Ecological Collapses of Pre-industrial Societies

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Historians often justify the study of history on the grounds that it gives us the opportunity to learn from human errors in the past. Until recently, though, it seemed that we had nothing to learn from the past about how to avoid the environmental predicament in which human societies find themselves today. The greatest risk to humanity in coming decades is the risk that we may continue to damage our environment to a degree incompatible with our current standard of living, or even incompatible with our existence. That risk has seemed a unique one in human history, a consequence of our uniquely high modern numbers coupled with our uniquely potent destructive modern technology. There has been a widespread belief that pre-industrial peoples, unlike us moderns, respected Nature and lived in harmony with their environment and were wise stewards of natural resources.

But, in fact, many pre-industrial societies did collapse. Let us define "collapse of a society" as a local drastic decrease in human population numbers and/or in political, economic, or social complexity. Collapse can even proceed to the point that the human population completely disappears over a large area. By those definitions, the long list of victims of pre-industrial collapses includes the Anasazi of the U.S. Southwest, Angkor Wat, Cahokia outside St. Louis, Classic Lowland Maya, Easter Island and some other Polynesian societies, Fertile Crescent societies, Great Zimbabwe, the Greenland Norse, Harappan Indus Valley civilization, Mycenean Greece, and the Western Roman Empire. These vanished civilizations have fascinated us for a long time, as romantic mysteries.

Recent overwhelming evidence from archaeology and other disciplines is now demonstrating that some of those romantically mysterious

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collapses actually were self-inflicted ecological disasters, similar to the ecological suicide that we risk committing today. Those pre-industrial suicides unfolded despite the fact that past societies had much smaller populations and much less potent destructive technology than we possess today. We really can learn from the past. But this proves to be a very complicated problem. This is not a problem for anyone who likes simple answers or one-factor explanations, just as life itself is not an enterprise for anyone who likes simple answers or one-factor explanations.

What are some of the complications? First of all, it is certainly not the case that all pre-industrial societies were doomed to collapse. There are many parts of the world, like Japan and Java and Tonga and Tikopia, where human societies have existed continuously for thousands of years without any signs of collapse. Is this just because some environments are ecologically robust and other environments are ecologically fragile, and is it that the societies that collapsed were the ones in the fragile environments?

Second, environments may deteriorate not only as a result of human impacts, but also as a result of external climate changes, such as drought or cooling or an El Ninõ event. It is hard enough to distinguish internally from externally caused environmental change when it happens under our eyes today. How do we distinguish them in the past? Isn't it likely that societies that damaged their environments were most likely to collapse at a time of some added external stress like a drought, causing the two types of explanations to be inextricably linked?

Third, most human societies are connected to and dependent on other human societies through trade. Isn't it possible that societies in robust environments might be dragged down by collapses of neighboring societies in fragile environments?

Fourth, this same fact that most societies don't exist in a vacuum causes an obvious further problem. When a society that has neighbors disintegrates for any reason, the usual result is conquest or absorption by an intact neighboring society with which the failing society has been chronically at war for a long time anyway. Hence it is regularly difficult to decide whether the basic cause of collapse was "purely" military reasons or whether the conquest was just the coup-de-grace to a society already fatally weakened for fundamentally ecological reasons. For example, remember the long-standing debate over the fall of the Western Roman Empire: were those barbarian invasions the real cause, or was it instead the case that Rome's internal problems, such as environmental problems, merely allowed the barbarians chronically at Rome's borders to prevail at last?

Finally, people are not just helpless, ignorant victims of events. There is no doubt that many or most traditional societies were far more knowledgeable about their natural environments than most of us moderns are, if only because they were living much closer to their natural environments than we do today. People look around, they notice things, they are capable of very complex reasoning and planning, and they are motivated to act in their own self-interests. Why didn't people see obvious environmental disaster looming, and why didn't they take precautions to avert disaster? Sometimes they did take precautions that succeeded, like replanting of forests, or terracing to prevent erosion, or agricultural intensification. Why did they sometimes fail? Is it more likely that societies in some environments than in other environments will succeed in developing responses capable of mastering environmental problems?

I shall not attempt to review the fate of every pre-industrial society that ever did or did not collapse and to apportion the causes of collapse in every case. Instead, I shall discuss just two sets of cases, which nevertheless illustrate many or most of the problems involved in pre-industrial collapses. The first set consists of collapses and non-collapses of Polynesian and other societies on islands in the Pacific Ocean between about 1600 B.C. and A.D. 1800. The second set is much closer to home for Americans and consists of the collapses of most Native American farming societies in the U.S. Southwest between about A.D. 1100 and 1500.

The clearest examples of collapses of isolated societies involve remote Polynesian islands. Polynesia was settled by canoe voyagers, originating ultimately from the islands of the Bismarck Archipelago north of New Guinea, between about 1600 B.C. and A.D. 1000 (Bellwood 1987; Kirch 1997a; Kirch 2000; Spriggs 1997). Many Polynesian islands lie hundreds or even thousands of miles from the nearest other land. Hence many Polynesian societies, once they were founded by canoe voyagers, eventually lost contact with their ancestral source population and became totally cut off from other peoples for a thousand years or more, so we can be certain that the fates of those societies were not due to military conquest by neighbors, and we can thereby exclude one set of potential causes of collapses.

Among such isolated Polynesian societies, different ones experienced very different fates. Some, such as the Tongan Archipelago, are socially stratified kingdoms that have persisted uninterruptedly for about 3,600 years from their founding until the present, without any signs of a marked decline in population or in societal complexity (Kirch 1984). Others, such as the societies of Easter Island and New Zealand's South Island, did decline drastically in human numbers and complexity but continued to exist. A dozen other Polynesian societies, including those of Henderson Island and Necker Island and pre-*Bounty*-mutineer Pitcairn Island, collapsed so completely that no human remained alive.

The most spectacular collapse is also the one best documented archaeologically (Bahn and Flenley 1992; Flenley 1979; Flenley and King 1984; Steadman et al. 1994). Easter Island, the most remote habitable scrap of land in the world, lies in the Pacific Ocean about 2,000 miles west of South America and almost an equal distance east of the nearest inhabited Polynesian island. Easter is famous for its hundreds of giant stone statues, weighing up to 80 tons, that were carved, dragged miles overland, and erected on platforms by a people with stone tools but no metal tools, and without sources of power except for their own muscles. When Europeans "discovered" Easter in A.D. 1722, the carving of statues had already ceased, and the statues were being pulled down by the islanders themselves. But the ultimate cause of that collapse, which inspired an expedition by Thor Heyerdahl, invocations of extraterrestrial astronauts by Erich Von Däniken, and much wild speculation by others, was for a long time in doubt.

The ecological origins of Easter's collapse became clear only within the last twenty years, when palynological evidence for Easter's former vegetation began to be uncovered. That evidence has now been fleshed out by archaeological and paleontological excavations, which are still ongoing. The following picture of Easter's history has emerged.

Today, Easter Island is barren, eroded, devoid of native trees, devoid of native land birds, and with just a few species of breeding seabirds confined to offshore rock stacks. But when discovered by Polynesians around A.D. 300, Easter was covered with tropical forest, including the world's largest palm tree (Dransfield et al. 1984). In that forest lived at least six species of land birds, including herons, rails, parrots, and owls. The breeding seabirds, which included albatrosses, boobies, frigate birds, petrels, shearwaters, storm petrels, terns, and tropic birds, numbered about thirty species, more than are known from any other single

Polynesian island. The first Polynesian settlers began to clear the forest for agriculture. They used the trees for firewood and to build canoes with which they went to sea to catch porpoises and deep-water fish. They ate the native land birds, the seabirds, and the fruits of the palm tree. They also used the trunks of the palm trees as rollers and levers to transport and erect their giant statues.

In this initially rich environment, Easter's human population exploded to about 10,000 people, living at a population density of about 160 people per square mile. Eventually, the forest was cleared so completely that all of the tree species, all of the land bird species, and most of the seabird species became extinct. Without logs as rollers and levers, it became impossible to transport and erect statues. Without tree cover, the topsoil eroded, agricultural yields fell, and fuel sources other than weeds and crop wastes disappeared. Without canoes, deep-sea fishing became impossible, porpoises disappeared from the diet, and the sole remaining large animal source of protein became—other humans. The tree and bird extinctions and the soil erosion eliminated much of Easter's resource base and left no possibility of rebuilding Easter society. While humans themselves did not become extinct on Easter, three-quarters of the human population did die out in an orgy of cannibalism, starvation, and warfare. What had been one of the world's most remarkable civilizations self-destructed.

The fate of Easter Island society seizes hold of our imagination, because the parallel between Easter Island isolated in the Pacific Ocean and Planet Earth isolated in our own galaxy is so obvious. When the Easter Islanders got into serious difficulties encompassing their entire island, they had nowhere to flee, no one to whom to turn for help—just as would be true for all of us humans today if we should face a similar worldwide crisis. I can't stop wondering what were the words of the Easter Islander who cut down the last palm tree. Did he shout "jobs, not trees"? Did he invoke private property rights, a plea to keep big government of the chiefs off his back, the uncertainties behind the extrapolations of fear-mongering environmentalists, and technology's power somehow to solve all problems?

I mentioned at the outset that history, like life itself, is complicated. That was true also in Polynesia, where history on different islands ran very different courses. On some islands, including Tonga, Tikopia, Tahiti, Rarotonga, and the high Marquesan islands, human populations continued to flourish for thousands of years, from the arrival of ancestral Polynesians until European arrival in the seventeenth or eighteenth centuries. On other islands there were environmental degradation and population declines as on Easter Island; those other islands included Mangaia, Mangareva, Rapa, low Marquesan islands, parts of New Caledonia, and parts of Fiji. On still other islands, including Henderson, pre-*Bounty* Pitcairn, the Line Islands, Necker, and Nihoa, the trajectory of Polynesian history ended before European arrival with complete abandonment or die-off: not a single person was left alive. How can we account for these very different courses of Polynesian history?

Numerous environmental factors as well as numerous cultural factors appear to have played a role. Among environmental factors, a leading one was rainfall: low-rainfall islands like Easter were more likely to become deforested than higher-rainfall islands like Tahiti and Tonga, for the obvious reason that rates of regrowth of vegetation after cutting increase with rainfall. Deforestation tended to be more extensive on low islands than on high islands because of so-called orographic rain: rainfall above an elevation of 3,000 feet on high Marquesan islands fed streams carrying nutrients leached from mountain soils and descending to the drier lowlands of those islands. Deforestation tended to increase with latitude, for the obvious reason that vegetation regrowth is slower at the cooler temperatures of high latitudes, as on Easter and New Zealand's South Island. Young or active volcanoes, such as Tikopia and Tonga and Hawaii's Big Island, were less likely to become deforested than old weathered islands because of higher levels or rates of replenishment of soil nutrients (cf. Chadwick et al. 1999).

Those are some of the environmental factors, but there were also cultural factors, i.e., different cultural responses. People on some islands limited deforestation by abandoning slash-and-burn shifting cultivation in favor of intensive agriculture on fixed garden plots, relying either on tree orchards as on Tikopia and the Marquesas (Rolett 1998) or else on irrigated taro fields as on Rarotonga and Rapa. P. V. Kirch (1997b) has pointed out that small islands, such as Tikopia, had the potential for developing bottoms-up conservation measures, because everyone could see what was happening to the whole island; large islands with centralized political leadership, such as Tonga, had the potential for developing top-down centrally imposed conservation measures; and medium-sized islands might fall between those two stools and fail to develop either set of conservation measures. Very isolated islands, such as Easter and Rapa, were prone to deforestation because their inhabitants were unlikely to resort to immigration as an escape valve for population buildup. But, conversely, societies on some islands with larger neighbors, such as Pitcairn and Henderson, whose Polynesian populations depended on trade with Mangareva 300 miles distant, were fatally destroyed when that neighbor became deforested (Weisler 1994).

Does this mean that we shall never arrive at real explanations, but only at a long laundry list of possible explanations why some islands were abandoned, other island societies declined but did not disappear, and still other societies continued to thrive? Clearly, this is a complicated problem, but I think that we shall eventually succeed in achieving a more satisfying synthesis than a mere laundry list. There are probably fewer than ten major explanatory factors, and possibly considerably fewer than ten because some of the cultural factors really were not independent variables but instead arose only in certain environments. Our available database will consist of different outcomes of human history on dozens of different islands. Hence I hope that we shall eventually be able to answer the question which are the most fragile Pacific island environments, in which pre-industrial societies were most likely to collapse.

My other set of examples is the collapse of Anasazi and other Native American societies in the U.S. Southwest in the centuries before Columbus's arrival (Cordell 1994, 1997; Crown and Judge 1991; Gumerman 1998; Hegmon 2000; Lister and Lister 1981; Plog 1997; Sebastian 1992; Vivian 1990). While agriculture reached the Southwest from Mexico around 1800 B.C., it was not until around A.D. 500 that people began living in settled villages. Thereafter, populations exploded in numbers and spread over the landscape, only to collapse in regional abandonments or drastic reorganizations at different times in different areas: in the middle or late twelfth century for Chaco Canyon, Mimbres, North Black Mesa, and the Virgin Anasazi; around A.D. 1300 for Kayenta, Mesa Verde, and Mogollon; and in the middle of the fifteenth century for the Hohokam. What accounts for these abandonments, collapses, or reorganizations? Favorite single-factor explanations invoke environmental damage, drought, or warfare and cannibalism.

Actually, the field of U.S. southwestern pre-history is a graveyard for single-factor explanations. Multiple factors have operated, but they all go back to the fundamental problem that the U.S. Southwest is a fragile and marginal environment for agriculture. It has low and unpredictable rainfall, quickly exhausted soils, and very low rates of forest regrowth. External environmental problems, especially major droughts and episodes of arroyo-cutting, tend to recur at intervals much longer than a human lifetime or oral memory span, so people without writing could not possibly plan for such events. Given those fundamental problems, it is impressive that Native Americans in the Southwest developed such complex farming societies, large villages, and large populations as they did. Testimony to their success is that most of this area now supports a much sparser population growing their own food than it did in Anasazi times. It is an unforgettable experience to drive through areas dotted with the remains of former Anasazi stone houses, dams, and irrigation systems and to see now a virtually empty landscape with only the occasional occupied modern house.

Today our attention is drawn to a few large and famous archaeological sites that were occupied continuously for several centuries, such as Pueblo Bonito in New Mexico's Chaco Canyon. In reality, most southwestern archaeological sites were occupied for only a few decades until its people moved on, probably compelled to move by problems of deforestation and soil nutrient exhaustion. They could practice that shifting settlement strategy as long as human population numbers were so low that there were large unoccupied areas or that each area was left unoccupied for sufficiently long after occupation that vegetation and soil nutrients had time to recover. Eventually, though, once human populations had increased to fill up the landscape, people could no longer escape their problems by moving.

Multiple environmental problems and cultural responses contributed to abandonments in the U.S. Southwest, and different factors were of different importance in different areas. For example, deforestation was a problem for the Anasazi, who required trees to supply the roof beams of their houses, but not for the Hohokam, who did not use beams in their houses. Salinization resulting from irrigation agriculture was a problem for the Hohokam, who had to irrigate their fields, but not for the Mesa Verdeans, who did not have to irrigate. Other southwestern peoples were done in by dropping water tables or by soil nutrient exhaustion. Despite these varying proximate causes of abandonments, all were ultimately due to the same fundamental problem: people living in fragile environments, adopting solutions that were brilliantly successful and understandable in the short run, but that failed or else created fatal problems in the long run when confronted with external environmental changes or human-caused environmental changes that people without written histories or archaeologists could not have anticipated.

Our understanding of pre-history in the U.S. Southwest is exceptionally detailed because of two advantages that archaeologists in this area enjoy. First, rather than having to date sites by the radiocarbon method used by archaeologists elsewhere, with its inevitable errors of 50–100 years, they date sites to the nearest year by the tree rings of the site's wood construction beams (Dean and Robinson 1978; Dean et al. 1996; Windes and Ford 1996). The widths of the rings vary from year to year, depending on rainfall and drought conditions each year. Tree rings thus provide southwestern archaeologists with uniquely exact dating and uniquely detailed year-to-year environmental information. Second, the Southwest is infested with small rodents called packrats, which have the virtue for archaeologists that they shelter themselves in structures called middens made of vegetation gathered within a few dozen yards. The packrats urinate in their own middens, their urine dries out and crystalizes, and the midden becomes a solidified dry mass of vegetation that the animals abandon after a decade or two. Thus, the midden is in effect a high-resolution time capsule of the local vegetation: a paleoecologist can return there up to 40,000 years later, identify the plant remains in the midden, radiocarbon-date the midden, and state what plants were growing in the vicinity at that date in the past (Betancourt 1984; Betancourt and Van Devender 1981).

As I mentioned, different southwestern sites were abandoned or transformed at different times for different specific reasons (Dean et al. 1985). The most intensively studied abandonment was of the most spectacular and largest set of sites, the Anasazi sites in Chaco Canyon of northwestern New Mexico (Lister and Lister 1981; Sebastian 1992; Vivian 1990). Chaco Anasazi society flourished from about A.D. 600 for more than five centuries until it disappeared sometime between 1150 and 1200. It was a complexly organized, geographically extensive, regionally integrated society whose stone buildings were the largest buildings erected in North America until the Chicago skyscrapers of the 1880s. Even more than the barren treeless landscape of Easter Island, the barren treeless landscape of Chaco Canyon today, with its deep-cut arroyos and sparse low vegetation of salt-tolerant bushes, astonishes us, because Chaco Canyon is now completely uninhabited except for a few National Park Service ranger houses. Why would anyone have built the most advanced city in North America in that wasteland,

and why, having gone to all that work of building it, did they then abandon it?

When Native American farmers moved into the Chaco Canyon area around A.D. 600, they initially lived in underground pithouses, as did other contemporary Native Americans in the Southwest. Around A.D. 700 the Chaco Anasazi, completely out of contact with Native American societies building structures of stone a thousand miles to the south in Mexico, invented for themselves the techniques of stone construction. Initially, those structures were only one story high, but around A.D. 920 what eventually became the largest Chacoan site of Pueblo Bonito went up to two stories, then over the next two centuries rose to five stories with 600 rooms whose roof supports were logs up to 16 feet long and weighing up to 700 pounds.

Why, out of all the Anasazi sites, was it at Chaco Canyon that construction techniques and political and societal complexity reached their apogee? Likely reasons are some environmental advantages of Chaco Canyon, which initially represented a favorable environmental oasis within northwestern New Mexico. The narrow canyon caught rain runoff from a large upland area, which resulted in high alluvial groundwater levels permitting farming independent of local rainfall in some areas and also high rates of soil renewal from the runoff. The Chaco area has a high diversity of wild plant and animal species and a relatively low elevation that provides a long growing season for crops. Nearby pinyon and juniper woodlands supplied wood for construction timber and firewood. The earliest roof beams identified by their tree rings are of locally available pinyon pines, and firewood remains in early hearths are of locally available pinyon and juniper. Anasazi diets were heavily dependent on growing corn, plus some squash and beans, but early archaeological levels also show much consumption of wild plants such as pinyon nuts, and much hunting of deer.

One environmental problem caused by the growing population developed by around A.D. 1000, when packrat middens show that the pinyon and juniper woodland initially in the vicinity of the large Chaco Canyon settlements had been completely cut down. The loss of the woodland not only eliminated pinyon nuts as a local food supply but also forced Chaco residents to turn to a different timber source for their fuel (Kohler and Matthews 1988) and construction needs. That source consisted of ponderosa pine, spruce, and fir trees growing in mountains up to fifty miles away at elevations several thousand feet higher than Chaco Canyon (Betancourt et al. 1986). With no draft animals available, logs weighing up to 700 pounds were transported in prodigious quantities to Chaco Canyon by human muscle power alone. Construction at Chaco Canyon used about 200,000 trees.

The other environmental problem that developed early involved hydrology (Bryan 1941). Initially, rain runoff would have been as a broad sheet over the canyon bottom, permitting floodplain agriculture watered by the runoff and also watered by a high alluvial groundwater table. When the Anasazi began diverting water into channels for irrigation, the concentration of water runoff in irrigation channels, and removal of vegetation, resulted by sometime before A.D. 1025 in the cutting of deep arroyos in which the water level was below field levels, making irrigation agriculture or agriculture based on groundwater impossible for people without pumps.

Despite the development of these two environmental problems that reduced crop production and virtually eliminated timber supplies within Chaco Canyon itself, the population of Chaco Canyon continued to increase, particularly in a big spurt of construction that began in A.D. 1029. A dense population is attested not only by the famous Great Houses (such as Pueblo Bonito) spaced about a mile apart on the north side of Chaco Canyon, but also by post holes indicating a continuous line of residences at the base of the cliffs between the Great Houses and by the remains of hundreds of small settlements on the south side of the canyon. This dense population was no longer self-supporting but became subsidized by outlying satellite settlements constructed in similar architectural styles and joined to Chaco Canyon in a regional network of hundreds of miles of roads. Chaco Canyon became a black hole into which goods were imported but from which nothing material was exported. Into Chaco Canyon came those tens of thousands of big trees for construction; pottery (all late-period pottery in Chaco Canyon was imported, probably because exhaustion of local firewood supplies precluded firing pots within the canyon itself); stone for making stone tools; turquoise for making ornaments, from other areas of New Mexico; macaws and copper balls from Mexico, as luxury goods; and probably food. Food remains in rubbish at archaeological sites attest to the growing problems of the canyon's inhabitants in nourishing themselves: deer declined in their diets, to be replaced by smaller game, especially rabbits and mice. Remains of complete headless mice suggest that people were catching mice in the fields, beheading them, and popping them into their mouths whole.

Why would outlying settlements have supported the Chaco center, dutifully delivering timber, pots, stone, turquoise, luxury goods, and food without receiving anything material in return? The answer is probably the same reason why outlying areas today support our cities such as Rome and Washington, D.C., which produce no timber or food but serve as religious and political centers. Chacoans were now irreversibly committed to living in a complex, interdependent society. They could no longer revert to their original condition of self-supporting mobile little groups, because the trees in the canyon were now gone, the arroyos were cut below field levels, and the growing population had filled up the region and left no unoccupied suitable areas to which to move. When the pinyon and juniper trees were cut down, the nutrients in the litter underneath the trees were flushed out. Today, more than 800 years later, there is still no pinyon/juniper woodland growing anywhere near the packrat middens that contain remains of the woodland before A.D. 1000.

The last construction beams at Pueblo Bonito, dating from the decade after 1110, are from a wall enclosing the plazas, which had formerly been open to the outside. That suggests strife: people were evidently now visiting Pueblo Bonito not just to participate in its religious ceremonies and to receive orders, but also to make trouble. The last tree-ring-dated roof beam at the nearby Great House of Chetro Ketl was cut in A.D. 1117, and the last roof beam anywhere in Chaco Canyon was put up in A.D. 1170. Other Anasazi sites show more abundant evidence of strife, including convincing evidence of cannibalism, plus settlements at the tops of steep cliffs at long distances from fields and water and understandable only as easily defended locations (Haas and Creamer 1993).

The last straw for Chacoans was a drought that tree rings show to have begun around A.D. 1130. There had been similar droughts previously, around A.D. 1090 and 1040, but the difference this time was that Chaco Canyon held more people, more dependent on outlying settlements, and with no unoccupied land to which to move. A drought that lasted more than three years would have been fatal, because modern Puebloans can store corn for only two or three years, after which it is too rotten or infested to eat. Sometime between A.D. 1150 and 1200, Chaco Canyon was abandoned and remained largely empty until Navajo sheepherders reoccupied it 600 years later. What actually happened to the thousands of Chacoan inhabitants? By analogy with historically witnessed abandonments of other pueblos during a drought in the 1670s (Vivian 1979), probably many people starved to death, some people killed each other, and the survivors fled to other settled areas in the Southwest.

We can now return to the question subject to longstanding debate: was Chaco Canyon abandoned because of human impact on the environment or because of drought? The answer is: it was abandoned for both reasons. Over the course of five centuries the human population of Chaco Canyon grew, their demands on the environment grew, their environmental resources declined, and people came to be living increasingly close to the margin of what the environment could support. That was the ultimate cause of abandonment. The proximate cause, the proverbial last straw that broke the camel's back, was a drought that finally pushed Chacoans over the edge.

That type of conclusion is likely to apply to many other collapses of past societies, and to our own destiny today. All of us today—house-owners, investors, politicians, university administrators, and others—can get away with a lot of waste when the economy is good. We forget that conditions fluctuate, and we may not be able to anticipate when conditions will change. By that time, we may already have become irreversibly committed to an expensive lifestyle, leaving bankruptcy as the sole out.

We have now considered pre-industrial collapses of societies in ecologically fragile environments, among Pacific Islanders and among Native Americans of the U.S. Southwest. The numerous other possible examples of collapses in fragile environments include those of Fertile Crescent societies, Great Zimbabwe, the Greenland Norse, Harappan Indus Valley civilization, and Mycenean Greece. There were also possible pre-industrial collapses in more robust environments, including Angkor Wat, Cahokia, Classic Lowland Maya, and Northwestern Europe. Hence pre-industrial societies can collapse for ecological reasons, not only because of problems in their own environments but also triggered by environmental collapses of neighbors (e.g., Weisler 1994). Can we extrapolate these historical findings to our prospects today?

There are obvious differences between past conditions and current conditions. Some of those differences make us less prone to collapse, while some of them make us more prone. Today we possess scientific ecological knowledge that past societies lacked. Offsetting that advantage, we have far more people today, wielding far more potent destructive technologies. Whereas ten thousand Easter Islanders wielding stone tools required many centuries to deforest their landscape, the Earth's six billion modern inhabitants, with their bulldozers and power machinery, deforest vast expanses in decades. In the past, societies could collapse in isolation without any effects elsewhere in the world. When Polynesian Easter Island society collapsed, nobody else in the world knew about it, nor was anybody affected. Today, no society, no matter how remote, can collapse without potential worldwide consequences. When distant Somalia collapsed, in went American troops; when the former Yugoslavia and Soviet Union collapsed, out went streams of refugees over all of Europe and the rest of world; and when changed conditions of society and settlement spread new diseases in Africa, those diseases spread over the world. Past societies faced frequent ecological crises of small amplitude over small areas. Modern global society faces less frequent but bigger crises over larger areas.

Is our situation hopeless? Of course not. We face big risks, but the biggest risks are not ones beyond our control, like a possible collision with an asteroid. Instead, the biggest risks are the ones that we are generating ourselves. Because we are the cause of our environmental problems, we are in control of them. The future is up for grabs, and it lies in our hands. We don't need new technologies to solve our problem; we just need the political will to apply solutions already available.

We tend to feel that our problems are so monumental that individuals can contribute nothing to solving them. In fact, there are many simple and cheap things that we can do as individuals. We can vote: many elections are decided by small margins, and the candidates often differ considerably in their environmental records and agendas. We can devote some time to causes that we think will help, such as population policy and environmental movements. We can work on fixing our local environment, which produces immediate benefits to us as individuals and also makes us citizens of the First World a credible example to other countries. We can contribute money: environmental organizations are so underfunded that a small contribution makes a big difference.

But our best hope is the media. When the Easter Islanders and the Anasazi were collapsing, they had no idea of the many other collapses going on elsewhere in the world around the same time (like those at

Angkor Wat, Cahokia, and Great Zimbabwe); nor had they any idea of the many similar collapses that had occurred in the past (like those of Fertile Crescent societies, Harappan society, and Mycenean Greece). We, in contrast, know of conditions in remote places and at remote times through books, newspapers, radio, television, movies, and other media. Most Americans have seen television footage of current conditions in Somalia and have seen TV documentaries about Easter Island or other vanished civilizations. We are the first societies in world history to have the opportunity of learning from the mistakes of many others. It's up to us to decide whether we choose to apply the obvious lessons.

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