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AVOIDING ECOLOGICAL SURPRISE: LESSONS FROM LONG-STANDING COMMUNITIES

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Increasingly ecologists have recognized the importance of sudden and unexpected changes in the natural environment—often called "surprises." Organizational scholars have not developed a theory of how to avoid ecological surprise. This article suggests one way to develop such a theory. Using ecology, systems analysis, and a historical comparison of four communities, the article concludes that organizing and managing natural resources in part as community property can play a central role in avoiding surprises.

Since the industrial revolution, most people have assumed that environmental change happens slowly and predictably and can be reversed at will (Timmerman, 1986). Theoretical and empirical discoveries have demonstrated that humankind can cause unexpected, precipitous, and irreversible changes in the natural environment (Begon, Harper, & Townsend, 1990). These ecological "surprises" form the foundation of modern concern over sustainable development (Clark & Munn, 1986). Environmental scientists once warned of the depletion of nonrenewable resources. Today, as a central point, they consider the potential for unforeseen repercussions to ecosystem functioning (Turner, 1990). Environmental scientists now worry less about the loss of nonrenewable resources such as oil than about how the combustion of this oil might destabilize the global and local climates (Clark & Munn, 1986). For nonacademics, the destructive catalytic action of (CFCs) on stratospheric ozone demonstrated the potential for ecological surprise.

Social scientists have made little progress in proposing structures that might avoid ecological surprise (Brooks, 1986; Gladwin, 1993). A few researchers have used concepts from physics or ecology to propose high-level principles for organization (Throop, Starik, & Rands, 1993), but a lack of sources for empirical evidence has hindered the development of theory (Brooks, 1986). Some scholars have studied "greening" organizations and institutions, but the short histories and equivocal behavior of these organizations have made extrapolation to theory difficult (Shrivastava & Hart,

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1994; Throop et al., 1993). Others have studied examples of surprise to uncover underlying pathologies, but they have not uncovered the social structures needed to avoid such surprise (Brooks, 1986; Holling, 1986).

In this article, I propose that theory can be generated by studying the histories of communities that have successfully avoided causing ecological surprise for many generations. Moreover, the multiple histories of world communities provide data with which to test theory. In this article, I use systems analysis and ecology to generate high-level requirements for avoiding ecological surprise and comparative history to create propositions for social organization. In a final section, implications for institutional and organizational theory and practice and reflections on recent organizational and institutional "greening" are discussed.

PREVIOUS RESEARCH ON SURPRISE

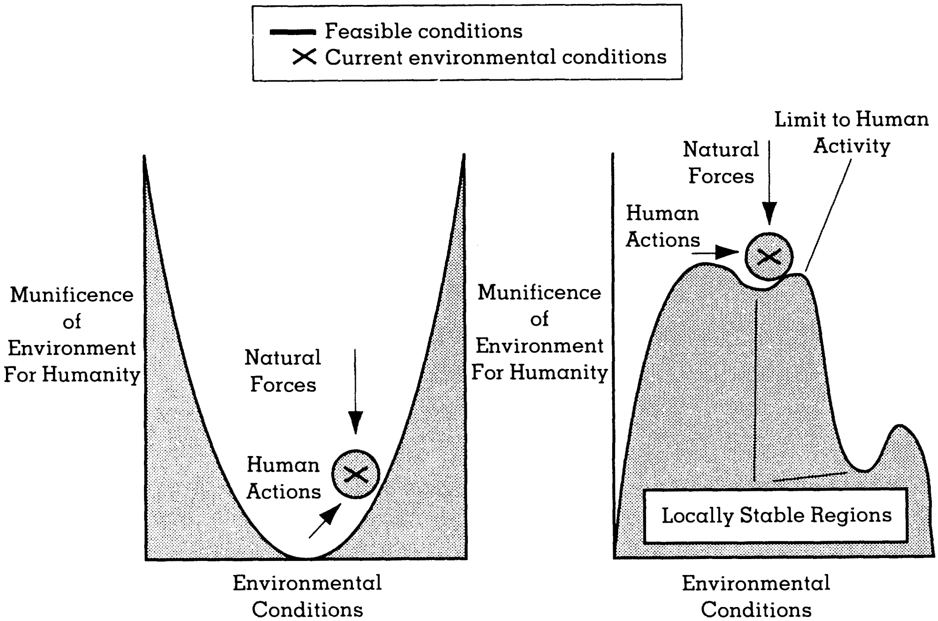
Scientists have long recognized that the natural environment evolves, but traditionally they have expected such change to occur gradually and systematically (Gould, 1980). Regarding humankind's potential to influence this change, most economists and even ecologists have assumed that (a) natural conditions represent an environmental minimum, (b) human action usually improves the world, and (c) people or natural forces can reverse environmental effects (Timmerman, 1986). According to this view, the natural environment behaves like a ball at the bottom of a bowl (see Figure 1). Humankind can improve the environment by pushing the ball out from equilibrium, but if the force is removed, the ball would fall back to its original position.

Such assumptions dominated theoretical debate in ecology until empirical studies in ecology and meteorology began to cast doubt on both the predictability of environmental behavior and the "myth of global sustainability" (Begon et al., 1990; Costanza, Wainger, Folke, & Maler, 1993; Gleick, 1987; Prigogine & Stengers, 1984). According to this newer view, ecosystems (and economies) may have multiple equilibria—some more munificent than others. Now, theories suggest that a person cannot forecast the dynamic behavior of such systems or accurately predict the boundaries between these equilibria (Brooks, 1986). A system may switch suddenly from one equilibrium to another. For example, the last Ice Age may have ended within a period of 10 years (Sullivan, 1994). In such a world, the potential for ecological surprise becomes central to concerns about sustainability. C. S. Holling (personal communication, November 7, 1994) suggested humankind can cause ecological surprise in principally two ways:

1. Human endeavor passes a threshold and causes the ecosystem to converge to a new equilibrium.
2. Humans make ecosystems increasingly unstable until natural fluctuations cause convergence to a new equilibrium.

Brooks (1986) identified similar causes.

FIGURE 1
Different Assumptions About Environmental Stability



Traditional Assumptions of Environmental Dynamics: Environment is inherently stable and human actions improve it.

Modern Assumptions of Environmental Dynamics: Environment is only locally stable and has stable states at lower levels of munificence.

Next, I review the literature pertaining to each of these potential causes of ecological surprise.

Surprise Caused by Passing an Ecological Threshold

Malthus (1789) suggested that the natural environment creates a ceiling for human development, and once reached, this limit can be sustained indefinitely. Since Malthus, most economists have doubted that any ceiling exists and have argued instead that "relative" constraints (Ricardo, 1973) simply redirect economic activity into other areas (less fertile land or other activities) (Barbier, 1989; Barnett & Morse, 1963). In the neoclassical view, the flow of the economy is "circular, self-renewing, and self-feeding" (Heilbroner & Thurow, 1981: 135). Thus, people can deplete a resource at an optimal rate and then switch to another resource (Dasgupta & Heal, 1974; Hotelling, 1931; Solow, 1974).

In the early 1970s, *The Limits to Growth* and other dynamic models of economic and environmental activity reiterated Malthus's warning of limits to human activity, and they suggested that delays in acquiring and responding to information about environmental damage could cause humankind to overshoot sustainable limits and could cause a relatively sudden environmental collapse (Forrester, 1971; Meadows, Meadows, Randers, & Behrens, 1972).

It might seem that long-range forecasting of environmental conditions might help avoid overshooting environmental limits. Unfortunately, ecological research has demonstrated that predicting ecosystem thresholds or behavior far in advance may be impossible (Clark & Munn, 1986; Lorenz, 1964). At best, humankind can use scientific understanding to provide short-term forecasting of ecological systems and thresholds (Ludwig, Hilborn, & Walters, 1993). In order to avoid ecological surprise, humans must engage in conservative action and rapidly discover, transfer, and respond to information about environmental change.

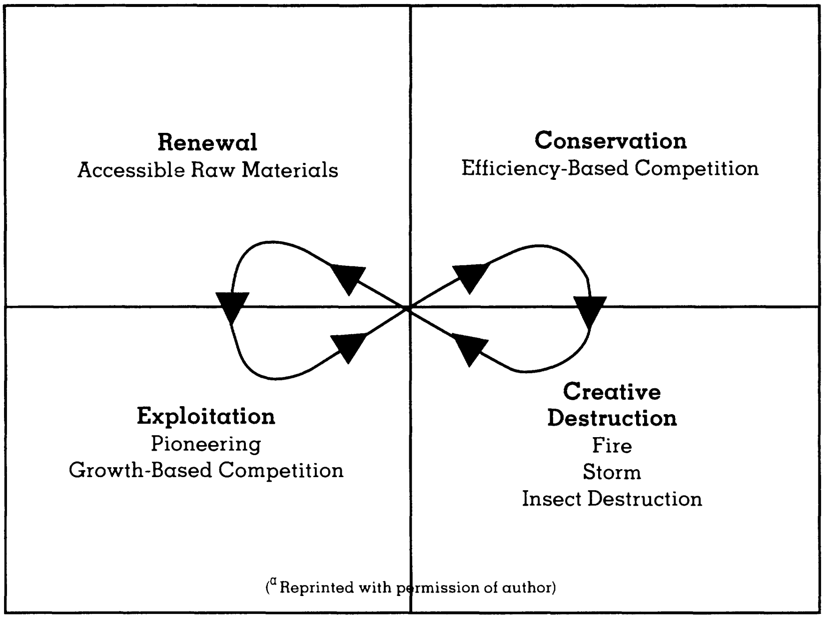
Surprise Caused by Increasing Instability

As stated previously, humanity can cause ecological surprise by pushing the natural environment past the limits of stability. Humanity also can cause ecological surprise by reducing the stability of the natural environment. To return to my analogy, human action can make the "bowl" that maintains current ecosystem conditions so shallow that a small natural disturbance can cause the ball to roll out of the bowl.

Optimizing a single environmental attribute, even one that seems to represent ecosystem health, such as trees per acre, can destabilize an ecosystem (Holling, 1980; Steele, 1985). Although ecosystems may seem constant, often they include cycles that are necessary for their health. For example, forest ecosystems may move toward a climax of efficient species (e.g., oak trees), which are occasionally rapidly destroyed by insects or fire. This creative destruction begins a process of renewal by releasing stored nutrients and thereby allowing exploitation by pioneer species (grasses, etc.), which are then slowly replaced by more efficient species (back to oak trees) (see Figure 2). Humans, by optimizing a single environmental attribute, can interfere with the natural scales and frequencies of these cycles and create an ecosystem that can collapse irrevocably (Holling, 1980; Stevens, 1994). In some forests, for example, the spatial variability (e.g., mix of trees and dead wood) ensures that the entire forest does not simultaneously undergo destruction by insects or fire (McNamee, McLeod, & Holling, 1981). By maximizing the growth of productive tree species, forest managers have fostered homogenous forests that irreversibly collapse as a result of insect outbreaks or fire (Gomez-Pompa, Vazquez-Yanes, & Guevara, 1972; Holling, 1980).

Reducing the frequency of these ecosystem cycles also can fundamentally change an ecosystem. Prairie ecosystems, because they are composed of inefficient pioneer species, depend on frequent fires to destroy more efficient slow-growing species (Moore, 1982). By restricting fire in the American West, humans caused forests and brush to replace prairie (Begon et al., 1990).

FIGURE 2
Stages in Ecosystem Cycling[a]



In summary, research suggests that humans' attempts to manage ecosystems to optimize a single attribute or control natural spatial or temporal variation can cause ecosystems to reach a critically unstable state.

Controlling Surprise

Why can't humans avoid surprise by better controlling the natural environment? That is, why can't humankind compensate for changes it makes to the environment by taking some other action? Dams have reduced the number of spawning salmon in the Columbia River (Lee, 1989), and to compensate, people have created hatcheries along the river to support and nurture fish spawning. Why can't such active control avoid ecological surprise?

Unfortunately, the theoretical conditions under which surprise-free control can occur are extraordinarily narrow (Athans & Falb, 1966; Auslander, Takahashi, & Rabins, 1974). Many simple linear systems are not controllable, or they are at best controllable within a small region around an equilibrium. In practice, limits on available energy for control further restrict or preclude control (Athans & Falb, 1966; Auslander et al., 1974). Almost any of the characteristics of the natural environment (multiple equilibria, nonlinearity, irreversibility, and information delay) is enough in itself to preclude control. Control theory suggests that any attempt to control such a system will lead to unexpected outcomes or surprise. Indeed, hatcheries built to save and restore the salmon population in the Columbia River in Oregon have further damaged the species by allowing fish with less suitable instincts and characteristics to survive and weaken the gene pool (Lee, 1989). The hatcheries, one ecologist noted, "have been able to do what a hundred years of dam building and overharvesting haven't: bring wild salmon to the brink of extinction" (Maxwell, 1994: 30).

As a result of environmental unpredictability, many environmental scientists have suggested that if people wish to avoid surprise, they must engage in experiments, that is, making small changes in their behavior and then evaluating the environmental response (Brooks, 1986; Holling, 1980; Lee, 1989). If environmental deterioration begins, people must rapidly cease and desist their actions. Finally, people should avoid reducing environmental stability (Brooks, 1986; Holling, 1980; Lee, 1989).

In conclusion, systems analysis and ecology suggest that to avoid ecological surprise, societies must organize to (a) rapidly sense and use information about natural environmental deterioration; (b) cautiously and slowly change human activity, except when environmental damage is sensed, in which case move rapidly to control human activity; (c) avoid managing the ecosystem for a single objective; and (d) allow spatial and temporal variability.

CREATING ORGANIZING PRINCIPLES FOR SURPRISE AVOIDANCE

Several scholars have shown that management and organizational theory largely ignore the natural environment and ecological sustainability (Gladwin, 1993; Shrivastava, 1994; Throop, Starik, & Rands, 1993). The major impediment to the formation of a theory has been the lack of an empirical laboratory in which to study sustainable organization. Some researchers have attempted to use "greening" organizations and institutions to discern a vector toward "sustainability" (Shrivastava, 1995; Throop et al., 1993; Vredenburg & Westley, 1993). Extrapolation from this initial vector may be misleading because most greening organizations and institutions have both equivocal and short histories, so that their eventual impact cannot yet be determined (Stipp, 1991).

A related field of research investigates the link among institutional structure, efficiency, and environmental damage. Usually, these theories begin with an institutional structure and identify potential mechanisms for environmental damage, or they identify institutional arrangements that will lead to environmental damage (Demsetz, 1967; Hardin, 1968; Hardin & Baden, 1977; Ophuls, 1973). For example, Hardin (1968; Hardin & Baden, 1977) argued that common property inevitably leads to environmental tragedy, and he suggested that a powerful and exogenous government must either regulate such commons or privatize them. Since Hardin, common property management has received extensive research. More recent work suggests that under certain conditions a common pool of resources need not lead to tragedy (Anderson & Simmons, 1993; Ostrom, 1990; Stevenson, 1991).

I propose that institutional and organizational scholars can benefit by reversing the direction of research. Instead of beginning with an institutional structure and then investigating the conditions under which it operates effectively, I propose that scholars should attempt to find conditions that will favor institutions with particular characteristics. For example, Tawney (1966) and Scott (1976) have suggested that conditions in Asia favored communities with institutions that prevented accidental damage to natural resources. "There are districts in which the position of the rural population is that of a man standing permanently up to the neck in water, so that even a ripple is sufficient to drown him" (Tawney, 1966: 77).

By looking at communities that lived under the risk of ecological surprise for extended periods of time without causing environmental damage, a researcher may be able to find institutional and organizational structures that prevent ripples (surprises) and, thus, prevent other structures from producing surprises as well. I propose that by comparing communities widely spaced across geographical and cultural regions, researchers can begin to understand institutional and organizational forms that can help to avoid ecological surprise.

Identifying Surprise-Avoiding Communities

Ecological surprise is a relatively recent concept. No one has yet created a criterion for qualifying communities as avoiding surprise. Thus, I propose the following criterion:

> *Surprise-avoiding communities have the capacity to transform the natural environment, but for several generations they do not cause sudden and unexpected changes to the natural environment that (holding technology constant) reduce the natural environment's capacity to support life.*

Operationalizing such a definition to form selection criteria proves difficult. In historical examples, a researcher can rarely determine if changes were expected or not (Richards, 1986). Thus, in qualifying surprise-avoiding communities, I require that the ecosystem exhibit a constant or increasing capacity to support life, which is operationalized as (a) biological diversity, (b) total "biomass," and (c) the human population.

Table 1 lists four communities and the criteria used for the inclusion of each. The sample was created through a search of the historical literature for communities that received long-term social and ecological study and met the criteria for surprise avoidance. Ostrom (1990) and Stevenson (1991) have identified other communities; however, because they only considered communities with particular institutional forms, I did not include these examples (although they are consistent with my findings).

The organization of the four communities in my sample may not have been optimal or sufficient for avoiding ecological surprise, but these communities avoided ecological surprise better than their predecessors,

TABLE 1
Four Examples of Surprise-Avoiding Communities

Example	Criteria for Inclusion
Villages in Sierra de Espadan after the Muslim expulsion (e.g., Aín 1650 to 1936)	No soil loss and maintenance of diversity and extent of vegetation cover (Butzler, 1990)
Medieval village communities in Japan (e.g., Imabori 1050 to 1550)	Forest area, species diversity, and biomass production maintained (Totman, 1989)
Pre-industrial English agrarian communities (e.g., Laxton 1600 to 1800)	Preservation of soil productivity and species diversity (Orwin & Orwin, 1954)[a]
Pre-colonial villages of Southeast Asia (e.g., Quang Tri Province 1800 to 1900)	Preservation of forest area, field productivity, and fuel sources[b] (Scott, 1976)

[a] Orwin and Orwin (1954) principally discuss Laxton. Current historiography suggests that numerous similar communities existed in 17th- and 18th-century England. For a good review and discussion, see Neeson (1993).

[b] Scott (1976) clearly argued that these communities were surprise avoiding, but he justifies his contention based on human population and welfare more than on ecosystem health.

peers, or descendants, and, thus, they can help us uncover initial propositions for how communities *can* organize to avoid ecological surprise.

These four communities did not live in a state of untouched nature. All lived in transformed and highly managed worlds where humankind had already exterminated most large predators and introduced many foreign species. Each society had the capacity to further modify the environment through forestry, fire, or agriculture. In all cases, communities that preceded, followed, or neighbored the four considered caused precipitous environmental damage that led to substantial loss of natural resources and human population (Butzler, 1990; McKean, 1982; Neeson, 1993; Orwin & Orwin, 1954; Scott, 1976; Stevenson, 1991; Totman, 1989). For example, the Moors caused massive soil erosion in the Sierra de Espadan. In contrast, during the period following their expulsion, topsoil was replenished (Butzler, 1990).

Although these communities seem to have avoided causing environmental collapse, they did experience substantial environmental change. The world experienced the Little Ice Age between the 14th and 18th centuries (McElroy, 1986). Plagues and wars struck all of the communities. The phyloxera epidemic that came to France from the Americas eventually spread to Spain and destroyed vineyards (Butzler, 1990). In all cases, these disturbances occurred exogenously, and the communities may have damped some of their influence. For example, plagues affected rural communities much less than they affected urban areas, and rural communities may have preserved and sheltered local populations. In each case, population increased over the time period.

The dates represent conservative estimates for the surprise-avoiding period. Laxton, for example, may have maintained a generally increasing population and avoided ecological surprise from the Domesday (1085) until 1935. All of these communities underwent substantial change after the periods considered.

COMMON FEATURES ACROSS THE FOUR COMMUNITIES

The four communities had great autonomy to control ecological resources around them. In all cases, central state government played a very limited role in the governance of each community. Each community developed its own rules and structures to match and govern local means of production. As noted by Orwin and Orwin (1954), local institutions and production "interlock[ed] so completely as to be quite inseparable" and created "a system involving so much joint responsibility, [that it] could never have been exercised by the Lord's steward" (1954: 149).

These communities held important natural resources in common (Anderson & Simmons, 1993; Butzler, 1990; McKean, 1982; Orwin & Orwin, 1954; Scott, 1976; Totman, 1989). Although each community administered these commons differently, there are broad similarities (see Table 2). Individuals or groups within each community held limited rights to manage, use, or withdraw particular aspects of the resource. The community maintained the right of access and the right to prohibit access.

Use rights were in no way absolute. The community or other individuals often held rights to the same resource for some part of the year or to some other aspect of the resource. For example, one individual would hold the right to farm a piece of land, but the community would hold the right to graze livestock on it after the harvest (Anderson & Simmons, 1993; Orwin & Orwin, 1954; Stevenson, 1991). In other cases, an individual

TABLE 2
Rights of Resource Use In the Four Communities

Access	Withdrawal	Management	Exclusion	Alienation
Access usually open to community members only and governed by the community.	Use right usually allows withdrawal of particular elements of resource for some time period. In some cases, the product is shared with community.	Holder of use right has right to manage, subject to community control. Sometimes entire community cooperates in management.	Holder of use right could exclude some other users.	Rights could usually be traded or sold.

would have the right to withdraw grain from a field, but not chaff or spilled grain (Thompson, 1993). In some cases, use rights could be sold or traded (alienation).

In unusual conditions, holders of rights might exclude other users (of certain types and for some part of the year), but usually the community determined rights of access, and these rights were very broad. In Imabori, for example, people could not be excluded from common forests unless they were carrying harvesting tools (Totman, 1989). Thompson (1993) and Orwin and Orwin (1954) noted several cases of penalties levied for creating barriers to access.

Procedures and institutions for controlling the use of resources were complex. For example, rules governed when farmers might burn trimmings (potentially valuable forage for someone else), when livestock must be driven from common meadows, and where farmers must make fences to protect common cropland (McKean, 1982; Orwin & Orwin, 1954; Thompson, 1993; Totman, 1989). Rules governed compensation for aggrieved parties—farmers might use dogs to hunt deer that left the forest and harmed their crops (Thompson, 1975, 1993). Rules governed the punishment of violators through rough music (midnight raucous revelry outside of the offender's house), public shaming, or even corporal punishment (Thompson, 1975).

Common ownership and use did not preclude competition, and villagers sought to increase their share or rights to the land (Butzler, 1990; Orwin & Orwin, 1954). Common property coexisted with privately owned land. A majority of the community's resources in Laxton, Imabori, and Quang Tri were held in "common," but individuals held exclusive rights to some assets—some land, a house, barn or garden property (Orwin & Orwin, 1954; Scott, 1976; Totman, 1989).

In at least two cases, social or environmental changes forced the community to substantially change its behavior. Aín became overpopulated several times. Each time, the community responded either by delaying marriage or encouraging primitive birth control. The phyloxera epidemic also caused the community to switch from vineyards to cork plantations (Butzler, 1990). In Imabori, initial measures to protect the forest proved insufficient, and the community initiated more stringent penalties (Totman, 1989).

Members of these communities seemed to accept the community's right to constrain the conditions for improving their personal welfare. For example, in Sierra de Espadan "a strong sense of community persisted . . . to the point that differential wealth was a taboo subject for all informants. This very reluctance to discuss inequity suggests that the structural changes in land distribution during the late 1800s did not sunder the socioeconomic fabric" (Butzler, 1990: 690). Several authors have called this socioeconomic fabric a "moral economy" and have noted that it includes a commonly shared goal of local stability (Scott, 1976; Thompson, 1971). As a result, these communities violently opposed speculation on any of the community's resources (grain, wood, peat, etc.) (Thompson, 1993; Tilly, 1986).

The term *community property management* is used here to describe this method of community organization and control of resources. I choose to use this term to emphasize the importance of community management and to avoid confusion with common pool or common property management (see, for example, Ostrom 1990). Thus, *community property management* is defined as a form of resource management in which a well-delineated group of competing users participate in the use of jointly held natural resources according to explicitly or implicitly understood rules. These rules emphasize community control of access or exclusion and the distribution among individuals and the community of limited overlapping rights to use and manage particular aspects of the resource (extended from Stevenson's definition, 1991).

PROPOSITIONS FOR SURPRISE-AVOIDING SOCIAL ORGANIZATION

Garrett Hardin claimed that common property leads to a free-for-all of consumption because commons represent "pastures open to all." "It is," he argued, "to be expected that each herdsman will try to keep as many cattle as possible on the commons" (Hardin & Baden, 1977: 20). Following Hardin (1968), many authors have decried the environmental "tragedy of the commons" (Norman, 1984; Scharpf, 1989). How then does one explain the prevalence and success of community property among the four example communities?

Prompt Discovery and Use of Information About Ecological Change

One explanation is that organization of environmental resources into community property encouraged complete and diverse use of these resources and allowed the community to rapidly and completely perceive and internalize environmental change. To see how this might be true, consider the modern example of a paper mill polluting a lake. If the paper mill owns the lake and precludes other uses of the lake (e.g., fishing), then pollution has no marginal cost to society (no human is damaged), and the paper mill may pollute the lake without welfare loss long after the lake is completely devoid of life. However, because one of the basic rules of ecology is that everything is interconnected, the polluted lake will likely affect a stream or riparian ecosystem and eventually will harm people (Begon et al., 1990) and perhaps even cause a general ecological surprise. For this reason, environmental economists now argue that pollution is rarely local in nature (Daly, 1993). Specialized use of resources simply delays information, thus allowing greater "intertemporal slippage" (Daly, 1993). Community property allows members of the community great access and observation of resources and helps to prevent such information delay.

Organization of resources into community property allowed diverse use of resources. Communities often apportioned overlapping rights. For example, people held time-share rights (e.g., the right to farm in summer but not to graze livestock in winter) or rights to particular aspects of a resource (e.g., to collect wood but not to hunt deer). Theories of environmental management suggest this diverse use may have helped communities perceive environmental changes. According to these theories, ecological systems have numerous attributes, and economic actors tend to be aware of only a small subset of each. Thus, a river's ecological health may include the flow, the number of certain species, water temperature, siltation, and so on (Lee, 1989). Different actors have both different interests and sensitivity to different attributes (Holling, 1980; Lee, 1989). Any single actor may perceive only a single attribute; more diverse actors perceive more aspects of ecological health.

> *Proposition 1: By allowing access both to more users and for more diverse use, community property management can encourage fast and complete perception of ecological change.*

Coase (1960) argued that people can efficiently negotiate environmental disputes as long as rights are defined and transaction costs are low. High transaction costs often result from an inability either to link the polluter with the pollution or to monitor compliance once an agreement is reached (Coase, 1960). Community property allowed free access (but not free use) to resources and facilitated identification of resource degradation and the monitoring of agreements. The right of access was clearly maintained by the community and an exclusion of the right was rarely given to users of the resource. For example, in England, "so much of the land was in some way shared . . . you could walk across the parish from one end to the other . . . without fear of trespass" (Orwin & Orwin, 1954: 3).

> There's a path if you chuse it
> That wanders between
> The wheat in the ear
> And the blossoming bean
> Where the wheat tyde across
> By some mischevous clown
> Made you laugh though you tumbled
> And stained your new gown.
> (John Clare's "Love hearken the skylarks," 2nd stanza, quoted in Robinson & Summerfield, 1967)

Thus, members of the community easily observed changes in practice or breach of social agreements. For example, Orwin and Orwin (1954) noted numerous examples of penalties for violation of use agreements, for example, "1651—putting a ston'd horse in the Long Meadow" (1954: 170). Such observation could even allow feedback prior to action. English communities demonstrated against *plans* to harvest forest timber or create fish ponds (Thompson, 1975).

Proposition 2: By making change observable, community property management can speed identification of sources of ecological change.

One of the remarkable characteristics of all of these communities is the existence of structures and traditions that facilitated direct negotiation between different members of the community. In England, forest courts settled conflicting claims (Anderson & Simmons, 1993; Orwin & Orwin, 1954; Thompson, 1975). In the Sierra de Espadan, disagreements were decided at town council meetings (Butzler, 1990; Pitt-Rivers, 1971). In the Japanese village of Imabori, villagers met to decide use and penalties for misuse (Totman, 1989).

These communities also included checks and balances against abuse of trust. In some communities, members could detain rulebreakers through a citizen's arrest (McKean, 1982). All of these communities had what Ostrom (1990) described as a "right to organize." Thus, community members could guard against any individual infringing on the rights of the community by publicly demonstrating against or even sanctioning members. For example, McKean (1982) reported that in another Japanese village, the head man set one date for harvesting trellis poles, but farmers, facing an earlier need for these poles, collectively decided to change the harvesting date (McKean, 1982). In England, communities demonstrated against actions or rulings and impressed local magistrates to give an official stamp to the proceedings (Thompson, 1993). In fact, many of these traditions held great legal authority. Thompson (1993), Tilly (1986), and Scott (1976) showed how these traditions served to regulate trade, resources, and even divorce!

Such institutions resulted in part from the organization of resources into community property. Thompson (1993) argued that community "custumals and by-laws" derived from common right usage filtered through bargaining and compromise between the principle members of the community. These by-laws then served to facilitate negotiation within the entire community (Thompson, 1975). This law with a lowercase "l," as Thompson called it, represented structures neatly tailored to facilitate resolution of local problems. Scott (1976) argued that community property was centrally important in creating and reinforcing the legitimacy of local institutions. Orwin and Orwin (1954), Butzler (1990), and Totman (1989) showed that administration of local commons encouraged the creation of governing institutions.

Proposition 3: By encouraging institutions for negotiating disputes, community property management can speed transfer of information about environmental damage and the internalization of its cost.

Conservative Development but Rapid Response to Ecological Change

The previous analysis suggests that surprise-avoiding communities must exhibit selective resistance to change. Sometimes, they must respond to indications of ecological damage by rapidly curbing use or modification of resources. In contrast, because every change carries some risk of ecological surprise, they must also resist rapid or risky development. Thus, they must slowly and cautiously respond to some changes (e.g., prices) while rapidly responding to others (e.g., ecological damage).

Theory does not provide clear guidance for how social organizations might accomplish this balancing act. According to organizational theory, people, organizations, and institutions develop momentum that perpetuates a particular vector of actions and precludes rapid response to all changes (Hannan & Freeman, 1990). The history of these four communities suggests, however, that the nature of assets and the distribution of these assets throughout the community can help societies and organizations to respond rapidly to some changes but overall to develop conservatively.

Several authors have suggested that economic actors respond slowly to changing conditions if they possess assets that cannot be modified to fit new conditions. For example, organizational economists have argued that assets that can be used only for specialized activities lead to long contracts, and population ecologists have argued that such assets lead to "organizational inertia" (Abernathy & Clark, 1985; Hannan & Freeman, 1990; Joskow, 1988; Tushman & Romanelli, 1985). One way to reduce such "asset specificity" is for each actor to hold a diverse portfolio of human or technical assets (Hannan & Freeman, 1990; Joskow, 1988; Turner, Doktor, & Adger, 1994). Obviously, diverse portfolios of assets, like portfolios of stocks, can reduce the risk of investment and allow investors greater flexibility.

Moerman (1968), Butzler (1990), Scott (1976), and Orwin and Orwin (1954) suggested that communities organize resources into community properties in part to allow the use of portfolios of assets. They argued that the European method of allocating rights to farm scattered strips of land on common fields helped each owner to include land of varying quality. Strips of land scattered on commons allowed each farmer to have a portfolio of crops planted at different times, in different soils, and subject to different microecological changes (insects, changes in water tables, etc.). In the Spanish Sierra, individuals often pooled resources and invested in a portfolio of assets—pigs, olive trees, cork, and so forth (Pitt-Rivers, 1971). In England, several farmers often cooperated to buy heavy plows—an expensive and relatively inflexible technological asset (Neeson, 1993).

Community property management also encouraged community members to keep assets flexible and nonspecific. Assets that were managed for multiple objectives could not be tailored to a single activity. Each was flexible enough to be useful to multiple members of the community.

> *Proposition 4: By encouraging the use of a diverse portfolio of flexible assets, community property management can speed human reaction to environmental information.*

Rapid curbing of human action helps to prevent ecological surprise, but rapid development of new technologies, structures, or behaviors can cause surprise. Thus, surprise-avoiding communities discourage risky development.

People engage in more risky actions when they perceive themselves to be in a position of loss (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). March and Shapira (1992) showed that people engage in much more risky behavior if they perceive their resources to be either below or far above their aspirations. Not surprisingly then, the four communities avoided such perception. First, they provided insurance against catastrophic loss and, second, they minimized relative differences in wealth.

Insurance against disastrous loss was central to all four communities. For example, Scott (1976) noted that "few village studies of Southeast Asia fail to remark on the informal social controls which act to provide for the minimal needs of the village poor." In England, the community held the right to seize food in times of scarcity (Thompson, 1993). In the Sierra de Espadan, the community assumed responsibility for the poor (Butzler, 1990).

Scott (1976) and Orwin and Orwin (1954) suggested that the need for disaster insurance was what motivated communities to organize resources into community property in the first place. Thompson (1971), Scott (1976), and McKean (1982) suggested that the use of common resources and the distribution of use rights created expectations of social responsibility and the appropriate distribution of assets in many preindustrial village communities. This "moral economy" of social responsibility provided a limit to the disparity between the wealthy and the poor. It was this "social fabric" that prevented in Aín even the discussion of wealth (Butzler, 1990).

The organization of natural resources into community property may have *directly* limited differences in wealth. Common resources that were accessible to the community were hostage to the will of members of the community. If the community felt that someone had unfairly extended his or her holdings, communities could and did seize and redistribute land (McKean, 1982; Scott, 1976; Stevenson, 1991; Thompson, 1993).

Evenly distributed wealth also may have reduced risky investment by requiring individuals and organizations to pool resources when undertaking development projects. Large projects, such as the creation of cork groves after the phyloxera epidemic, required the consensus of the community (Butzler, 1990). Even much smaller projects often included many community members (Butzler, 1990; Pitt-Rivers, 1971; Scott, 1976). Theorists suggest that the cost of negotiating such community investment would bias investment toward projects where consensus previously had been reached (Nelson & Winter, 1982; Tushman & Romanelli, 1985). Such a bias would help preclude novel and, thus, risky investment.

> *Proposition 5: By providing insurance against disaster and by encouraging egalitarian distribution of assets, community property management can reduce risky modification of ecological resources.*

Maintenance of Ecological Stability

Previously, this article also suggested that surprise-avoiding communities should not manage ecological resources to reach a single objective. Diverse use of resources in all four communities prevented such optimization of a single attribute. People "search[ed] for a mix of strategies that reduce[d] risk to a socially acceptable minimum but that normally assure[d] an adequate production of staple foods and marketable commodities. Plants, animals and terrain with different susceptibility to cold or warmth, drought or excess water, [were] blended" (Butzler, 1990: 696).

According to our systems analysis, surprise-avoiding communities should allow natural spatial and temporal variability in the environment. To a degree almost unimaginable today, these communities allowed spatial and temporal variability. People planted crops in smaller scales or in long strips (Anderson & Simmons, 1993; Orwin & Orwin, 1954). Forests were used to grow sylvan species and to produce wood products (Thompson, 1975; Totman, 1989).

Organization of resources in community property helped limit barriers to natural flows and cycles. Because many resources were held in common, manmade boundaries did not place an artificial grid on the natural landscape. Fields and woods remained relatively unfenced and accessible to both wildlife and human beings. Open fields were bounded by fences or hedges only at the periphery, rather than around each plot. In Aín, farmers terraced fields, but these boundaries did not prevent animals from traversing the landscape (Butzler, 1990)

Holling (1992) emphasized the importance of allowing temporal variation in avoiding ecological surprise. These communities seem to have reveled in natural cycles. People worked more in the summer and less in the winter. During the summer they worked in the fields; in the winter they worked on crafts or in small industries. They celebrated this seasonality with fairs and harvest festivals (McKean, 1982; Pitt-Rivers, 1971; Thompson, 1993). In fact, the recognition and observance of these natural cycles so dominated life that one of the principle roles of managers during the industrial revolution was to instill time and work discipline (Rowlands, 1975; Thompson, 1993). Workers who were accustomed to changing their activities with the season or weather did not easily adjust to continued employment during a set time each day.

Proposition 6a: By encouraging diverse use of resources, community property management prevents control of ecological resources from optimizing a single attribute.

Proposition 6b: By limiting physical barriers in the natural environment, community property management restricts human control of ecological variability.

CONCLUSION

I have argued that social organization of resources into community property can play a central role in preventing conditions that might cause a disastrous collapse of the ecosystem. Why then did Hardin (1968) and other scholars denounce common property resources as environmentally destructive?

First, Hardin conflates the ownership of common property with the uncontrolled use of resources. In fact, none of the four communities allowed free use of resources held in common, and individuals held limited and overlapping rights to some aspect of these resources. Coase (1960) himself warned against such oversimplification of property rights and suggested it would hinder accurate analysis.

Second, research suggests that "there are instances in which common property is not a tragedy" (Anderson & Simmons, 1993: 9). Ostrom (1990) and others showed that if faced with a common resource, communities can sometimes organize institutions to viably manage this resource. For example, a community may effectively manage a common water source, if a clear community boundary exists (Ostrom, 1990).

Finally, this article suggests that communities may benefit from some communal property rights, even when private property is an option, because such rights, in combination with appropriate institutions, can help to reduce the risk of ecological surprise. As summarized in Figure 3, community property management facilitated observability of use, gradual modification of ecological resources, and the rapid transfer and negotiation of ecological disputes. It encouraged diverse portfolios of flexible assets, insurance against loss, and the distribution of wealth. Finally, it encouraged many uses of resources and restricted the use of physical barriers. In turn, these characteristics may have helped prevent ecological surprise.

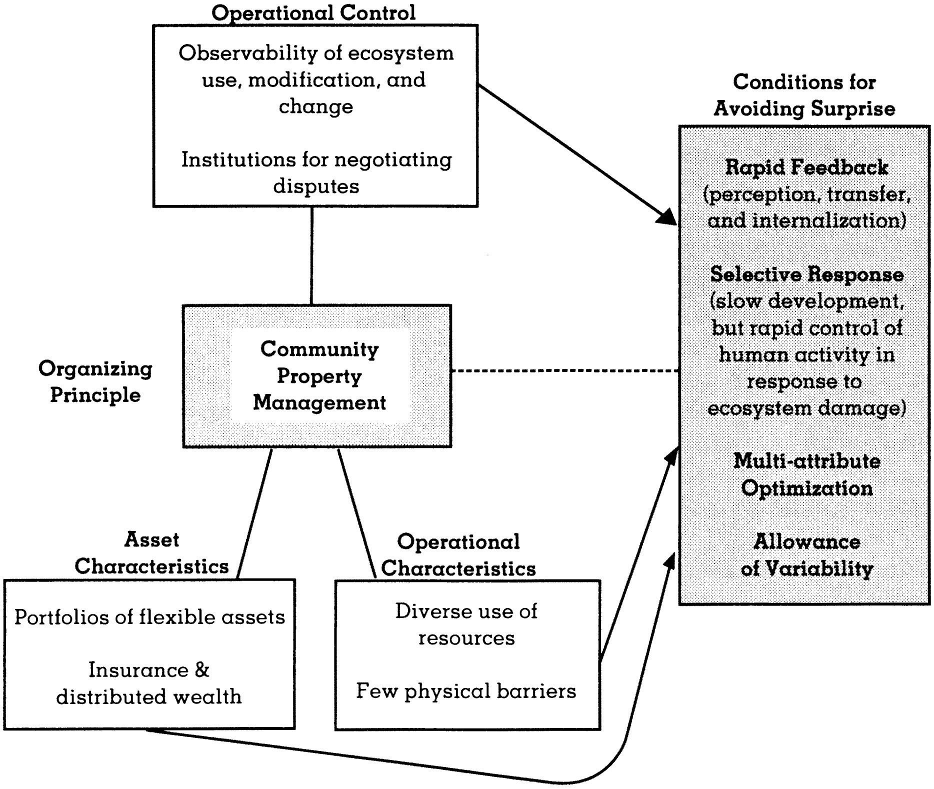
This article suggests that organizing resources as community property *can* help avoid ecological surprise. It does not demonstrate that such social organization always avoids surprise, or that there is a single best institutional arrangement for avoiding surprise. Under different physical or social conditions, community property management may have different effects. For example, community ownership of an ocean fishery might not improve observability. Alternately, a larger sample of communities might uncover different patterns of management and organization that also help avoid ecological surprise.

DISCUSSION

This article attempts to extend institutional and organizational theory by linking it to ecosystem dynamics. It suggests an inductive approach to developing theories of sustainable organizing, and it develops initial propositions by comparing four surprise-avoiding communities.

This article reminds researchers that their assumptions about

FIGURE 3
Direct and Indirect Effects of Community Property Management



system dynamics determine how they perceive institutions. Structures such as community property management that appear unwieldy in a predictable and stable world may appear well suited to an unpredictable and unstable world.

For institutional economics, the analysis suggests limitations in the use of the transaction as the primary unit of analysis. It suggests that the environment can be so fragile that the external costs or benefits of a transaction may outweigh internal costs. Moreover, information about the costs and benefits of a transactional or institutional arrangement may be delayed, and thus transactions may best be studied through an inductive approach and in a collective manner.

This article introduces the concept of ecological surprise into institutionalism. It suggests that such surprise may have served as an important mechanism for institutional selection; thus differences in ancient ecological conditions might form the antecedents for some modern institutional arrangements. These community examples contain echoes of modern trust-based institutions. Did these modern institutions have ecological origins?

Cycles, like the ecological ones discussed here, are found in modern economies (Schumpeter, 1949). Therefore, this article suggests that institutional analysis should not unduly emphasize efficiency as the criteria for institutional selection. Perhaps efficient institutions, like efficient species, may create critical instability, which in turn raises their vulnerability to destruction. In the future, researchers might want to understand how institutions prevent such collapses from occurring.

Finally, this article suggests that *ecological resiliency* may be a better objective than ecological sustainability. The resiliency of the four communities to natural cycles helped prevent them from overcontrolling their ecosystems. This, in turn maintained the resiliency of the ecosystem. These communities came to an end because they were not resilient to changes in the societies around them. Researchers might seek to uncover examples of existing communities that have avoided ecological surprise *and* that remain resilient to changes in surrounding societies.

This article suggests that *if* society is to avoid ecological surprise, it may have to undo modern institutions that encourage individual action by protecting the individual from the community. The four communities discussed in this article differ fundamentally from modern institutions. Whereas these communities emphasized surprise avoidance, modern institutions emphasize improvement. Whereas these communities emphasized the control of the individual by the community, modern institutions emphasize individual optimization and personal freedom. Whereas these communities emphasized observability and community-determined rights of property, modern institutions emphasize privacy and rights to property. Consider, for example, the dominant legal form for businesses—the corporation. This structure appeared during the industrial revolution to encourage individual investment in improvements such as colleges, canals, and railroads. It placed the "wealth of innumerable individuals under central control," and it limited liability, disruption, or even observation by the society (Berle & Means, 1932; Clark, 1986). Corporations have become central to our economy and society. Are they also incompatible to avoid surprise?

This article also suggests that "sustainable" organizations, which may look very different from modern organizations, will face novel challenges. Consider, for example, the organization's boundary to the environment. Smokestacks now represent the dominant relationship—they allow waste to flow into the environment but do not allow the environment to enter the organization. Such a boundary allows tractable management, because it can be spanned or buffered (King, 1995; Thompson, 1967). This article suggests that sustainable organizations may resemble estuaries. The organization will mix with the environment, other organizations, and society. A person may not be able to distinguish when he or she is inside or outside of an organization or not, and it may not be easy to tell when an individual is working for the organization, acting as a stakeholder, or engaged in institutional activities.

Future research should consider the continued usefulness of community models. Management theorists should heed Buchanan's warning against extrapolation from small groups: "Volunteer fire departments arise in villages, not in metropolitan centers" (1977: 162). The four communities here are not even volunteer fire departments relative to the *Fortune* 1,000 companies of today. Business conditions have changed greatly. Modern organizations often engage in enterprises separated by great physical distances. Given this separation, how can institutions continue to provide rapid information feedback? Modern organizations contain extensive proprietary information. How can modern organizations be as open as their village ancestors? Humankind's technological ability to damage nature has advanced far beyond that of the village society. In a world of toxic chemicals and nuclear power, can permeable boundaries exist? Modern Western society enshrines privacy, rights of property, and freedom of action. How many of us would like to live in a community where "everything is everybody's business" (McKean, 1982: 77) and where our neighbor held the right to graze his or her goats on our front lawn?

Despite this, I find myself intrigued by evidence that some modern institutions and organizations may be taking the first steps in returning to some of the characteristics of their village ancestors. It is commonplace, for example, to observe that modern information technology is turning the world into a "global village." Technology is helping to overcome observability barriers caused by physical distance. Handy (1995) suggested that information technology is breaking down traditional organizational boundaries and allowing trust-based virtual organizations. Institutions have emerged to facilitate the transfer of environmental information. The U.S. government compiles information on toxic emissions and uses and distributes it on the global internet, and nongovernment organizations gather and distribute information about distant environmental impacts.

Many businesses are providing increased (if not yet totally free) access to information about their operations in order to more rapidly recognize and respond to environmental problems. Polaroid, for example, created the Environmental Assessment and Reporting System (EARS) program to identify, track, and report chemical emissions, and the company publishes this information to speed feedback from surrounding communities (Nash, Nutt, Maxwell, & Ehrenfeld, 1992). Other organizations such as Consumer's Power and Dow Chemical allow members of environmental groups great access to the company (Shabecoff, 1989). Church and Dwight's Chairman, Dwight Minton, argued that including diverse stakeholders in company decisions helps the company to avoid environmental problems and, if necessary, to respond to these problems more rapidly and efficiently (1994).

Organizations and institutions also seem to be using multiple use rights once again. Until recently, Consumer's Power and other large companies defined the boundary of their property with a fence and planted a short grass lawn inside. Hunters and other stakeholders pressured them to stop controlling the natural environment and to allow human and natural access. As a result, Consumer's Power reduced its fencing and now allows natural flora and fauna to grow on much of its corporate land, and it has given some members of surrounding communities "use right" to enjoy the land (Penn, 1992; Shabecoff, 1989). Dennis Marvin of Consumer's Power argued that barriers to the community and the environment, in the long run, are counterproductive: "Our basic philosophy of management is that the life of any business can't be separated from the surrounding environment in which it does business" (Penn, 1992: 91). Such a sentiment might well have been shared by one of Consumer Power's community ancestors.

REFERENCES

Abernathy, W. J., & Clark, K. B. 1985. Innovation: Mapping the winds of creative destruction. ***Research Policy,*** 14: 3–22.

Anderson, T. L., & Simons, R. T. (Eds.). 1993. ***The political economy of customs and culture: Informal solutions to the commons problem.*** Lanham, MD: Rowman & Littlefield.

Athans, M., & Falb, P. L. 1966. ***Optimal control—An introduction to the theory and its applications.*** New York: McGraw-Hill.

Auslander, D. M., Takahashi, Y., & Rabins, M. J. 1974. ***Introducing systems and control.*** New York: McGraw-Hill.

Barbier, E. B. 1989. ***Economics, natural-resource scarcity and development.*** London: Earthscan.

Barnett, H., & Morse, C. 1963. ***Scarcity and growth.*** Baltimore: Johns Hopkins University Press.

Begon, M., Harper, J. L., & Townsend, C. R. 1990. ***Ecology—Individuals, populations and communities.*** Cambridge, England: Blackwell Scientific Publications.

Berle, A. A., & Means, G. C. 1932. ***The modern corporation and private property.*** New York: Harcourt, Brace & World.

Brooks, H. 1986. The typology of surprises in technology, institutions, and development. In W. C. Clark & R. E. Munn (Eds.), ***Sustainable development of the biosphere:*** 325–350. Vienna: Gistel Druck.

Buchanan, J. M. 1977. ***Freedom in constitutional contract.*** College Station: Texas A & M University.

Butzler, K. W. 1990. The realm of cultural-human ecology: Adaptation and change in historical perspective. In B. L. Turner, II (Ed.), ***The earth as transformed by human action: Global and regional changes in the biosphere over the past 300 years:*** 685–702. New York: Cambridge University Press.

Clark, R. C. 1986. ***Corporate law.*** Boston: Little, Brown.

Clark, W. C., & Munn, R. E. (Eds.). 1986. ***Sustainable development of the biosphere.*** Vienna: Gistel Druck.

Coase, R. H. 1960. The problem of social cost. ***Journal Of Law and Economics,*** 3: 1–44.

Costanza, R., Wainger, L., Folke, C., & Maler, K.-G. 1993. Modeling complex ecological and economic systems. **Bioscience,** 43(8): 545–555.

Daly, H. 1993. The perils of free trade. **Scientific American,** November: 50–57.

Daly, H. E. 1991. **Steady-state economics.** Washington, DC: Island Press.

Dasgupta, P., & Heal, G. 1974. The optimal depletion of exhaustible resources. **Review Of Economic Studies,** Symposium: 3–28.

Demsetz, H. 1967. Toward a theory of property rights. **Economic Review,** 57(2): 347–359.

Forrester, J. W. 1971. **World dynamics.** Cambridge, MA: Wright-Allen Press.

Gladwin, T. N. 1993. The meaning of greening: A plea for organizational theory. In K. Fisher & J. Schot (Eds.), **Environmental strategies for industry:** 37–61. Washington, DC: Island Press.

Gleick, J. 1987. **Chaos: Making a new science.** Harrisonberg, VA: Donnelley.

Gomez-Pompa, A., Vazquez-Yanes, C., & Guevara, S. 1972. The tropical rain forest: A non-renewable resource. **Science,** 177: 762–765.

Gould, S. J. 1980. **The panda's thumb: More reflections in natural history.** New York: Norton.

Handy, C. 1995. Trust and the virtual corporation. **Harvard Business Review,** 73(3): 42–50.

Hannan, M. T., & Freeman, J. H. 1990. **Organizational ecology.** Cambridge, MA: Harvard University Press.

Hardin, G. 1968. The tragedy of the commons. **Science,** 162: 1243–1248.

Hardin, G., & Baden, J. (Eds.). 1977. **Managing the commons.** San Francisco: Freeman.

Hawken, P. 1993. **The ecology of commerce.** New York: Harper Business.

Heilbroner, R., & Thurow, L. 1981. **The economic problem.** Englewood Cliffs, NJ: Prentice Hall.

Holling, C. S. (Ed.). 1980. **Adaptive environmental assessment and management.** New York: Wiley.

Holling, C. S. 1986. The resilience of terrestrial ecosystems: Local surprise and global change. In W. C. Clark & R. E. Munn (Eds.), **Sustainable development of the biosphere:** 292–320. Vienna: Gistel Druck.

Holling, C. S. 1992. Cross-scale morphology, geometry, and dynamics of ecosystems. **Ecological Monographs,** 6(24): 447–502.

Hotelling, H. 1931. The economics of exhaustible resources. **Political Economy,** 39: 137–175.

Joskow, P. L. 1988. Asset specificity and the structure of vertical relationships: Empirical evidence. **Journal of Law Economics and Organization,** 4(1): 95-117.

Kahneman, D., & Tversky, A. 1979. Prospect theory: An analysis of decision under risk. **Econometrica,** 47: 263–291.

King, A. 1995. Innovation from differentiation: Pollution control departments and innovation in the printed circuit industry. **IEEE Transactions on Engineering Management,** 42(3): 270–277.

Lee, K. N. 1989. The Columbia River basin. **Environment,** 31(6): 6–33.

Lorenz, E. N. 1964. The problem of deducing climate from the governing equations. **Tellus,** 16: 1–11.

Ludwig, D., Hilborn, R., & Walters, C. 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. **Ecological Applications,** 3(4): 547–549.

Malthus, T. R. 1789. **An essay on the principle of population.** London: Johnson.

March, J. G., & Shapira, Z. 1992. Variable risk preferences and the focus of attention. ***Psychological Review,*** 99(1): 172–183.

Maxwell, J. 1994. How to save a salmon—Environmental concerns about fisheries management. ***Audubon,*** 96(4): 28–30.

McElroy, M. B. 1986. Change in the natural environment of the earth: The historical record. In W. C. Clark & R. E. Munn (Eds.), ***Sustainable development of the biosphere:*** 199–211. Cambridge, England: Cambridge University Press.

McKean, M. A. 1982. The Japanese experience with scarcity: Management of traditional common lands. ***Environmental Review,*** 6: 63–88.

McNamee, P. J., McLeod, J. M., & Holling, C. S. 1981. The structure and behavior of defoliating insect/forest systems. ***Researches on Population Ecology,*** 23: 280–298.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. I. 1972. ***The limits to growth.*** New York: Universe Books.

Minton, R. 1994. ***Keynote address.*** Conference on business environmental learning and leadership, Northwestern University, Evanston, IL.

Moerman, M. 1968. ***Agricultural change and peasant choice in a Thai village.*** Berkeley: University of California Press.

Moore, P. D. 1982. Fire: Catastrophic or creative force. ***Impact of Science on Society,*** 32: 5–14.

Nash, J., Nutt, K., Maxwell, J., & Ehrenfeld, J. 1992. Polaroid's environmental accounting and reporting system: Benefits and limitations of a TQEM measurement tool. ***Total Quality Environmental Management,*** Autumn: 3–15.

Neeson, J. M. 1993. ***Commoners: Common right, enclosure and social change in England, 1700–1820.*** Cambridge, England: Cambridge University Press.

Nelson, R., & Winter, S. 1982. ***An evolutionary theory of economic change.*** Cambridge, MA.: Harvard University Press.

Norman, C. 1984. No panacea for the firewood crisis. ***Science,*** 226: 676.

Ophuls, W. 1973. Leviatahan or oblivion. In H. E. Daly (Ed.), ***Toward a steady-state economy:*** 215–230. San Francisco: Freeman.

Orwin, C. S., & Orwin, C. S. 1954. ***The open fields*** (2nd ed.). Oxford, England: Clarendon Press.

Ostrom, E. 1990. ***Governing the commons: The evolution of institutions for collective action.*** New York: Cambridge University Press.

Penn, A. C. 1992. Home on the corporate range. ***USAir Magazine,*** July: 90–91.

Pitt-Rivers, J. A. 1971. ***The people of the sierra*** (2nd ed.). Chicago: University of Chicago Press.

Prigogine, I., & Stengers, I. 1984. ***Order out of chaos.*** Toronto: Bantam.

Ricardo, D. 1973. ***The principles of political economy.*** London: Denst.

Richards, J. F. 1986. World environmental history and economic development. In W. C. Clark & R. E. Munn (Eds.), ***Sustainable development of the biosphere:*** 53–74. Vienna: Gistel Druck.

Robinson, E., & Summerfield, G. (Eds.). 1967. ***Selected poems and prose of John Clare.*** London: Oxford University Press.

Rowlands, M. 1975. ***Masters and men.*** New York: Pantheon.

Scharpf, F. W. 1989. Decision rules, decision styles, and policy choices. ***Journal of Theoretical Politics,*** 1: 151–178.

Schlager, E., & Ostrom, E. 1993. Property-rights regimes and coastal fisheries: An empirical analysis. In T. L. Anderson & R. T. Simmons (Eds.), **The political economy of customs and culture: Informal solutions to the commons problem:** 13–42. Lanham, MD: Rowman & Littlefield.

Schumpeter, J. A. 1949. **The theory of economic development.** Cambridge, MA: Harvard University Press.

Scott, J. C. 1976. **The moral economy of the peasant.** New Haven, CT: Yale University Press.

Shabecoff, P. 1989. Corporate property—Where the wild things are. **New York Times,** March 19: Section 3, 13.

Shrivastava, P. 1994. Castrated environment: Greening organizational science. **Organization Studies,** 20: 705–726.

Shrivastava, P. 1995. Ecocentric management for a risk society. **Academy of Management Review,** 20: 118–137.

Shrivastava, P., & Hart, S. 1994. Greening organizations—2000. **International Journal of Public Administration,** 17(3–4): 607–635.

Solow, R. M. 1974. Intergenerational equity and exhaustible resources. **Review of Economic Studies:** 139–152.

Steele, J. H. 1985. A comparison of terrestrial and marine systems. **Nature,** 313: 355–358.

Stevens, W. K. 1994. Extinction of the fittest may be the legacy of lost habitats. **New York Times,** September 27: C3.

Stevenson, G. G. 1991. **Common property economics: A general theory and land use applications.** New York: Cambridge University Press.

Stipp, D. 1991. Life-cycle analysis measures greenness, but results may not be black and white. **Wall Street Journal,** February 28: B5, C1.

Sullivan, W. 1994. Great climate cycles seen in last ice age. **New York Times,** February 3: C1, C8.

Tawney, R. H. 1966. **Land and labor in China.** Boston: Beacon Press.

Thompson, E. P. 1971. The moral economy of the English crowd in the eighteenth century. **Past and Present,** 50: 76–136.

Thompson, E. P. 1975. **Whigs and hunters—The origin of the Black Act.** New York: Pantheon Books.

Thompson, E. P. 1993. **Customs in common.** New York: New Press.

Thompson, J. D. 1967. **Organizations in action.** New York: McGraw-Hill.

Throop, G. M., Starik, M., & Rands, G. 1993. Sustainable strategy in a greening world: Integrating the natural environment into strategic management. **Advances in Strategic Management,** 9: 63–92.

Tibbs, H. 1991. **Industrial ecology: An environmental agenda for industry.** Boston: Arthur D. Little.

Tilly, C. 1986. **The contentious French.** London: Belknap Press.

Timmerman, P. 1986. Mythology and surprise in the sustainable development of the biosphere. In W. C. Clark & R. E. Munn (Eds.), **Sustainable development of the biosphere:** 435–452. Cambridge, England: Cambridge University Press.

Totman, C. 1989. **The green archipelago: Forestry in preindustrial Japan.** Berkeley: University of California Press.

Turner, B. L., II (Ed.). 1990. **The earth as transformed by human action: Global and regional**

changes in the biosphere over the past 300 years. New York: Cambridge University Press.

Turner, R. K., Doktor, P., & Adger, N. 1994. Sea-level rise and coastal wetlands in the United Kingdom: Mitigation strategies for sustainable management. In A. Jansson, M. Hammer, C. Folke, & R. Costanza (Eds.), ***Investing in natural capital: The ecological economics approach to sustainability:*** 266–290. Washington, DC: Island Press.

Tushman, M. L., & Romanelli, E. 1985. Organizational evolution: A metamorphosis model of convergence and reorientation. In L. L. Cummings & B. M. Staw (Eds.), ***Research in organizational behavior,*** vol. 7: 171–222. Greenwich, CT: JAI Press.

Tversky, A., & Kahneman, D. 1981. The framing of decisions and the psychology of choice. ***Science,*** 211: 453–458.

Vredenburg, H., & Westley, F. 1993. Environmental leadership in three contexts: Managing for global competitiveness. In J. Pasquero & D. Collins (Eds.), ***Proceedings of the fourth annual conference of the International Association of Business and Society:*** 495–500.

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