncertainty. We suggest that the appropriate response to uncertainty depends on the degree of uncertainty and the degree to which a system can be controlled. When control is difficult and uncertainty is high, scenario planning is an effective way of coping. In other situations, hedging, adaptive management, and optimal management may be more appropriate (Fig. 1).

Scenario planning, although potentially rewarding, risks falling into the same traps as other planning or modeling exercises. However, a variety of factors, such as overly

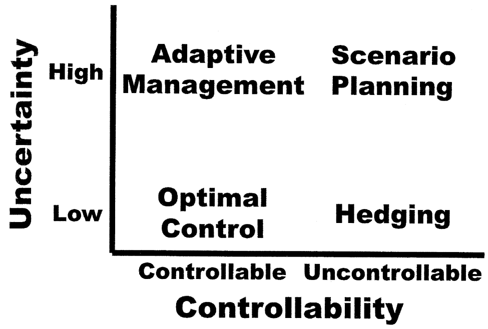

Figure 1. Scenario planning is appropriate for systems in which there is a lot of uncertainty that is not controllable. In other cases optimal control, hedging, or adaptive management may be appropriate responses.

weighting the present and overestimating our ability to control the future, can reduce the range of uncertainty considered. Furthermore, relying on expert opinion or local knowledge can be constraining because scenarios often deal with poorly understood issues outside the expertise of most people. In such situations the predictions of experts or local people may be no better, and may even be worse, than those of nonexperts or outside people. Finally, the biggest traps of scenario planning are the inability of participants to perceive their own assumptions (Keepin & Wynne 1984) and the potential consequences of being wrong. There are no easy ways to avoid these traps, but being aware of them, being reflective, and trying to maintain an open process that includes a variety of world views can help guard against them (Ney & Thompson 2000).

Many current conservation problems are too complex and involve too many different interest groups to be solved through narrowly focused, predictive studies. The long-term success or failure of conservation is heavily dependent on co-operative, long-term, and broad-scale human efforts. As we try to conserve and manage ecosystems, scenario planning offers a structured way of coping with the many uncertainties that lie ahead.

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