

Resilience and Pluralism

Ecosystems and Society in a Great Transition

Nicolas J. Lucas and Elena Bennett



GTI Paper Series

Frontiers of a Great Transition

14

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Resilience and Pluralism: Ecosystems and Society in the Great Transition

The Shape of the Earth at the End of the 20th Century

Like *economy* and *ecology*, the term *ecosystem* has its roots in *oikos*, Greek for *home*. The choice of words to designate the natural space in which we build our societies and pursue our individual and collective goals connotes an aspiration: to make the biosphere ours; or, in the words of that ancient biblical mandate, to “fill the earth and subdue it”. By 2000, human beings had largely realized that aspiration. Large parts of the biosphere had been transformed in our image to become a territory primarily devoted to providing humans with food, water, fiber, fuel, and timber.

Compare the maps below. The first one shows the “natural” distribution of the biomes of the world, that is, in the absence of significant human intervention; the second one shows the pattern of land cover today. In 2000 about 25% of land surface had been transformed into cultivated systems, 8% had been urbanized, and three to six times as much water was held in human-made reservoirs as in natural rivers. Deserts and polar systems cover much of the land mass that has not been subdued.

Figure 1: “Natural” Distribution of World Biomes, Absent Human Intervention

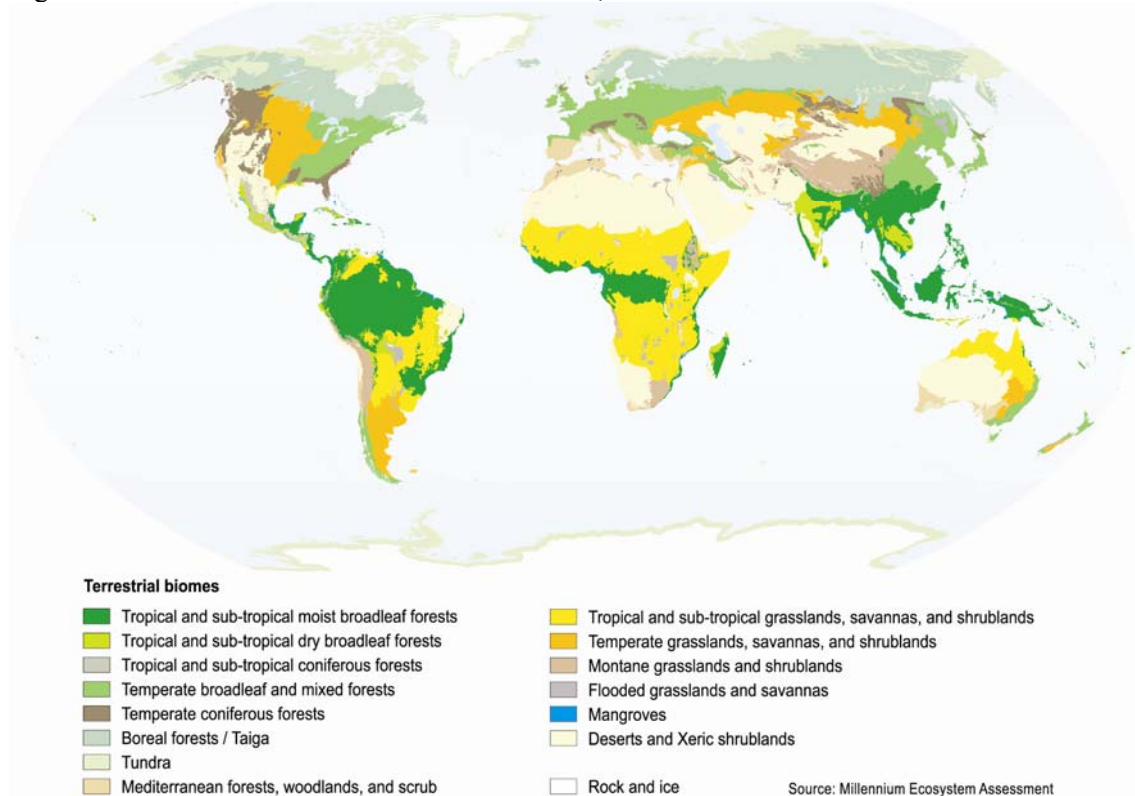
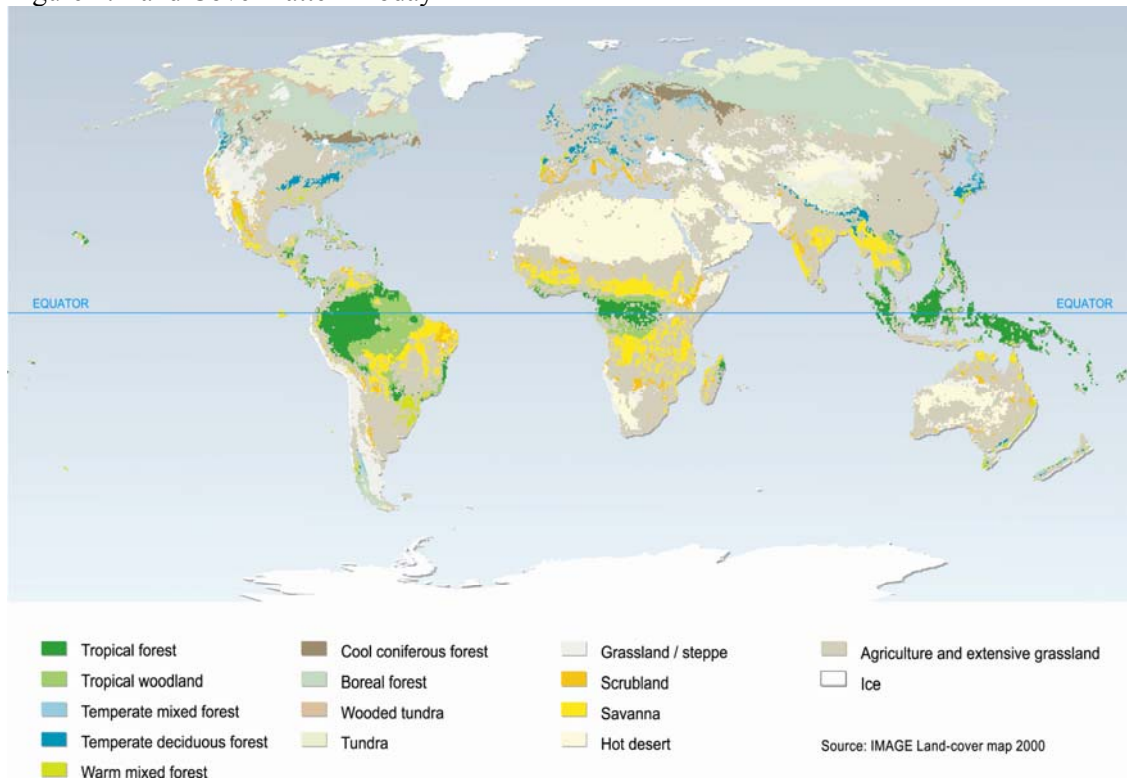


Figure 2: Land Cover Pattern Today



The picture is similar in the oceans of the world. Reported catches from oceans increased steadily over the twentieth century, reached a peak in the mid-1980s, and then began to decline. Fleets catch fish at greater and greater distances from shore and in deeper and deeper waters as coastal fisheries are depleted. As fishing expanded across the open ocean, the proportion of depleted stocks rose from 4% in 1950 to 25% in 2000, while the “undeveloped” stocks plummeted from 65% to 0%. During the period of increased catch, the overall consequences of the serial depletion of fisheries did not become obvious until all major ocean fish stocks had been exploited on an industrial scale. Fishing has a significant impact on ocean ecosystems above and beyond removing massive amounts of biomass and depleting individual species. As much as 90% of large predatory fish—sharks, tuna, marlin, and swordfish—have been removed by industrial fishing. Over-fishing these large species has changed the composition of the oceans, modified interactions among species, and resulted in the targeting of previously less desirable species that feed lower in the food web. Widespread collapses, over-fishing of top predators, and declining catches are all symptoms of seriously disrupted ocean ecosystems (Millennium Ecosystem Assessment, 2005a).

These massive transformations of land and oceans are matched by equally large transformations in the basic biological, chemical, and hydrological cycles. The amount of water impounded behind dams quadrupled between 1960 and 2000, and large reservoir construction doubled or tripled the residence time of river water—that is, the average time that a drop of water takes to reach the sea. Water withdrawals from rivers and lakes doubled in the same period, mostly for agricultural use (which constitutes

70% of total human water use worldwide). Humans use about 10% of global renewable fresh water supply, and in some regions, such as the Middle East and North Africa, humans use 120% of renewable supplies* (Millennium Ecosystem Assessment, 2005a). Similarly, humans have doubled the global nitrogen cycle and tripled the rate of phosphorus cycling (Bennett et al. 2001).

Such is the shape of the earth as the twenty-first century begins. In a very physical sense, natural and human systems have become integrated. Nature is no longer an external space of conquest in which society has a place, but an element inside the global human *oikos*.

In our image...

Human impact on the planet has been occurring for thousands of years. Societies cannot escape changing their natural environments. In fact, the changes that have been made to ecosystems since the 1950s have contributed to substantial gains in human well-being (Millennium Ecosystem Assessment 2005d). The United Nations' Human Development Index[†], to take one measure of human well-being, has steadily improved from 1970 to 2000 everywhere except Sub-Saharan Africa (United Nations Development Programme, 2005).

Yet, there is something especially challenging about human impacts at this point in time. The scale and rate of change make the second half of the twentieth century a qualitatively different period, not only in human history but in natural history, as well.

On the one hand, we are witnessing the dawn of a planetary phase civilization:

Globally connected information and communication technology penetrates to the furthest outposts, changing values and cultures, while triggering traditionalist backlash. New global governance mechanisms, such as the World Trade Organization (WTO) and international banks, begin to supersede the prerogatives of the nation-state. The stability of the global economy becomes subject to regional financial disruptions. Excluded, marginalized, and inundated with images of affluence, the global poor seek immigration and a better global bargain. A complex mix of despair and fundamentalist reaction feeds the globalization of terrorism... Ever hungry for new markets, resources, and investment opportunities, the self-expanding and colonizing industrial system [has] begun its long march toward a world system (Raskin et al., 2002).

On the other hand, this planetary phase of civilization has its correlate in natural history: the unprecedented emergence of a world in which

Humankind has begun to match and even exceed some of the great forces of nature in changing the biosphere. There is no evidence that the Earth System has previously

* The excess is obtained through the use of groundwater supplies at rates greater than their rate of recharge.

† The human development index (HDI) is a composite index that measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate and the combined gross enrolment ratio for primary, secondary and tertiary schools; and a decent standard of living, as measured by GDP per capita in purchasing power parity (PPP) US dollars.

experienced these types, scales, and rates of change. The Earth System is now in a no-analogue situation, best referred to as a new era in the geological history of Earth, the Anthropocene (Steffen et al., 2004).

The planetary dynamics of civilization increasingly govern and transform the components of the earth system. The planetary phase of civilization is the sociopolitical face of the anthropocene, and global ecosystem change is its biophysical print.

... in whose benefit?

But the emergence of a planetary civilization is not a process with globally uniform manifestations. Societies participate in it with different endowments and different histories. The concentration of economic and political power, for instance, in a handful of countries is well known. Eight countries (United States, Canada, Germany, France, United Kingdom, Italy, Russia, and Japan) account for about 66% of global GDP, 44% of global trade, 80% of permanent UN Security Council seats with veto power, 96% of active nuclear warheads, and so on.

This particular human geography is reflected in the biophysical transformation of the earth. Prevailing social, political, and economic conditions largely determine how ecosystem transformation occurs and results in a particular accumulation of benefits among and within societies. In the second half of the twentieth century, these conditions favored an international concentration of wealth and power among former colonial powers and, nationally, among urban populations, especially those sectors most integrated in and adjusted to globalization.

Take the case of changes in the atmosphere leading to climate change, the most global of examples. Those same eight countries mentioned above account for about 40% of current greenhouse gas emissions, and 62% of cumulative emissions in the period 1850-2002 (World Resources Institute, 2005b). The expected negative consequences of climate change include intensification of extreme weather events and flooding, sea level rise, and vector disease expansion. There are no quantifications, yet, of countries' capacities to adapt to these changes, but it is safe to assume that the wealthy countries—which are largely responsible for the problem—will best be able to cope with its consequences. Although the pattern of unequal distribution of benefits and costs is similar with other global ecological problems, it is most pronounced with the transformation of the atmosphere. Benefits and costs are distributed such that those who directly benefited from the use of the global atmospheric commons as a sink for the by-products of industrial development are not subject to the costs that will be paid by those who may have their development constrained by efforts to reduce greenhouse gas emissions, and who will suffer most from climate change.

The same pattern can be seen in other global ecosystem changes. Like globalization, these large-scale transformations are not uniformly spread over the biosphere. Changes in nutrient cycling, freshwater flows, land cover, and biological diversity have configured a new biophysical map that reflects the socioeconomic processes that caused them.

For example, by 1950 (see Maps 1 and 2), 70% of landscapes located in the more developed regions had been converted from their natural state into cultivated systems, as these societies grew, expanded, and gave birth to the industrial age. Relatively little

change has occurred in those biomes since, and even less is expected in the future. On the contrary, future change is expected to take place in the “developing world”. But, because the distribution of benefits and vulnerabilities that results from ecosystem change mirrors the economic and political pattern of globalization, the benefits that result from the transformation of ecosystems will tend to flow in the same direction as social, economic, and political benefits, leading in the end to a concentration of power among particular sectors and regions. Vulnerabilities, in turn, will tend to flow in the opposite direction.

In many parts of the world, the vulnerability of humans is growing more severe as they are exposed to increasing physical threats to their well-being and to their capacity as individuals and as communities to cope with those threats (United Nations Environment Programme, 2002). Vulnerability grows most where development is constrained most. The case of the dry lands of the world is especially clear. These are the areas with the lowest natural productivity, the lowest per capita income, and the highest population growth rates in the world (Millennium Ecosystem Assessment, 2005d). The combination of ecological fragility and socioeconomic circumstances contributes to a situation of particularly high vulnerability to continued environmental deterioration or an unexpected spike in environmental disturbance. These areas are not only marginalized from the benefits of globalization, but the populations that live in them have not benefited proportionally from the ecosystem change they have endured.

As with the benefits derived from ecosystem change, the distribution of vulnerabilities is uneven. Compare, for example, the ability to respond to natural disasters such as flooding (e.g., the immediate response to flooding in the Rhine region in Europe versus the limited response to flooding of the Paraná river in South America) or the ability to obtain food from ecosystems (e.g., industrial fishing by the European fleets off the coast of West Africa versus local fishing communities). The massive transformation of ecosystems has resulted in the accumulation of coping capacity in more developed regions, and the accumulation of vulnerabilities in the less developed regions where the greatest transformations occur.

This pattern suggests that the societies that became powerful over the last couple of centuries are those that most transformed the biosphere and those that captured the majority of the benefits of ecosystem transformation. A successful route that less developed societies should also travel, some might argue.

However, assume for a moment that the global political and economic structure is redesigned so that less developed nations can freely (and speedily) catch up with more developed societies; in other words, assume that there are no international institutional constraints to equitable global development. In order to seize such an opportunity for development, today’s less developed societies would still have to overcome an emerging biophysical constraint.

Unlike at the dawn of the industrial age a couple of centuries ago, dumping carbon dioxide into the atmosphere today is highly problematic. Similarly, where the human demands for goods and services from ecosystems were once tolerable, today they exceed the biological capacity of the earth to renew those services on a sustainable basis. According to some estimates, humanity has moved from using, in net terms, about half the planet’s biocapacity in 1961 to more than 1.2 times the biocapacity of the earth in 2002. That is, the human demand for food, water, biofuels, fiber, and timber

represents the supply of 1.2 planets.* Moreover, trends in the direct causes of changes in ecosystems that degrade their ability to provide goods and services—especially conversion of land to agriculture, climate change, alien species invasion, over-exploitation of natural resources and pollution—either persist or are growing in intensity almost everywhere. Driving this increase in environmental stress, gross world product is expected to grow three- to six-fold over the next 50 years, and population will grow to perhaps nine billion people (50% more than in 2000) before stabilizing in mid-century.

In this context, actions to obtain more of a given ecosystem good or service can harm other ecosystem functions. For example, increasing agricultural productivity through greater use of irrigation, pesticides, and fertilizer degrades the quality and quantity of the freshwater that flows through that same system.

Declines in biodiversity and poor ecosystem management affect ecosystem resilience, that is, ecosystems' ability to absorb and adapt to change, especially human-induced change. This increases the likelihood of changes that are abrupt and potentially irreversible. These dynamics are especially clear for societies that live in the biomes projected to lose habitat and local species most rapidly in the next fifty years. These particularly fragile biomes, along with most of the less developed countries, are largely located in the tropics.

As a corollary, those societies that failed to accumulate the benefits of ecosystem transformation over the nineteenth and twentieth centuries will find it harder to do so during the twenty-first. Today, biophysical constraints place a formidable additional challenge on the development agenda of many societies. They must now design their development strategies in a biosphere that is more interconnected and less resilient, with degraded local ecosystems and much larger human populations than in the first wave of industrialization. Further complicating development strategies, today's populations have not only basic material needs, but high consumption expectations that governments are under pressure to satisfy.

The challenge of space and time

It is increasingly the case that there is no such thing as a “natural” system as opposed to a “human” system. Science shows that today there are only “socio-ecological” systems. The need to conquer and tame a vast, unknown wilderness exists no more. And neither does the option that societies had until recently to expand their economic frontiers by incorporating such vast, undisturbed ecosystems into their territorial domains.

Despite their interconnectedness, political and natural systems operate on radically different spatial and temporal scales. Societies have collapsed in the past because of this mismatch, and contemporary examples abound.

For instance, in the absence of human intervention, the formation of a layer of soil deep enough to support agriculture in a temperate climate takes 750 presidential cycles in a typical democracy; yet land management is more determined by short term

* This difference is possible in the short-term because humanity can liquidate its ecological capital rather than living off annual yields. See www.footprintnetwork.org.

political dynamics than ecological realities, ultimately leading to desertification, “potentially the most threatening ecosystem change impacting the livelihoods of the poor” (Millennium Ecosystem Assessment, 2005e). Once it sets in, desertification will not stop at national boundaries, and areas affected are sometimes located thousands of kilometers away. Anthropogenic carbon dioxide which has been emitted for the last 200 years, causing climate change today, was recognized widely as a policy issue only 15 years ago; the consequences of climate change will be felt even in locations that did not emit greenhouse gases. The global community realized that the capacity of the North Atlantic cod fishery to sustain industrial fishing had been surpassed only after the system collapsed in 1992. European fishermen admitted that the species was commercially extinct only in 1994, at which point they turned on another over-fished species, turbot, eventually leading to armed conflict between Spain and Canada in 1995.

In the planetary phase of civilization, aka the anthropocene, the challenge of coherence in time and space between the workings of ecosystems and the workings of politics, economics, and society has become a central political matter.

The understanding and sustainable management of ecosystems is made particularly difficult by several factors. Many of the effects of ecosystem change are slow to become apparent and they may be expressed primarily at some distance from where the ecosystem was changed. In particular, the slow pace at which many impacts become apparent can result in the costs of changes being deferred to future generations (Millennium Ecosystem Assessment, 2005d).

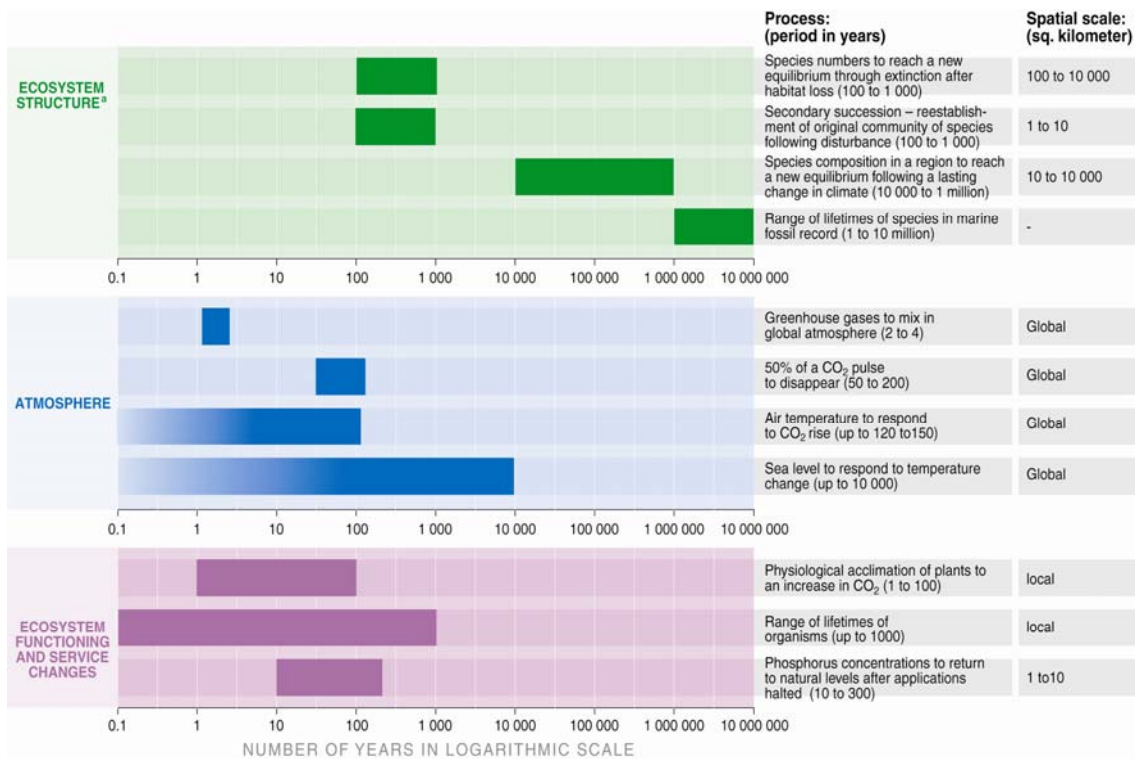
The aggregated effects of localized ecosystem change can have impacts across regional and national boundaries, and the causes of these changes are increasingly woven into the economic, social, and political fabric of globalization. The case of climate change is perhaps the most dramatic illustration: emissions anywhere in the world ultimately have consequences everywhere. But high levels of interconnection between ecosystems are also visible in the case of pollution, habitat change, invasive species, and over-exploitation. For example, the expansion of cultivated systems often involves replacing native plant and animal species with a monocrop of alien species, which can alter a region’s landscape, hydrology, ecology, and culture. This can change the quality and quantity of freshwater, rate of soil formation, level of pollution from more pesticide and fertilizer use, and local climate patterns. Monocrop cultivation can even change lifestyles and displace populations. Such transformation of ecosystems into cultivated systems leads to the decline of genetic diversity, particularly among cultivated species; increase in the eutrophication of coastal and inland water systems due to greater influx of nitrogen and phosphorus; and cultural erosion. None of these phenomena respect political boundaries.

Also, the inertia of the various factors that cause ecosystem change differs considerably, and this strongly influences the time frame for solving ecosystem-related problems once they are identified (see Figure 3) (Millennium Ecosystem Assessment, 2005d). For example, the consequences of over-exploitation of particular species can become apparent and be addressed within short time frames. In other cases, such as excessive phosphorus accumulation in agricultural soils, it may take years or decades before the full impact becomes apparent through erosion and other processes. Significant inertia exists in the process of species extinctions that result from habitat

loss. Even if habitat loss were to end today, it would take hundreds of years for species numbers to reach a new—albeit, less diverse—equilibrium due to the habitat changes that have taken place in the last centuries (Millennium Ecosystem Assessment, 2005b).

Figure 3: Characteristic Time and Space Scales Related to Ecosystems and Their Services

The time scale of change refers to the time required for the effects of a perturbation of a process to be expressed. Time scales relevant to ecosystems and their services are shown in the figure below. Inertia refers to the delay or slowness in the response of a system to factors altering their rate of change, including continuation of change in the system after the cause of that change has been removed. Resilience refers to the amount of disturbance or stress that a system can absorb and still remain capable of returning to its pre-disturbance state.



^a The ecosystem structure category includes also the “range size of vertebrate species” for which the time scale is not available. The spatial scale goes from 0.1 to 100 million square kilometers.

Sources: IPCC, Millennium Ecosystem Assessment

Source: Millennium Ecosystem Assessment

Harmonizing human response timeframes with those of ecological change requires, first, recognition of the complexity of biophysical time and space dimensions. Second, it requires institutional ingenuity across scales, from improved local management to redesigned political organizations. In order to design effective responses to ecosystem change, time scale differences, system inertia, resilience, and non-linear changes need to be politically recognized.

The twenty-first century began with the category *nation-state* still firmly established as the fundamental political unit. This concept is called into question by the future

relations between societies and ecosystems in a *Great Transition*—from the territorial demarcation, which is seldom consistent with the bioregions that sustain them, to the very notion of sovereignty. From an ecosystem perspective, the nation-state appears to be increasingly problematic.

Conclusion

The human transformation of the biosphere is occurring at an unprecedented rate and extent in the planetary phase of history. With the radical transformation of ecosystems, the resilience of socio-ecological systems is at risk. Trade-offs among ecosystem functions and synergies that reinforce individual impacts are becoming commonplace. The effective administration of territories is increasingly determined by social, economic, political, and ecological interconnections that transcend territorial boundaries. Global ecosystem change has effectively added a biophysical constraint to the political and economic conditions of development. The alteration of the material conditions for continued human development poses sharp questions about the viability of the traditional nation-state, raises the need for novel governance arrangements aligned with the cross-scale character of ecological challenges, and calls for a re-assessment of the basic paradigm of global development in the twenty-first century.

The Shape of the Earth at the End of the 21st Century

By 2084, it had long been recognized that nature could not be understood outside society. Aside from fundamental or catastrophic natural occurrences, such as solar radiation or volcanic eruptions, human factors were acknowledged as the dominant drivers of ecosystem change. Climate change, which by 2084 was a phenomenon driven by its own momentum and internal dynamics, was the legacy of past human agency rather than contemporary anthropogenic alterations of the atmosphere. But the actions and choices of human actors were well-understood as the ultimate driver of changes in land cover, the numbers and distribution of species, the nitrogen and phosphorus cycles, the emergence of new diseases, local weather patterns, and many other features of the earth system. During the twenty-first century, the biophysical map of the world became a reflection of the social, economic, and political map—the human map.

But by 2084 the human map had also changed. Hundreds of regions, diverse in character and size, had gradually coalesced. Some of these new regions corresponded to the national boundaries of a century ago, others were federations of earlier states, and others were parts of former states. They forged regional identities and institutions around the boundaries of river basins and other ecosystems (so-called “bio-regions”), urban centers, and in relation to history and shared cultural traditions (see the following box).

Ecosystems were still highly fragmented. But landscapes that during the twentieth century had been largely devoted to the extraction of food, timber, and fresh water had been re-converted and were now managed to sustain other ecosystem functions, such as the regulation of local climate and hydrology, pest and disease control, pollination, protection against extreme weather events, wildlife refuge, recreation, and spiritual connection.

The world was still dealing with the heritage of climate change, biodiversity loss, hydrological fragmentation, and nutrient overloading. Many problems initiated in the heady days of the twentieth and early twenty-first century were irreversible. For example, decades of high fertilizer use in agriculture led to nutrient accumulations in the ocean that did not vanish. This left aquatic systems extremely vulnerable to eutrophication, despite today’s decreased use of fertilizers.

But these problems had been identified, along with the necessary policy responses to address them. Ecosystem alterations of the previous 150 years had resulted in a number of episodes where critical thresholds of destabilization were crossed—the collapse of fisheries in the Pacific, the runaway eutrophication of major estuaries, the outbreak of a series of diseases that quickly spread around the world, desertification in North Africa and West and Central Asia—that eventually put ecosystem management high on the political agenda. By 2084 it was generally understood that if socio-ecological systems were to provide a stable flow of benefits to humankind, a major policy goal had to be the preservation of the capacity of ecosystems to absorb and adapt to change without losing their function or the services they provide.

Regions in a Great Transition World*

The fabric of planetary society is woven with hundreds of regions that are astonishingly diverse in character and size. Some correspond to the national boundaries of a century ago and others are federations of earlier states. Still others are parts of former states, forging a common identity around the boundaries of river basins and other ecosystems (so-called “bio-regions”), around urban centers, and around cultural traditions. Nevertheless, most regions can be clustered crudely into one of three major types, called *Agoria*, *Ecodemia*, and *Arcadia*, although few regions are pure cases.

Agoria

These regions would be most recognizable to a visitor from the year 2000. Some critics call *Agoria* “Sweden Supreme”, with its more conventional consumer patterns, lifestyles, and institutions. Its economy remains dominated by large shareholder corporations. However, when compared to even the most outstanding examples of social democratic models of the last century, the commitment to social equality, the environment, and democratic engagement from the level of the firm to the globe is of a different order. The key is a vast array of policies and regulations, supported by popular values, that align corporate behavior with social goals, stimulate sustainable technology, and moderate material consumption in order to maintain highly equitable, responsible, and environmental societies.

Ecodemia

The distinguishing feature of *Ecodemia* is its fundamental departure from the capitalist economic system. The new system, often referred to as “economic democracy”, banishes the capitalist from two key arenas of economic life. First, the model of the firm as comprised of private owners and hired workers has been replaced by worker ownership in large-scale enterprises, complemented by non-profits and highly regulated small businesses. Second, private capitalist markets have given way to socialized investment processes. Worker ownership and workplace democracy have reduced the expansionary tendency of the traditional capitalist firm since the focus is on profit per worker (rather than absolute profit) and the popular goal of “time affluence” shortens work weeks. Publicly controlled regional and community investment banks, supported by participatory regulatory processes, re-cycle social savings and tax-generated capital funds. Their mandate is to ensure that successful applications from capital-seeking entrepreneurs satisfy social and environmental criteria, as well as traditional financial criteria.

Arcadia

Relative to other regions, the bias in *Arcadia* is toward self-reliant economies, small enterprises, face-to-face democracy (at least in cyberspace), community engagement, and love of nature. Lifestyles tend to emphasize material sufficiency, folk crafts, and reverence for tradition. While the local is emphasized, most people are highly connected with cosmopolitan culture and world affairs through advanced communication technology and transportation systems. *Arcadia* has centers of innovation in some technologies (organic agriculture, modular solar devices, human-scale transport devices, etc.) and arts (new music, craft products, etc.). Exports of these products and services, along with eco-tourism, supports the modest trade requirements of these relatively time-rich and slow-moving societies.

This discussion of differences should be balanced by a reminder that the regions also have much in common. Relative to the nations of a century ago, contemporary regions enjoy a high degree of political participation, healthy environments, universal education and healthcare, high social cohesion, no absolute poverty, and more fulfilling lives. Finally, people the world over share the historically novel attribute of citizenship in a world community.

* Summarized from Raskin (2006).

Thus resilience became a central policy and management goal. The historical focus of policies and management practices on the productivity of ecosystems—their ability to provide food, fuel, timber, and fiber—shifted towards a focus on the ability of ecosystems to sustain human demands while retaining the ability to perform a broader range of functions needed to ensure the survival of all the species in the natural environment, humans among them.

The case of river basins is especially illustrative. The role of healthy, non-disturbed ecosystems in river basins—especially in hydrologic regulation, soil fertility, flood and

landslide control, water and air quality regulation, and recreation—was recognized faster than for other ecosystems. The twenty-first century saw an increase of extreme weather events, several new disease outbreaks, and marked increases in the price of water due to higher purification costs. All of these affected quality of life and were clearly linked to human disturbance and poor management of river basins. But these crises led to improved policies and management. For instance, the multiple functions of freshwater ecosystems were explicitly recognized in public policy making. This provided a framework for the emergence of agreements between cities and rural communities that encouraged the development of systems to manage ecosystems for multiple services.

This concern with socio-ecological functionality was framed not only as a matter of “security”, but also of economic development. Especially in what used to be called the “developing” world, regional governments realized that the combined effects of global ecosystem change and global economic integration had placed severe constraints on their capacity to strengthen their economies. Increases in crop yield now had to be balanced against the quality of fresh water and the risks associated with genetically modified organisms; increases in freshwater aquaculture output, against dwindling marine fisheries; urban expansion, against air and water quality; and new technologies, against the costs of intellectual property rights. Tradeoffs between ecosystem services were the norm.

By 2084 it was deeply understood that the expectations of populations for material wealth needed to be tempered by the need to sustainably exploit natural resources. By 2050, governments had realized that in the previous centuries not only had political and economic opportunities been lost, but so had the opportunity for ecological preservation. This political awareness was accompanied by a growing concern with preserving the ability of socio-ecological systems to absorb change, avoid thresholds, and sustain development—socio-ecological resilience.

It took strong local empowerment to transform the balance of power that had driven changes in the past and to establish new relations. This global citizens movement was largely empowered by global interconnection among Arcadian communities, accompanied by strong movements in Agorian and Ecodemian societies to regulate markets in favor of sustainability. A creative tension developed between societies that were more globalized and those that reaffirmed local culture, all of them generally more able and better prepared to make long term policy and management decisions. With increasing awareness and empowerment in rural areas and among certain sectors of civil society in the more urbanized societies, large scale drivers of ecosystem change started to meet strong resistance. Eventually policies and institutions emerged that, on balance, transformed the extractive impulse that came from highly globalized growth-oriented societies into opportunities for environmental sustainability.

The combination of the political pluralism characteristic of the late twenty-first century and the emergence of resilience as an organizing concept of environmental policy resulted in a biophysical map that showed dynamic borders between ecosystems, with areas continually shifting from natural to cultivated to mixed states over periods of time more consistent with natural cycles.

Resilience: Ecosystem condition and trends in the Great Transition

By 2084, geography had become vastly more complex than it was in the early twentieth century. The climate had changed in many places, humans had altered ecosystems, and different types of systems coexisted in areas that used to be dominated by one single biome. The notion of *socio-ecological system* gained significance in public discourse and was eventually preferred over *natural resources* to describe the relations between human societies and the ecosystems that provide for their well-being. The necessity and efficiency of the *ecological* component in the functioning of the system was clearly established, and this implied ensuring the biophysical conditions that sustained societal development.

The importance of managing for multiple ecosystem functions or services was well established. Farmers were no longer trying to maximize agricultural output, but focusing instead on diverse ecological farming that provided a mix of services. A single farmer was able to improve biodiversity by providing some habitat for animals, provide recreational sites, improve water quality through advanced farm management techniques, and produce food all at the same time. Forests were no longer clear-cut, but managed for habitat, nutrient cycling, carbon storage, recreation, air purification, and wood products. This stemmed the loss of species but could not reverse the momentum completely—in 2084 biodiversity was 15% lower than at the turn of the century with significant implications for resilience in many places.

Coherent policies were put in place around the world to encourage such management for multiple ecosystem services, which became the universal paradigm for resource use. A key strategy lay in giving economic recognition to ecosystem services wherever possible, so that a number of broadly accepted pricing schemes reflecting their value emerged. Where market mechanisms were not feasible and voluntary ecological commitments were not sufficient, strong regulatory frameworks were adopted, especially in Ecodemia, but also in Agoria and, to a lesser extent, Arcadia. “Adaptive management” gradually became a mainstream approach to productive activities. In this approach, management activities were seen as experiments, with data collected pre- and post-management to determine the efficacy of each management intervention. If necessary, appropriate mid-course corrections were adopted. Managers learned to focus on variables that change slowly in addition to those which change quickly. It was understood that slowly changing variables underlie the resilience of ecosystems.

The understanding in society and among decision makers of ecosystem functioning, structure, conditions, and trends was largely framed in terms of how human beings interacted with them. To describe these complex interactions conceptually and technically, an economic discourse developed with a large influence on environmental policy. This discourse framed the relations between people and ecosystems in terms of services, focusing on the role of ecosystems as the sources of benefits for human well-being. These services were categorized according to their more or less direct relation with human development, and trends in their “production” were monitored globally and sub-globally. Table one (below) shows a summary of the condition and trends of ecosystems in 2050.

Table 1 – Ecosystem Services and Human Well-Being in 2050, compared with a 2000 baseline (Adapted from Millennium Ecosystem Assessment, 2005b, Table S3)

	Agoria		Arcadia		Ecodemia	
	Industrial ^a	Developing ^a	Industrial ^a	Developing ^a	Industrial ^a	Developing ^a
ECOSYSTEM SERVICES						
<i>Provisioning Services</i>						
Sufficient access to food	↑	↑	↔	↓	↑	↑
Fuel	↑	↑	↑	↑	↑	↑
Genetic resources	↔	↔	↑	↑	↔	↑
Biochemicals/Pharmaceuticals discoveries	↓	↑	↔	↔	↑	↑
Ornamental resources	↔	↔	↑	↑	↔	↔
Freshwater	↑	↑	↑	↓	↑	↔
<i>Regulating Services</i>						
Air quality regulation	↔	↔	↔	↔	↑	↑
Climate regulation	↔	↔	↔	↔	↑	↑
Water regulation	↔	↓	↑	↑	↔	↑
Erosion control	↔	↓	↑	↑	↔	↑
Water purification	↔	↓	↑	↑	↔	↑
Disease control: Human	↔	↑	↔	↑	↑	↑
Disease control: Pests	↔	↓	↑	↑	↔	↔
Pollination	↓	↓	↔	↔	↓	↓
Storm protection	↔	↓	↑	↑	↑	↔
<i>Cultural Services</i>						
Spiritual/religious values	↔	↔	↑	↑	↓	↓
Aesthetic values	↔	↔	↑	↑	↔	↔
Recreation and ecotourism	↓	↑	↓	↓	↑	↑
Cultural diversity	↓	↓	↑	↑	↓	↓
Knowledge systems (diversity and memory)	↔	↓	↑	↑	↔	↔
HUMAN WELL-BEING						
Material well-being	↑	↑	↔	↑	↑	↑
Health	↑	↑	↑	↑	↑	↑
Security	↑	↑	↑	↑	↑	↑
Social Relations	↔	↑	↑	↑	↓	↓
Freedom and Choice	↔	↑	↑	↑	↑	↑

Key: ↑ = increase in ecosystems' ability to provide the service, ↔ = ability of ecosystem to provide the service remains the same as in 2000, ↓ = decrease in ecosystems' ability to provide the service

Pluralism: The human/nature interface in the Great Transition

The Agorian, Ecodemian, and Arcadian societies that existed in 2084 had different emphases and different approaches to achieving more equitable and sustainable societies. But they also had very strong synergies and a common awareness that they were part of a single global civilization. This diversity made for the creative tensions

that enabled the coexistence of natural resilience and political pluralism. Pluralism was, ultimately, the universal adaptive response to global ecosystem change.

It would not be possible to list the many institutions, policies, and instruments that emerged and evolved over the decades to form the organized socio-ecological systems of 2084, but two general features were particularly important to explain their effectiveness. First, the coherence between sectoral policies grew consistently stronger, reducing the ambiguity of incentives and the contradictions between policy goals. This encouraged and facilitated long-term planning. Second, key policies recognized and supported the established need to increase the resilience of socio-ecological systems and the continuing flow of benefits to societies. These policies provided strong incentives for mitigating chronic stress through the development of ecosystem management practices that maintained: a diversity of approaches and instruments; functional groupings of human, plant, and animal communities; and biodiversity.

Among the institutions that emerged, three were especially important:

- Following a general trend in the reform of international institutions, international environmental rules became more people centered and changed their focus from growing bureaucratization to the consolidation of regimes of rights and access to international redress. This process of international reorganization was highly synergistic with struggles to empower citizens and communities, largely at the expense of the traditional power of the nation-state, and also led to increasing levels of integration among international regimes (environmental, financial, trade, developmental, and human rights). In the case of ecosystem management, Arcadian societies and sectors of civil society in Agorian and Ecodemian societies were especially active in this process of reform. These forces were the drivers of cross-regional policy integration and coordination of shared ecosystems. This experience enhanced the power of globally connected forces for ecological resilience and gave them a larger role in global decision making. For instance, in many river basins Arcadian communities managed to establish dual access regimes to fresh water: internally (that is, within and between Arcadian communities) based on needs and regulations; and externally (that is, when dealing with Agorian and Ecodemian communities) based on pricing schemes structured around basin ecosystem services.
- Stimulated by increasingly frequent and costly extreme events that resulted from poor ecosystem management, the finance and economics administrations of regional governments took the lead in integrating ecosystems into sectoral planning. The first significant step was the reformulation of regional accounts to reflect ecosystem services and their degradation or enhancement. The measure of development was no longer just the size of the economy (GDP), but the real sustainable wealth of society. The popular political energy for such change was driven by the increasing awareness of citizens that their daily lives were affected by ecosystem services and trade-offs. The media eventually played an important role in ecological reporting and educational curricula increasingly

emphasized ecological consciousness, which provided a strong incentive for governments to act on. These reformulated national accounts had a significant impact on the behavior of major economic agents and were highly synergistic with the evolution of a new generation of economic incentives and market regulations.

- The higher levels of education and material well-being, together with the emergence of new political identities, led to the improvement of institutional quality, especially in terms of transparency and participation. Information was harder to hide or manipulate, and corruption seemed to be retreating from many areas of public and private management. This facilitated the development of ecosystem management techniques that were both technically and politically feasible.

Economic policy differed greatly among Agorian, Ecodemian, and Arcadian communities, but their impacts on ecosystems were broadly consistent with the current understanding of socio-ecological systems and their resilience. For instance:*

- Agorian communities shifted most taxes from labor to pollution creation and natural resource consumption. They also established cap-and-trade schemes, such as for greenhouse gas emissions. Moderately high taxes on pollution and natural resources made recycling of most materials highly cost-effective.
- The development of conservation and environmentally friendly production processes was facilitated by a greater democratization of capital ownership through policies that ranged from widespread worker ownership (in Ecodemian communities) to more participatory regulatory bodies and a more horizontal distribution of entrepreneurship through rules that favored smaller scale business.
- Many business organizations tended to operate more on a regional level than on a national or global level, which facilitated production better adjusted to socio-ecological systems. And sustainable development plans were required, especially in Ecodemian communities, which relied more heavily on active state intervention.
- The new generation of market regulations and the strengthening of “fair trade” rules for international trade allowed societies to have more control over the consequences of changes in international prices. For instance, whereas in the past, changes in the price of a crop translated almost directly into the extension of the agricultural frontier and higher fertilizer input, these signals in 2084 often resulted in technological improvements and the strengthening of sustainable agriculture practices.

* Most bullets below were adapted from Rosen (2006).

Especially important was the development of technologies* that increased crop yields with very low harmful impacts related to water, nutrient, and pesticide use. These technologies allowed farmers to avoid further expansion of the agricultural frontier while they managed ecosystems for multiple uses (Millennium Ecosystem Assessment, 2005d). Also, ecological restoration techniques became more available and were widely implemented, as were technologies to increase energy efficiency and recycle materials.

None of these processes was free of conflict. Along the way many traumatic events occurred, the consequences of which were still visible in the turbulences of the late twenty-first century. Migration was still an issue, and in many communities, especially among Arcadian societies, a certain degree of xenophobia was still visible, often justified on ecosystem management grounds. A very strong generational rupture as hadn't been seen since the mid twentieth century took place around 2030, which had a very strong impact on land property patterns, and hence made transition to sustainable ecosystem management more challenging. And criminal activity was ever more sophisticated, with natural resources very much at the center of it. But the overall balance, compared to the twentieth century, was positive.

These institutions and policies were sustained by the strength and prevalence of certain values, which varied from community to community, but were generally consistent with a more ecocentric ethos. Even when the non-human environment was still largely seen at the service of human beings, the status of other life on earth was strongly recognized and respected.

How Do We Get There?

The socio-ecological challenge we face cannot be understated; and while the emergence of a *Great Transition* in response to the current state of affairs is a clear possibility, the challenge is immense. A *Great Transition* requires no less than incorporating the cadence of biosphere processes into policy making, a reconsideration of what economic growth means, and a new political geography that de-emphasizes the nation-state. Society will have to muster energies, inspiration, and ideas from many sources to meet this challenge.

Much of this energy will come from a stronger identification of people with their biophysical surroundings—their landscapes, ecosystems, and wildlife—whether immediate or remote, real or imaginary. There is a growing awareness that overall, nature no longer threatens our physical existence, except through our own actions. It is increasingly clear to larger numbers of people that our well-being depends on the way we treat our natural home. But a *Great Transition* requires that societies go a crucial step beyond these practical considerations and recognize that each one of us belongs, with other species, in a single biosphere. It is on this shared, non-utilitarian basis that policies and actions can be based—thereby limiting the inevitable tensions and struggles of a paradigm shift.

The trajectory from here to a future of sustainability will need the development of a set of institutions, policies, and behaviors very diverse, yet converging. The emergence

* Adapted from MA Synthesis, Ch. 8.

of environmental awareness, or ‘global ethos’ (Boff, 2003), stands as one of the most powerful drivers of this convergence of diversity.

A generous identity

In the global phase of civilization, societies are not only closer to each other through language, technologies, and values, but biophysically as well, as was shown in the first part of this essay. Under such conditions of proximity, it is hard to imagine a *Great Transition* without an interpretation of the world, ourselves, and our destiny that is sufficiently widespread and based on set of shared beliefs—that is, a shared identity.

Identities are, in fact, realigning globally, which does not mean they are becoming universal. Only a handful of these have a viable claim to universality, and these tend to be based on very fundamental aspects of human existence, such as equal human dignity, peace on earth, or religious beliefs.

The identity based on environmental or ecological awareness is one of these, perhaps the soundest. Ecological awareness has grown steadily stronger over the last 50 years, in parallel with the period of fastest transformations of the biosphere. At the heart of this emerging identity is the notion that life must be cherished and that human beings share life with many, many other species. This new identity as a species is the only global identity put forward on behalf of all human beings, regardless of their specific social, historical, religious or gender attachments. Moreover, this ecological awareness can be easily integrated with multifaceted, historical traditions, languages, and cultural symbols (Castells, 1997).

In effect, ecological awareness as a basis for value, policy, and behavioral change is spreading across cultures, socioeconomic strata, areas of activity, and political boundaries. More and more people find in it a clear anchor in the turbulence of globalization. Unlike many other sources of identity, notoriously those based on ethnicity, the socio-ecological is a generous identity. It does not define us by what we are not, but by what complements us. It invites not discrimination, but integration. It does not demand submission, but coexistence in diversity.

The push of reality

Writer Jorge Luis Borges once said of his native Buenos Aires that “the city is now like a map / of my humiliations and failures...it is not love that bonds us, but fear”. Like Borges’s Buenos Aires, it is the earth that today reflects back our humiliations and failures. The signs of abuse are everywhere—dead rivers, collapsed fisheries, desertification, climate change, species extinctions—and the consequences on human well-being increasingly clear. The pull of identification with ecological awareness, as a driver of change in perception, policies, and behaviors, would be only a long-term proposition if it wasn’t reinforced by its short term utility. Because societies have not yet sufficiently internalized them as important issues, climate change and ecosystem alternations are very likely to result in human suffering. The *Great Transition* may well be accelerated by “natural” and “human-made” disasters. Like the writer and his city, societies may well be forced to hold tightly to the biosphere not out of conviction, but sheer necessity.

In the face of large environmental problems, societies will (and already do) turn to environmentalism for plausible and useful interpretations of reality. The discourse that comes from environmentalism is very much science-based. Not always the best science, but never in explicit opposition to it. Ecologists use science to challenge science on behalf of life. The advocated principle is not the negation of knowledge, but superior knowledge—the wisdom of a holistic vision (Castells, 1997). Hence, policy responses put forth from this perspective carry a significant load of credibility.

Moreover, because diversity is valued, difference tends to be respected in environmental institutions. And because difference is appreciated, dialogue becomes a central feature of established environmental institutions. Communities that subscribe to this global ethos are very well positioned to deal with diversity and resolve the tensions of difference in coherent positive ways.

These rather practical features are likely to favor the dissemination, within diverse societies, of the new policies and behaviors that result from ecological awareness, environmentalism, or socio-environmental identity.

The nerve to say the king is naked

In late 2005, an environmental NGO with strong international support presented a management plan for one of the largest wetlands in the world, *Esteros del Iberá*, in northeastern Argentina. The wetland is in need of a plan. Transformation into cropland as well as pollution coming chiefly from fertilizer use, are the two strongest drivers of wetland loss in the world, which, incidentally, is happening fast, and *Iberá* is no exception (Millennium Ecosystem Assessment, 2005f).

According to a local newspaper, “the reaction [of the community to the plan presented by the NGO] couldn’t have been more adverse. The plan, funded by international organizations, proposed limiting production and halting intensive agriculture in the wetland, outraging conservatives and the vernacular left alike. Everyone opined against it”.

To make things even more complex, *Iberá* lies above the third largest aquifer in the world (the *Guaraní* aquifer). And it so happens that a US citizen, a millionaire turned philanthropist, had bought about 300,000 hectares of that wetland, purportedly to turn them into a protected area. It wasn’t long before local and national groups began to express concerns about the “foreign ownership of strategic natural resources”, that is, the freshwater in the aquifer. A couple of months after the management plan was presented and rejected, an Argentine government official showed up in the area to demand that the foreign millionaire/philanthropist’s property be expropriated.

These reactions may well have resulted in part from failure to consider the interests of the different communities that use the wetland when developing the plan, or from poor communication between the foreign owner and the national government. But something deeper was at play. The NGO and its plan, together with the circumstantial ownership of a large tract of land by an citizen of the United States, proved too much of a threat for two of the sacred cows of the 20th century: national sovereignty and economic growth. By questioning both institutions, the NGO managed to alienate the whole traditional social and political spectrum and create a bizarre alliance of conservative landowners and social activists.

That effect, paradoxically, is environmentalism's strength. It reveals how deeply it transcends traditional categories of social, political and economic interpretation. And it shows that the socio-ecological identity is in effect a source of new paradigms and policy options for development.

It takes and will take a lot of courage to say that economic growth has now become an idol, and that the nation-state is not only obsolete, but outright harmful. It is especially difficult to say so in the South. It is one thing to find virtue in the end of the nation-state from the standpoint of the powerful, i.e., those who can afford to do away with the protection that "sovereignty" provides—and another to subscribe to this thesis from the periphery of the international system. In the midst of globalization, the nation-state and national sovereignty still have a very large tactical value as instruments against dispossession. In addition, calls to universalism based on such ecological awareness have long been suspect in the South, with good reason, of being functional to neocolonial and neo-nationalist policies of Northern societies (Riechmann, 1994).

But, be it as it may, socio-ecological awareness is in dialectical opposition to the nation-state. The identity based on the mother- and father-land is permeable to social, historical, gender, or religious preferences. It can coexist or synergize with multifaceted, historical traditions, languages, and cultures. But it cannot coexist peacefully with state-nationalism (Castells, 1997).

Socio-ecological identity, values, policies, and actions are at odds with the territorial basis of sovereignty that the nation-state claims, because they redefine the rationale of those boundaries. The institutions derived from socio-ecological identity acknowledge that territories are interdependent, favor global cooperation, and value diversity. These institutions also erode the notion that the biophysical world is a resource for appropriation and distribution through a national government and proposes identifications that transcend current administrative boundaries. They threaten the bases of peoples' allegiance to the sovereign.

Moreover, ecosystem change as a fact of reality puts the territorial basis of sovereignty in question, especially in the "developing" world. Sovereignty is being biophysically eroded to the point that nation-states will have to abandon the hope that natural resource exploitation will be the main driver of their societies' development. To meet the challenge of ecosystem change, nation-states will have to adapt and change, or be replaced by other forms of social organization.

Not unlike the mythical Cassandra, who could prophesize but was never believed, environmentalists are often discounted and parodied as doomsayers. Yet, rather than discouragement, such rejection leads to further study, stronger arguments and better communication skills. Like all strong and successful social movements, the values that organize them stand the test of rejection over time. Ecological awareness as a source of identity derives its strength from the irreducible fact that we are part of nature and depend on a functioning biosphere to survive. And, more than anything, from the conviction that it is life itself that is at stake.

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