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Synthesis, part of a Special Feature on Balancing Ecology and Community using Cumulative Effects Models

Local Actions, Global Effects? Understanding the Circumstances in which Locally Beneficial Environmental Actions Cumulate to Have Global Effects

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ABSTRACT. Environmentally beneficial actions come in diverse forms and occur in a wide range of settings ranging from personal decisions in households to negotiated agreements between nations. This article draws upon both social and ecological theory to outline, theoretically, the circumstances in which localized actions, undertaken by citizens, should cumulate to have global effects. The beliefs behind these actions tend to be either 'defensive environmentalism' in which actors work to improve their personal, local environments or 'altruistic environmentalism' in which actors work to improve the global environment. Defensive environmental actions such as creating common property institutions, limiting fertility, reducing waste streams, using energy efficient technologies, and eating organic foods have cumulative effects whereas altruistic environmental action often occurs through threshold crossings following a focusing event. Defensive environmentalism expedites altruistic environmentalism by persuading politicians, after focusing events, that rank and file citizens really do want a regime change. The resulting political transformation should, at least theoretically, create a sustainable development state that would promote additional defensive and altruistic environmental actions.

Key Words: *altruistic environmentalism; defensive environmentalism; focusing events; local-global interactions*

INTRODUCTION

In the past three decades a number of environmentally concerned observers have applauded the spread of environmentally friendly behaviors in communities around the globe and argued that, in the aggregate, these local efforts can have a global impact (Hawken 2007). This argument raises questions about the circumstances in which local environmental initiatives emerge, accumulate, and in some instances contribute to the stabilization of global environmental change. This article tries to identify the circumstances in which this 'scaling-up' might occur.

To assess the cumulative effects of local, environmentally friendly actions, we need to situate these actions in larger scale historical processes. The increasingly crowded and prosperous world should over time have created social conditions that reward individuals and communities for behaviors that begin to conserve or stabilize newly imperiled environments. Conservation and pollution control efforts usually have their origins in clusters of intense interaction between organisms in which environmentally damaging actions bring negative feedbacks, either in the form of environmental degradation or hostile acts by other individuals. In this way organisms learn to engage in environment conserving activities (Levin 1999, Levin et al. 2001). Examples of this dynamic abound among humans, especially in local arenas. Small aggregations of people, using territorially defined resources, harvest or catch less if they fail to organize to halt the depletion of the resource (Ostrom 1990). When families from one generation bear more children than they can successfully rear, subsequent generations may take note of the earlier

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generation's struggles and decide to have fewer children (Wrigley 1969). When people make waste, at least some of it accumulates locally, so, if people do not dispose of the waste, they will see, feel, and smell the consequences of their failure. Finally, as the risks associated with hazardous wastes became more apparent during the 1980s, corporations have to pay more to dispose of their hazardous wastes, so they cut back on the use of these materials (Szasz 1994). In all of these instances humans experience negative feedbacks that prompt courses of action that lighten the human impact on the environment.

These courses of action constitute 'defensive environmentalism' (A. Owen, E. Conover, J. Videras, S. Ellingson, and S. Wu, *unpublished manuscript*). This type of environmentalism enhances the immediate environment of the individual, but, in so doing, it has a stratifying effect because other individuals cannot take similar protective actions. If everyone were to take these protective actions, then the larger global environment would benefit. Recycling, adopting restrictive land use controls, instituting catch shares in territorially defined fisheries, fertility limitation through family planning, and purchasing energy efficient technologies all represent instances of defensive environmentalism that occur either in households or communities. In contrast, 'altruistic environmentalism' involves actions by people and governments that produce no short term benefits for the individual but may produce beneficial effects for the globe. An individual's decision to walk rather than drive a car to work in order to reduce greenhouse gas emissions or the adoption of emission reducing regulations by a government would be instances of altruistic environmentalism.

The following pages describe the historical circumstances that give rise to locally oriented, defensive environmentalism and globally oriented, altruistic environmentalism. The final section of the paper describes the dynamic in the aftermath of focusing events that, theoretically, should bring local together with global environmentalism in a sustainable development state.

DEFENSIVE, MODULAR ENVIRONMENTALISM

In the 20th century, both social and ecological theorists created theories to explain how communities of organisms change as their populations grow and over time transform their places of residence. Social scientists referred to these intellectual constructs as theories of development while natural scientists referred to them as theories of succession. Both theories, as outlined below, postulate the emergence of specific types of defensive environmentalism as communities grow in size over time.

Social scientists concerned with development, beginning with Emile Durkheim (1893) and modernization theorists (Inglehart and Baker 2000), outlined a theory about how population growth alters the structure of societies. This theory traces out how changes in individuals and small groups stem from and respond to changes in the larger structure of societies as people become more numerous. Durkheim argues that population growth intensifies competition between individuals for resources, and under competitive pressures, people begin to specialize in particular occupations. With increased specialization, people become more productive, more interdependent, and more interested in limiting the number of their offspring. Specialization also lays the foundation for gains from trade. The comparative advantages from trade become more compeling, and spatial scale of economies expand in what has come to be known as globalization. As workforces begin to produce for larger markets, societies industrialize and urbanize. With people living at greater densities and generating larger economic surpluses, elites organize governments to provide a wide variety of services and, among other things, centralize power.

A venerable theoretical tradition in ecology describes an analogous set of changes that occur in ecological communities as they age. This line of theorizing begins with Frederic Clement's (1916) theory of succession, gets synthesized in Eugene Odum's (1969) work, and receives its most recent expression in the study of 'patch dynamics' (Wu and Loucks 1995). In the early 20th century, Frederic Clements (1916) outlined the pattern of changes that plant communities experience after a large scale disturbance occurs. Later in the 20th century, ecologists, most notably Eugene Odum, began theorizing, much like Clement, about patterns of change over time in ecosystems. Odum summarized these patterns in a widely read 1969 article, entitled "The Strategy of Ecosystem Development" (Odum 1969). He outlined a series

of changes in the structure of ecosystems as they undergo 'development', in other words as they progress from aggregations of r-selected, pioneering species that reproduce and occupy sites rapidly after a disturbance to older, well-established communities of organisms. Odum pointed out how, in the absence of disturbances, communities become over time more spatially heterogeneous with larger amounts of biomass, more specialist, 'K' selected species which are slow to reproduce, and nutrient flows that nourish larger amounts of biomass. For Odum these trends, taken together, indicated that ecosystems frequently progress in orderly fashion from 'developmental' to 'mature' stages of growth. He went so far as to endow ecosystems, at least metaphorically, with 'strategies'.

To some readers, it may have appeared that Odum had produced a model that better described the dynamics of change in human ecosystems than the dynamics of change in ecosystems. Critics took issue with Odum's emphasis on orderly patterns of change and his imputation of 'strategies' to clusters of organisms (Botkin 1990, Kingsland 2005). For them, disturbances, rather than orderly patterns of change, characterized most ecological communities. By extension random fluctuations, sometimes described as 'the accidents of history', characterized most ecosystems. In response to these criticisms community ecologists developed a 'hierarchical patch dynamics' paradigm that views communities as "dynamic mosaics of patches differing in successional stages" (Pickett and White 1985, Wu and Loucks 1995:447). This theoretical framework makes no assumptions about equilibria, adopting an almost Heraclitean view of patches and connections between patches as islands of order set in seas of change (Kingsland 2005). Within these patches modular succession might occur, with negative feedbacks inducing the adoption of defensive environmental activities.

Both the social and the ecological theories identify four domains in which defensive environmentalist actions might emerge: Land use control, fertility limitation, waste management, and energy consumption.

Land use control

The increasing division of labor in human societies promotes patchiness in human dominated landscapes, with some tracts of land devoted to one use, like agriculture, and other tracts of land devoted to another land use, like forests. Clusters of users develop around each natural resource and specialize in its use. If over time the resource declines or degrades, then the users may organize themselves into a common property institution to prevent further declines in the resource or to restore it to its earlier condition (Firey 1960, Ostrom 1990). Classes emerge, defined by who has and does not have access to the resource.

Fertility limitation

The increasing competitive pressures that propel more fine-grained divisions of labor would also explain a shift in the composition of populations from 'r' strategists who take advantage of shifting opportunities to 'K' strategists who specialize in delivering particular goods or services. Patterns of fertility change when the composition of populations shifts from pioneers (r-selected) to specialists (K-selected). While the pioneers produce many offspring with the expectation that some will not survive past childhood, specialists produce fewer offspring and invest in them extensively to help them compete in the larger world. This shift in reproductive behavior, called 'the demographic transition' by demographers, has reduced human fertility rates in many places to below the replacement rate (2.1 children per woman). Many of these societies now face the prospect of absolute population losses in the coming decades (Morgan 2003).

Waste management

Because specialization makes people more productive, the overall volume of goods and services increases. The large concentrations of people and goods, largely in cities, deplete accessible natural resources and create waste disposal problems. As the volume of waste increases, waste disposal practices come under increasing scrutiny. The sites for disposing of waste diminish, and the costs of waste disposal climb. Under these circumstances people create technologies and markets for recycling products or reusing waste. Because recycling resources prolongs their utility, it can in some instances reduce human pressures on natural resources (Desrochers 2002). The recent rapid expansion of organic agriculture represents a similar trend; organic

material from recycled plant and animal waste plays a vital role in fertilizing the next season's crops. In ecological terms, recycling and organic agriculture expand the role of detritus cycling in human communities.

Energy consumption

Growth over time in productive activities in human communities increases the stock of goods which in turn creates incentives to support more goods and biomass with established flows of energy and nutrients. These energy expenditures pollute the immediate environment and contribute to production costs, so business executives want to reduce their energy expenditures. Under these circumstances they engage in what analysts have called 'ecological modernization', the substitution of newer, cleaner technologies and more efficient energy sources for older, more polluting technologies and less efficient energy sources (Mol et al. 2009). The primary actors in these reform movements are business enterprises and their regulators. In terms of ecological structure, this trend increases the stocks of goods relative to the flows of energy in a community as it grows older.

In all of these instances individuals, communities, and businesses calculate the short-run personal benefits of undertaking ecologically friendly actions. Some of these actors improve their local environments through an 'inverted quarantine' in which wealthy individuals insulate themselves from disturbances by restricting access to their communities and purchasing contaminant free foods (Szasz 2008). The defensive environmental activities also exhibit 'projectivity' (Mische 2009), meaning the frequency with which they occur can be quantified and projected into the future. For example, efforts to envision what a climate challenged world will look like in 2050 regularly include a projected world population of 9 billion people. In this sense it becomes possible to measure the degree to which defensive environmental behaviors have or have not accumulated in a population. By extension it may become possible to measure the cumulative effects of these trends or alternatively, identify thresholds in environment-society relations which, once passed, alter environmentally significant behaviors in fundamental ways.

ALTRUISTIC, GLOBAL ENVIRONMENTALISM

During the late 19th century, Herbert Spencer (Carneiro 1967) initiated an alternative line of thinking about social and ecological change in the world system. Spencer worried about the strain that population increases placed on the social fabric in the form of increased competition for food and natural resources. He acknowledged, like Durkheim, that the competition would lead to increased differentiation among people, but he also argued that the increased conflict over resources could lead to the dissolution of societies. Spencer observed that some societies avert conflict and dissolution by creating a set of encompassing institutions that bring the conflicting parties together and resolve conflicts. By creating these new institutions, the members of these societies promote the survival of their societies and themselves.

The frequent absence of direct feedback effects at larger geographic scales makes populations confronted with global environmental changes particularly reliant on the creation of encompassing organizations to promote sustainability. In these larger geographical arenas changes like global warming have highly unequal effects that vary across populations. Affluent greenhouse gas emitters in suburban North America experience virtually no climactic effects from their carbon emissions while herders in subarctic Siberia have their pastoral way of life transformed (Crate 2006). Under these circumstances green behaviors have to be imposed by organizations with interests that encompass a wide array of peoples and geographical areas. For this reason global sustainability relies to an extraordinary degree on the dynamic identified by Spencer, the creation of encompassing organizations that bring all of the competitors together to promote their common interests (Olson 1982).

Although Spencer's idea of encompassing succession offers a useful point of departure for understanding how change occurs in a world system, the immediate circumstances surrounding the creation of this new level of organization remain unclear. A model about the dynamics of change in expanding systems constructed by Per Bak and his colleagues outlines one possible set of conditions in which encompassing succession could occur (Bak

1996). Bak's model, referred to as "self-organized criticality" (SOC) begins with a system undergoing expansion through the steady addition of new elements. Human population increases would certainly qualify as an enabling condition in Bak's model. His favorite example involved sand piles with a thin stream of sand falling on the pile. As the sand accumulates, the sand pile grows taller, and the elements (grains of sand) become more tightly packed. In network terms the connectivity of the system increases; the elements become more interdependent, and the system reaches a 'critical' state in which small changes within the system radiate throughout the system, cross a threshold, and precipitate (in the sand pile metaphor) 'avalanches'. Transposed into human terms, the threshold crossing could induce major structural changes like a revolution. Although empirically unlikely, these changes can occur without perturbations from outside the system.

In writing about global warming, Clark (1985, as cited in Homer-Dixon 1999:38) captures the dynamic that leads to major structural changes in the system.

> *... slow variation in one property can continue for long periods without noticeable impact on the rest of the system. Eventually, however, the system reaches a state in which its buffering capacity or resilience has been so reduced that additional small changes in the same property, or otherwise insignificant external shocks, push the system across the threshold and precipitate a rapid transition to a new system state or equilibrium.*

SOC has a holistic emphasis. The crucial emergent behaviors in the system, the avalanches, cannot be understood in reductionist terms as an aggregate of individual actions. Although SOC could in theory apply to systems at any level of aggregation, Bak and Chen (1991) see it applying primarily to large scale systems. The logic behind SOC is very similar to Charles Perrow's argument about normal accidents in advanced technological systems (Perrow 1999, Clarke 2005). Tightly coupled technological systems, like nuclear power plants, have little slack and many feedback loops, so, on those rare occasions when multiple components fail at the same time, the effects radiate through the system in unpredictable ways, causing in some instances a complete breakdown. Because the structure of these systems contributes to these cascading effects, the accidents that occur, although rare, are in some senses a 'normal' part of the system's operation; they are, therefore, normal accidents. Nassim Taleb (2010) describes complex systems, using the same terms and the logic as Perrow, as tightly coupled and prone to sudden, unexpected, transformational changes, what Taleb calls 'the Black Swans'.

Other social scientists, like Taleb, describe the global economy in similar terms. As Lynn writes (2005, as cited in Perrow 2007:302),

> *Our corporations have built a global production system that is so complex, and geared so tightly and leveraged so finely, that a breakdown anywhere increasingly means a breakdown everywhere, much in the way that a small perturbation in the electricity grid in Ohio tripped the great North American blackout of August 2003.*

The steady increases in connectivity eventually give rise to threshold crossing events that initiate a cascade of fundamental changes in the system. As Jervis (1997:39), a political scientist, puts it,

> *Jumps rather than smooth progressions often characterize the operation of systems. ...when variables interact in a non-linear manner, changes may not be gradual. ...for a prolonged period there may be no deterioration, followed by sudden collapse or transformation.*

This picture of sudden change recurs in the literature in an increasingly crowded, connected world (Catton 1980, Diamond 2005, Brown 2006). The argument has Malthusian overtones. It resembles Malthus (1798) because, like his argument, it envisages a thoroughgoing change, in Malthus' terms a 'check', after the system crosses a threshold. It differs from Malthus because it finds the sources for checks in an increasingly interconnected society rather than in a population that has grown faster than its food supply. Although normally considered in opposition to Malthusians, world systems theorists (Wallerstein 2004) share a focus on global systems with the Malthusians. World systems theorists frequently hear criticisms about their failure to articulate the policy options or implications of their

analyses. They overlook policy implications because the preferred mode of change in their analyses is revolutionary. The system has to undergo a fundamental reorientation if it is to serve the needs of most people. Like Bak, world systems theorists focus on large scale systems and transformative events.

The pace of change in this model of global succession approximates the 'punctuated equilibrium' idea outlined by Gould and Eldredge (1977). Long periods of relative stasis alternate with shorter periods of rapid, thoroughgoing, sometimes revolutionary change. Similar patterns of alternating stasis and change have characterized recent American politics (Jones et al. 2003) and environmental politics in particular (Gunderson and Holling 2002, Repetto 2006). "Sudden qualitative shifts in environment-society dynamics" create a sense of a 'common fate' among the impacted people that spurs efforts at altruistic environmentalism and sparks efforts by political leaders to change the way we manage problems of pollution and natural resources (Levin et al. 2001:224, Sell and Love 2009).

In the aftermath of these shifts, newly motivated political leaders are more likely to come together to form the new levels of organization that Spencer sees as vital to maintaining a growing population. As game theorists argue, "new levels of organization evolve when the competing units on the lower level begin to cooperate" (Nowak 2006:1563). The new organizations are most likely to take an 'encompassing' as opposed to a 'special interest' form. Encompassing organizations include most if not all of all of the stakeholders who use a natural resource, and they typically ask their members to make sacrifices for the good of the larger group (Olson 1982). Prototypical encompassing organizations would include the United Nations, the European Community, and the Intergovernmental Panel on Climate Change (IPCC). As noted above, their role in achieving sustainability would increase with the scale of the threat to the environment.

The circumstances that give birth to encompassing organizations almost always involve some measure of political struggle. Both the United Nations and the European Community emerged in the aftermath of World War II. Elite groups often stand to lose from the restraints on their behavior imposed by encompassing organizations. For example, elite groups, composed of coal burning utility executives and oil company executives, vigorously opposed the Framework Convention on Climate Change (Fisher 2004). This political dynamic explains why encompassing organizations typically appear in the aftermath of threshold crossing events. The political impetus to create the encompassing organization only has enough force in the aftermath of extraordinary events when it becomes apparent to large segments of the elite that they cannot respond to the problem through 'business as usual' processes. Under these circumstances political leaders and observers call for personal sacrifices as part of a collective effort to address the newly appreciated problem (Maniates and Meyer 2010). In this sense, events play a crucial role in efforts to create social orders that address issues of sustainability (Walters and Vayda 2009).

LOCAL-GLOBAL DYNAMICS: FOCUSING EVENTS, MULTIPHASIC RESPONSES, AND SUSTAINABLE DEVELOPMENT STATES

The arguments presented to this point explain how local, modular, defensive environmentalism occurs and how global, encompassing patterns of altruistic environmentalism should occur. At the same time each pattern, by itself, offers an incomplete account of the dynamics of environmental change (Carpenter and Brock 2002) largely because each one models change at only one geographical scale. Modular, defensive environmentalism works best at the local level where effects cumulate over time. Altruistic environmentalism occurs primarily at the global level when a sudden change after a threshold crossing event spurs the formation of an encompassing organization. Models that focus on the changing resilience of coupled human and natural systems, developed by C. S. Holling and his colleagues, incorporate both scales into a single model that they refer to as an "adaptive cycle" (Holling et al. 2002:5). They describe coupled human-environment systems as progressing through four phases. The progression from the r phase, dominated by r selected individuals, to the K phase, characterized by K selected individuals, repeats the line of historical development outlined in succession theory. In other words, small communities of pioneering individuals grow in time into larger, interconnected populations of specialized individuals who practice defensive

environmentalism and whose societies exhibit the characteristics of 'self-organized criticality' (Carpenter and Brock 2002).

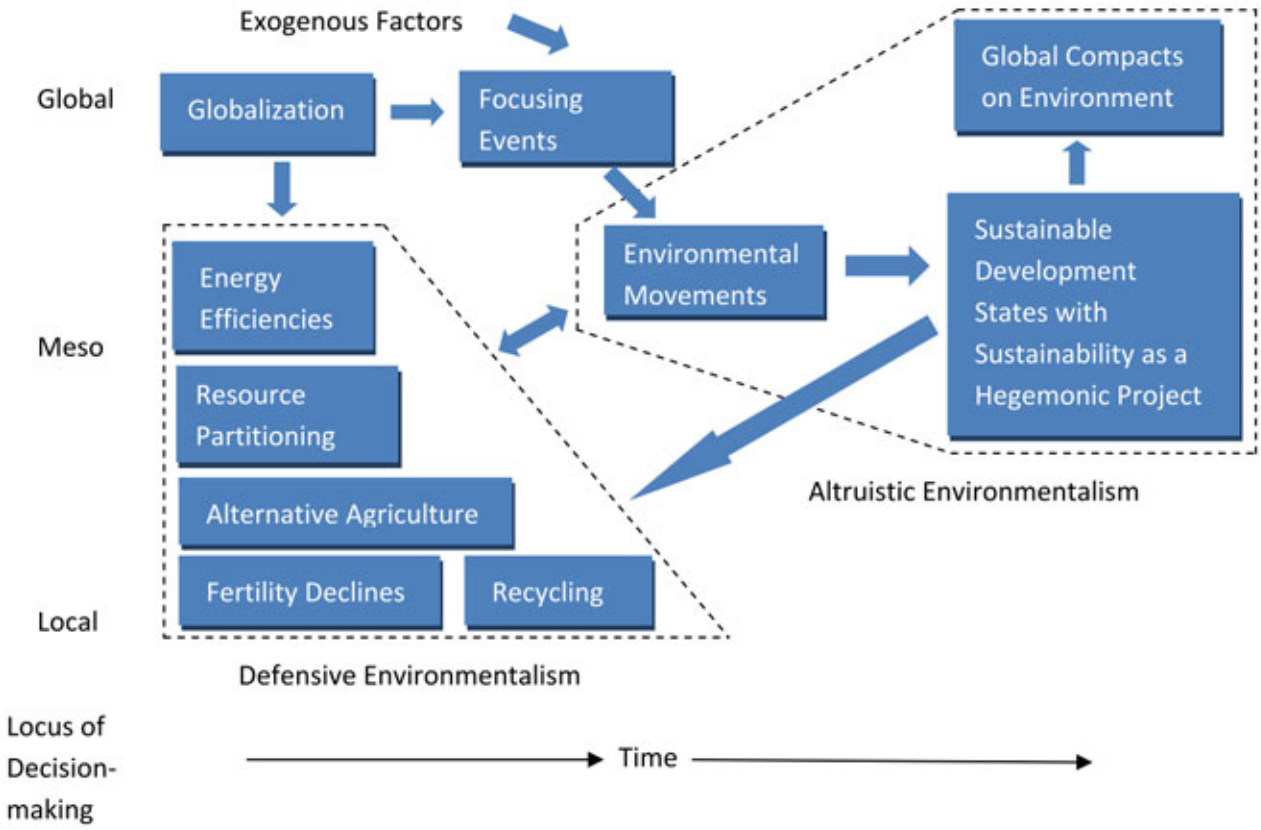
Eventually, these larger societies experience transformative, focusing events. Although we cannot predict the timing or the substance of these sometimes cataclysmic events, we can discuss the likely responses to them, based on the history of human responses to wars and disasters (Taleb 2010). As noted earlier, the big events may reinforce defensive environmentalist behaviors like growing one's own food or limiting fertility. This direct effect could have an indirect political effect. The suddenness and magnitude of the focusing event undermines 'business as usual' rationales used by the ruling elites and, through the 'common fate' dynamic described above, they spur people to undertake small scale, often defensive environmentalist initiatives. Seeing the surge in activities at the local level, politicians in larger scale political arenas are more likely to push for real political reforms that, substantively, represent altruistic environmentalism (Pollan 2008). The large scale political reforms in return can strengthen the local initiatives. A virtuous circle of reinforcing political actions at both local and more global scale emerges. The cumulating effects of defensive environmentalists facilitate the threshold crossing actions of altruistic environmentalists. These cross-scale initiatives directed at a common problem embody what Kingsley Davis (1963) called a multiphasic pattern of response. Preconditions do of course matter. If a population already exhibits deep cleavages, a focusing event and its reverberations may further divide people rather than bringing them together, so there is nothing inevitable about the common fate effect that follows focusing events.

The political reforms that follow a large scale focusing event have the potential of transforming the state. Just as the experience of World War II in the case of Japan, the Chinese Civil War in the case of Taiwan, and the Korean War in the case of South Korea created political conditions appropriate for the emergence of developmental states, so environmental focusing events have the potential of creating a 'sustainable development state'. In the aftermath of these events political leaders reorganize the state around a hegemonic project of sustainability, and make the case for both local and global sustainability initiatives that require sacrifices from constituents.

One well-known example of the ways in which this political dynamic unfolds occurred in the decade after the incident at Love Canal near Buffalo, New York where a municipality built a school on a capped toxic waste dump, and the first children to attend the school began to get sick. The nondescript, suburban setting of the contaminated area and an articulate spokesperson, Lois Gibbs, encouraged middle class Americans to think that similar contaminated areas could exist close to their homes. For the next decade people uncovered a succession of contaminated sites and formed local organizations to lobby for cleanups of the newly discovered sites. These sites existed throughout the United States, including rural areas of the South (Bullard 1990). The clean-up of environmentally contaminated sites was not part of the political agenda of the conservative president, Ronald Reagan, or the conservative members of his political party. The cumulative effects of discovering the new sites and the formation of groups in conservative congressional districts to lobby for their clean-up and the sustained focus of the media on this issue eventually convinced some conservative representatives to vote for an expanded federal system for cleaning up these sites (Szasz 1994).

Although this example does not have a single pivotal moment following a single large scale focusing event, it does exhibit the multiphasic, cross-scale political dynamic that can develop in the aftermath of well publicized, environmentally damaging events. It makes understandable the sense of urgency that would seem to explain both the rapid rates of change and the resort to multiple means of change. In this sense the multiphasic responses described by Davis need to be seen as occurring in a context marked by the punctuated equilibria described by Gould and others. Dramatic events like famines or hurricanes trigger or accelerate clusters of changes that occur simultaneously at the local and the national level, with the one reinforcing the other. Politicians in the larger national arena push for change in part because they see in their constituents' local activities a commitment to change. It is even possible to imagine how this type of political dynamic could occur across scales and across nations, following a series of climate related disasters, to produce a global climate compact.

Fig. 1. Model of environmental reform.



CONCLUSION

Figure 1 summarizes the argument about the dynamics, involving both locally cumulating effects and extra-local threshold crossing, through which local, frequently defensive environmentalisms scale up into global, altruistic environmentalisms. Further work on this theoretical framework should focus on two tasks: (1) measuring defensive and altruistic environmentalism and confirming the hypothesized relationship between them, and (2) clarifying the role that governments play in promoting these interacting processes.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol16/iss2/art19/responses/

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