THE GEORGE WRIGHT
FORUM
A JOURNAL OF CULTURAL AND NATURAL PARKS AND RESERVES

Volume 11 ❖ 1994 ❖ Number 3

POPULATION GROWTH DEMOGRAPHIC CHANGE

AND THE FUTURE OF PROTECTED AREAS

THE JOURNAL OF THE GEORGE WRIGHT SOCIETY
Dedicated to the Protection, Preservation and Management
of Cultural and Natural Parks and Reserves
Through Research and Education

The George Wright Society

The George Wright Society is a member of
US/ICOMOS (International Council on Monuments and Sites–U.S. Committee),
IUCN–The World Conservation Union, *and*
The Natural Resources Council of America

ISSN 0732-4715

Editorial guidelines may be found on the inside back cover.
The text paper of the FORUM is made of 50% recycled fibers.
Printing is by Weber & Sons, Park Falls, Wisconsin.

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On the Cover:

The future of the world's protected areas lies in the hands of the children of today. These Nepalese children live in a farm village which takes part in a development project aimed at improving people's lives by addressing population and environment concerns in a unified way. It is one of a growing number of such "integrated population-environment projects" worldwide; some directly involve parks, reserves, and other kinds of protected areas.

Photo by Renée Rogers, courtesy Population Action International, Washington, D.C.

William E. Brown

Letter from Gustavus

While Rome Burns

June 11, 1994

ON THE SUBJECT OF POPULATION the human capacity for folly would seem to be infinite. In all cases and across all cultures the blindness that besets us, on this matter, is an anachronism.

Most familiarly, this blindness comes to us in the religious triune descended from the vision of a few thousand threatened nomads in ancient Israel. The inspiriting pronouncement from their God to "multiply and subdue the Earth" still reigns over half the world—from the islands of Indonesia, across vast stretches of Asia, Africa, Europe, the Americas, and the multitude of farther outposts established by Jews, Christians, and Islamics.

In peasant societies, like India and China, a multitude of offspring still guarantees the requisite work force for intensive agriculture, and the care and shelter of aging parents.

In pastoral societies, from the Navajo Reservation to the savannahs and highlands of Africa, wealth and social status still depend on the numbers of livestock possessed.

It matters not that these livestock crater the soil itself in search of sustenance; nor that peasant plots divide and deplete to feed the multitudes whose very night-soil can't compensate the drain; nor that mechanized monoculture diverts the rivers and salts the world's best soils to feed the urban masses of industrialized countries. Nor that all of these results of perpetuated myths combine to desertify the Earth, kill its other inhabitants, and render land and water dead and poisonous.

And don't look for consistency of thought. People who know very well the limits of cows in a pasture continue to prate the notion that there is room for all of us and our doubling descendants.

In sum, we seem unable to face reality. Ignorance is part of it, in large parts of the world. But mostly our obliviousness to the most obvious signs of ecosystem and biospheric deterioration stems from two causes:

1. The utterly false notion inherited from ancient forebears of many religious stripes that we, human beings, are exempt from natural constraints, which, as most of us very well know, apply remorselessly to all other earthly inhabitants.

2. The hubristic idea—a modern secular perversion of the ancient belief in the Diety's merciful interventions for the Chosen People—that science and technology will save us. In its cruder form this means that we can dig deeper, change the course of rivers, replenish the deserts of our own making, and so on. A sobering example of this new faith is the Aswan Dam in Egypt, whose disruption of the Nile's annual replenishment of river-corridor soils and delta nutrients has—in less than thirty years—doomed the seething, multiplying population of a place that once knew sustainable civilization over millennia. Before we tut-tut the Egyptians (and the Russians who built the dam, beating our own aid program to the punch), we should look at our own devastation of the richest soil base in the world (aside from the Ukraine) in the Mississippi Basin, not to mention the destruction of the closest thing in Eden the New World knew, California.

In its highest form the new faith recalls the Titan, Prometheus, who stole fire from the gods. Unfortunately, we have no Hercules to kill the eagle that wrathful Zeus sent to eat the bound Prometheus' liver each day. And the mere centuries of his suffering

are as nothing compared with the millions of years of half-lives ticking away in the nuclear genii we have already unleashed—in the already-obsolescent, condemned power plants that still generate electricity, though they are bombs waiting to blow; in the piles of Cold War weapons now being traded to any solvent megalomaniac for food; in the waste, from both peace and war applications, whose storage and care is present disgrace and inevitable future tragedy.

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In large part, the madness manifested in these selected examples stems from the desperate need to feed and sustain large populations of human beings. We, acting as nation-states (and more recently as international corporations), mine to sterility all resources within our respective boundaries, and, if we are powerful, we take the lands and resources of others by economic or military means. The poor of the world join in the process, for slave wages, or stand by and starve as we mine their patrimony.

What does all this mean in terms of preserved lands? Well, isn't it obvious? Unless we as a species begin applying the same rules to ourselves as we routinely apply to scientific husbandry there will be no more preserved lands, or seas, or any other ecosystem. They will be invaded and consumed, overtly or subtly, until they are no more.

That process is already well advanced in Third World countries where desperate measures center on tactics for the next meal and parks and preserves employ small armies to save wildlife, and habitats being stripped for fuel and forage. For the relatively rich First World countries, strategic desperation is well advanced, but is allayed and camouflaged by rapacious extraction and importation from the poorer countries. But those sources are running out. Despite our illusions, even in the United States tactical desperation is pervasive. In our dying cities and devastated rural and once-industrial areas, our condition is different only in degree, and an evaporating insulation of timing, from that of Calcutta or the dust-blown villages of the Deccan plateau or the gutted industrial sectors of Eastern Europe.

No discussion of wildlife, habitat, or ecosystem preservation has any long-term meaning unless the human condition of overpopulation, and its amelioration and eventual solution, is the overarching context of discourse. All else is fiddling while Rome burns, playing games with research plots, taking record photos before assured destruction. Assuredly, all of these things must be going on. But if they go on in other than a context of human population control they will have no bearing on coming realities.

POPULATION GROWTH, DEMOGRAPHIC CHANGE, AND THE FUTURE OF PROTECTED AREAS

Introduction

THIS VOLUME IS TIMED TO COINCIDE with the International Conference on Population and Development (ICPD), the United Nations' decennial population conference, which is being held in Cairo during September 1994. The papers included here explore the interactions between population growth, demographic change, and protected area conservation. The published literature on population-environment interactions is by no means extensive, and that which refers specifically to protected areas is smaller still. There is a great deal of discursive evidence, however, that population pressures, both direct and indirect, are affecting protected areas in ways that will probably spell their fate over the next century.

Figures 1 and 2 tell the story in its most simplistic terms. The world's population has more than doubled since 1950. Meanwhile, the number of protected areas has increased about tenfold and their extent ninefold. This implies that people and protected areas are on some kind of collision course.

Or does it? That implication stems from assuming that the conservation objectives of protected areas are incompatible with the everyday needs of people. Could it be, however, that the remarkable growth in protected areas has come about precisely *because* there are more people? That concern about rapid population growth has driven conservation to the forefront of the official consciousness, resulting in a surge of new protected areas—including "second-wave" areas, such as biosphere reserves and protected landscapes, which are directly tied to human needs and concerns?

Yet how does such a sanguine interpretation square with the facts on the ground, which point overwhelmingly toward a global protected area estate that is beset with problems? In a few countries, there are no protected areas at all; in others, the protected areas could literally be described as being under siege. More than one reserve has been virtually degazetted by average people desperate for land on which to get a livelihood. Can one name a single country where the human population is *not* having some adverse effect on protected areas?

If these questions seems both complicated and contradictory, those surrounding the causes of and responses to population growth are even more so. These questions are raised here as a caution and a challenge: a caution, because one should not expect the papers in this issue of THE GEORGE WRIGHT FORUM to do other than scratch the surface; a challenge, because it is up to people working in protected areas, and those who care about their future, to go beyond this and explore the questions in depth. The effects of population growth and demographic change—whatever they are, whatever they turn out to be—are, arguably, the key to the future of protected areas.

Acknowledgments

The George Wright Society would like to thank Patricia Waak-Strom and Steven R. Brechin for their valuable contributions in helping organize this issue. In addition, we acknowledge the University of Michigan Press for their permission to republish "Protected Area Deforestation in South Sumatra, Indonesia" and an abridged version of "The Long View: Population-Environment Dynamics in Historical Perspective," both of which first appeared in *Population-Environment Dynamics,* edited by Gayl D. Ness, William D. Drake, and Steven R. Brechin, © 1993 The University of Michigan Press.

Figure 1. World population, 1950-1993

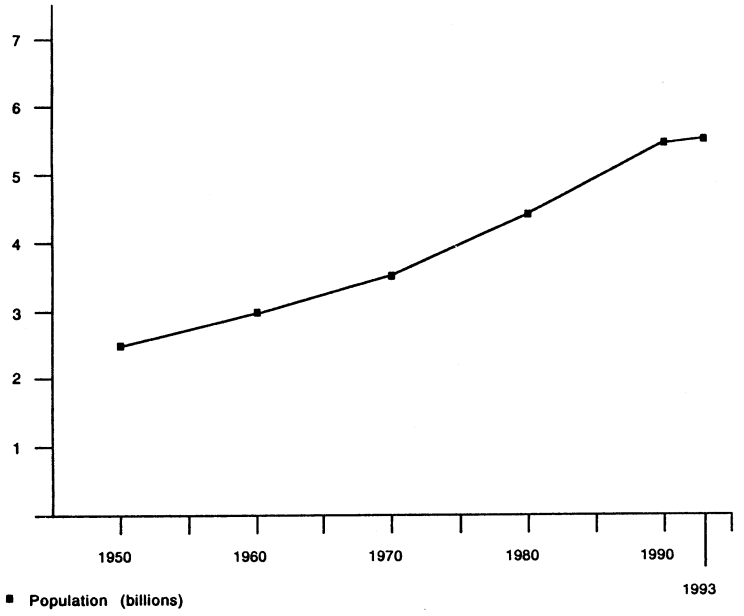

Figure 2. World number and extent of protected areas, 1950-1993

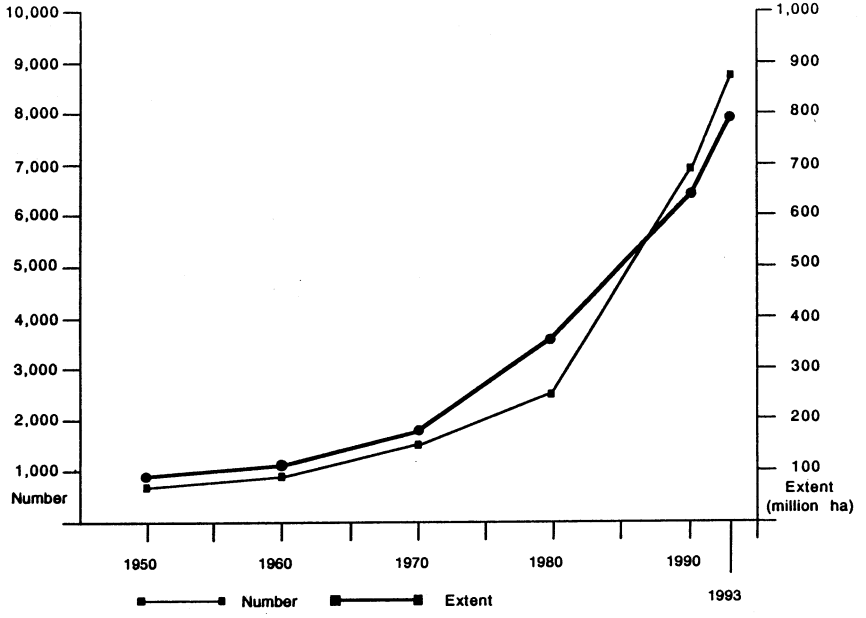

Figure sources: World Resources Institute, *World Resources 1994-95* (New York: Oxford University Press, 1994); IUCN, *1985 United Nations List of National Parks and Protected Areas* (Gland, Switzerland, and Cambridge, U.K.: IUCN, 1985); and United Nations, *Demographic Yearbook 1980,* 32nd ed. (New York: United Nations, 1982).

The Long View: Population–Environment Dynamics in Historical Perspective

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Introduction

THE HUMAN POPULATION IS MOST CLEARLY RELATED to global environmental change through its historical pattern of growth in numbers and productivity. This pattern is now fairly well known, if not fully understood. It consists of thousands of years of variation producing exceedingly slow net increases in total population. Only the last three centuries show exponential growth. The recent growth is closely associated with the significant increase in human productivity that has accompanied the rise of urban industrial society. The recent exponential population growth is associated with two major energy transformations that extend back for about five centuries. One was the shift to sails, starting in the fifteenth century. More important for modern global change, however, was the shift to fossil fuels, beginning in the late eighteenth century.

There is an association between this rapid population growth and the full range of environmental changes that is coming to be known as *Global Change*. This includes atmospheric chemical changes related to global warming and ozone depletion; degradation of the environment, including deforestation and the release of toxins into the earth, water and air; and the destruction of species.

This paper provides a brief summary of the long historical trends that link population growth to environmental change. It begins with a review of the past millennium of population growth on a global scale. It then presents the underlying population dynamics that mark our modern period, the *demographic transition*, which helps to explain differential growth rates in major regions of the world.

A Thousand Years of Population Growth and Economic Development

Population growth. The relationship between population and the environment has always been a reciprocal one. A brief review of the history of the human population makes this abundantly clear. From its probable origins in East Africa, the human species took perhaps up to 500,000 years to spread throughout the world. Growth rates of the total population were usually very close to nonexistent, and for many local populations the growth must often have been negative.

Even this slow population growth, however, was accompanied by substantial environmental change. McNeill (1976) notes the elimination of large animals (mammoths, etc.) from much of the territory invaded by man the hunter. The domestication of animals and plants, beginning around 9000 BC, had a substantial impact on the environment in relatively small, sparsely settled and disconnected societies. The population–environment relationship was, however, certainly a two-way street. The emergence of agriculture in MesoAmerica and the Middle East at roughly similar periods suggests the importance of environmental change resulting from the recession of the glaciers. Over the next few thousand years, agriculture spread to many parts of the globe, often implying radical alterations in the environment. The most dramatic of these are seen in irrigation and terracing, which molded the land to produce great increases in plant yields. While these transformations produced pockets of relatively high population density and some periods of

substantial growth, the overall process was still very slow.

By the year 1000 AD the human species had come to number about 265 million. For the next 700 years the historic pattern of slow growth continued. Growth rates were kept low by high human mortality, usually in the range of thirty to forty per thousand population. A variety of mechanisms had evolved, however, to offset these high death rates, such that fertility rates in the best of times usually hovered around five or ten points above mortality rates.[1] Under these conditions, population growth was predominantly governed by mortality, which rose and fell with both social and environmental changes.

This pattern of high birth and death rates began to change about 300 years ago, when the world entered into a series of *demographic transitions*. Death rates began to decline as some populations began to experience a transition from infectious to degenerative diseases as the leading causes of death.[2] Falling death rates brought a period of rapid population growth, as birth rates remained high. This was then followed by declining fertility and lower population growth rates. This transition was completed in most of the more developed countries by the early part of the twentieth century and is now being experienced in much of the less developed world. The expectation today is that the demographic transition will be accomplished throughout the world by the middle of the next century.

For the world as a whole, the demographic transition has given us rising numbers and rising rates of growth for the three centuries from 1700 through 2000. The population of roughly 265 million in the year 1000 rose to about 610 million by 1700, to 2.5 billion by 1950, and is expected to reach 6.2 billion at the end of this century. The growth rates rose steadily from less than 0.1% five centuries ago to a peak of 2.06% in the period 1960 to 1965, when the population reached 3.5 billion. Since then the growth rate has declined to about 1.7% today, though it will continue to grow in absolute numbers for some time.[3] Not all of the world's regions have experienced these changes at the same time, however.

The different timing of these transitions in different world regions can be seen in detail from an examination of average annual growth rates, shown in Table 1. The low growth rates that were universal up through 1700 rose in the eighteenth century to 0.4% in Europe and Asia, and to 0.6% in the Americas. Asia retained that rate of growth and was joined by Africa in the nineteenth century, while Europe's growth doubled to near 0.8%, and the Americas reached levels twice that. Through the twentieth century, European growth rates declined slightly and those in North America rose through 1950 then declined. Africa, Asia, and Latin America showed high and rising growth rates throughout the century, and are only expected to decline in the next century.

United Nations projections place the world's total population at about 8.5 billion in 2025. Beyond that, projections become very uncertain, and much depends on what happens to human fertility in the near future. For ex-ample, if we were to reach replacement level (2.1 total fertility rate) by the year 2000, which is possible though highly unlikely, the world's population would rise to just over eight billion by the year 2100 and then level off or decline. If we do not reach replacement-level fertility until 2080, in 2100 we shall have almost fourteen billion people and still be growing rapidly.

This general pattern of centuries of slow growth and recently rising growth rates is illustrated in Figure 1.[4] It also shows the two energy transformations and the rise of urban society, to which we now turn.

Growth of population and output. What is most remarkable about this recent exponential growth in population is its association with continued rising per capita output. Both agricultural and industrial output have risen more rapidly than population throughout this past three hundred years. The phenomenon is especially remarkable in the past fifty years, when the population growth rates

Table 1. World population by region, 1000-2025 (in millions with average annual growth rates)

Year	1000	1500	1700	1800	1900	1950	2000	2025
Region								
World	265	423	610	902	1622	2515	6248	8466
(a.a %)		.09	.18	.39	.58	.87	1.84	.62
Europe	36	81	120	180	390	572	816	863
(a.a %)		.16	.20	.41	.77	.72	.71	.22
Asia	185	280	415	625	970	1375	3698	4890
(a.a %)		.08	.20	.41	.44	.70	2.0	.56
Africa	33	46	61	70	110	224	872	1581
(a.a %)		.11	.14	.14	.45	1.25	2.75	1.19
Americas	9	14	13	24	145	332	831	1093
(a.a %)		.09	-.01	.61	1.8	1.6	1.9	.55
L. America	8.6	13.2	11.8	18	66	164	537	760
(a.a %)		.09	-.05	.04	1.3	1.8	2.4	1.4
N. America	0.4	0.8	1.2	6	79	168	294	333
(a.a %)		.15	.20	1.6	2.6	1.5	1.1	.5
Oceania	2	2	2.25	2.5	7	14	30	39
(a.a %)		.09	.06	.10	.58	.87	1.54	.53

Source: McEvedy and Jones 1978. The average annual growth rates (a.a%) given are for the full period from the prior date shown.

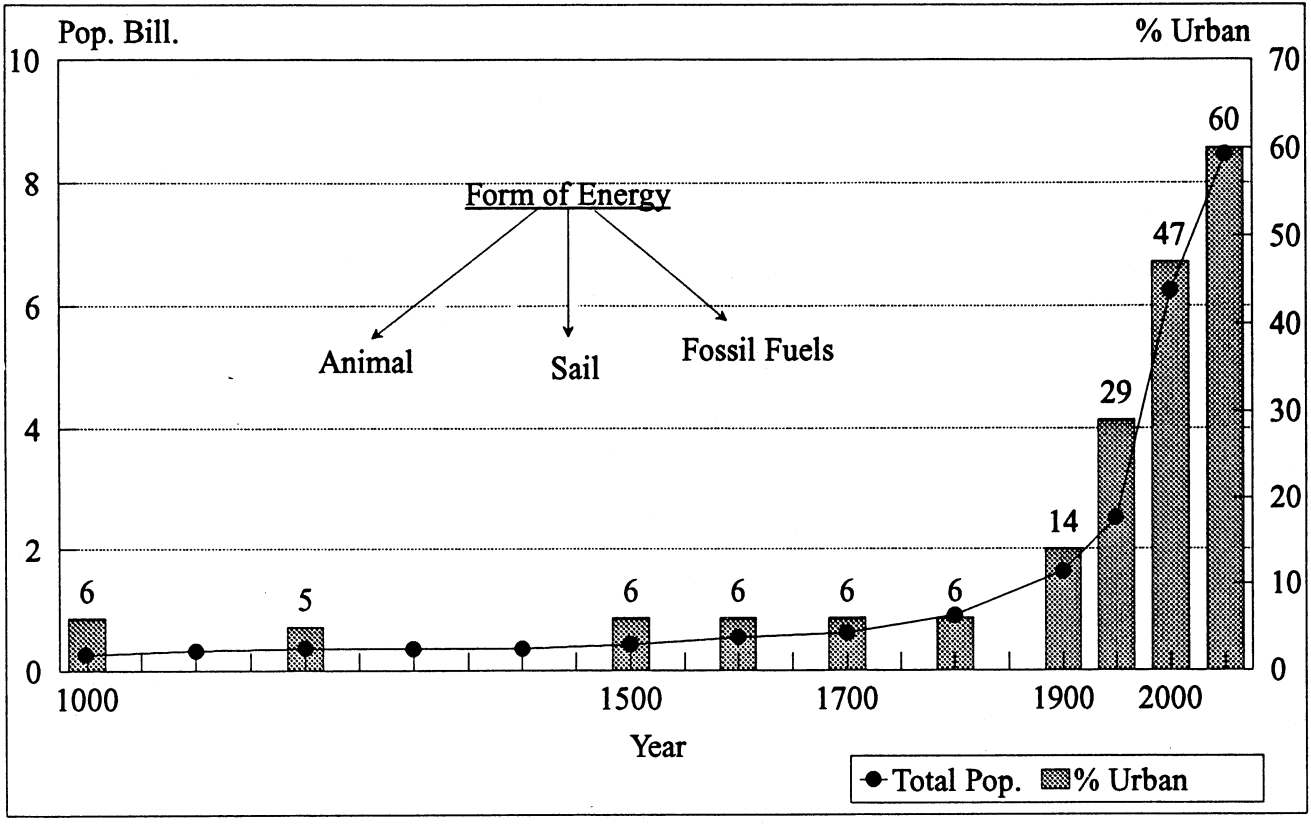


Figure 1. World population, energy, and urbanization, 1000-2025

have been so high. For at least the past fifty years annual increases in world cereal output, for example, have averaged over 3%, about one to two percentage points above world population growth rates.

The increase in output associated with rapid population growth is quite contrary to the gloomy predictions of Thomas Malthus. It is the result of the emergence of a new type of society: urban industrial society. The emergence of this new type of society was a consequence of two sequential revolutions in energy use: first the use of sails and then the use of fossil fuels.

Energy transformation I: Sails. The change from the oars of the Mediterranean galley to the sails of the Portuguese caravel occurred in the first half of the fifteenth century and represented a major development in naval architecture. The galley's one mast amidships was replaced with three-after, amidships, and forward. Oars were eliminated, the hull was raised farther out of the water and ultimately protected by guns rather than by swords (Cipolla 1965). The transition from oars and swords to sails and guns gave the West the technological capacity to "discover the seas."[5]

The transition began in 1415, when the Portuguese Prince Henry led a successful attack on Ceuta, giving them a permanent base in North Africa. From there the great Portuguese oceanic explorations pushed down the coast of Africa, turning the Bight of Benin in 1472, and rounding the Cape of Good Hope in 1488. Finally in 1498, Vasco DaGama reached the coast of India, linking for the first time Asia and Europe by sea.[6] Just over a decade later, in 1511, the Portuguese captured Malacca, a major port and seat of Islamic learning for all Southeast Asia. A decade later Magellan reached the Philippines by sailing across the Atlantic and Pacific, then returned through the Indian Ocean for the first circumnavigation of the globe. Thus in this one brief century, from 1415 to 1521, the world was encompassed by ships at sea.

This technological advance transformed world trade and transportation routes, linking all the continents by the seas, in effect making the world a single integrated environment for the human population. Henceforth human transportation would permit the spread of all localized flora and fauna to other parts of the globe. It took the human population half a million years to spread throughout the world, finding ecological niches in which it could adapt to the environment and survive. In the last 500 years, the human species turned the entire globe into one environment, in which human activities would become paramount in changing that environment.

The transformation of trade routes between 1500 and 1600 brought a series of highly productive crops from the Americas to many part of Asia, Africa and Europe. Everywhere these new crops increased the carrying capacity of the land, thus permitting the human population to greatly increase its numbers.

If the impact of the discovery of the seas was positive for Europe and Asia, it was anything but that for the Americas. There a population of perhaps as many as 100 million had emerged, isolated from the micro-organisms existing with people throughout Asia, Africa and Europe. Because of an absence of autoimmunity, the Americas suffered disastrously from the external contact. Their populations were reduced to one tenth their pre-Columbian populations in less than a century. In some cases, as in the Caribbean, the entire native population was wiped out.

It is important to note that this discovery of the seas was only partly a technological transformation. Equally important were its political and social dimensions. Half a century before Vasco DaGama reached the coast of India, and a century before Magellan's circumnavigation, the Chinese launched five major naval expeditions into the Indian Ocean, reaching the East Coast of Africa. In 1400, Chinese naval technology was far more advanced than that of the West. The great nine-masted flagship of Admiral Zhang He, which made the last of the five African expeditions between 1403 and 1433, was five times the

size of the tiny vessels that carried DaGama, Magellan, or Columbus. It had water-tight compartments, double hulls, and a stern rudder, and was navigated by complex and accurate astronomical calculations. Thus the Chinese had the naval technology to discover the seas. They would also have had the capacity to people the West Coast of the Americas, and halt the western advance into Asia. In effect they had the technological capacity to make the world a Chinese world, rather than the Western world it became. The Chinese decision not to use its technological advantage for conquest of the seas was thus of momentous importance.

The full explanation of the Chinese refusal and the Iberian rush to oceanic conquest is quite beyond the scope of this review,[7] but an instructive contrast can be drawn between the two in the history of the interaction between human institutions and ecological forces. China has been a land-based empire since its inception. Powerful groups arose by using the state to mold the land, digging canals for transportation and managing water for irrigation, drainage, and flood control. The result was greatly increased agricultural production, which brought immense wealth to the empire. Given the great land mass of China and its openness to Mongol populations, much of the empire's wealth was used for *defense of the land.* Three major power groups emerged: the court and the Emperor, the Bureaucracy, and the merchants. The first two were constantly in conflict over the control of the state, and both were allied against the merchants, who were seen as a lowly but lucrative tax base for the empire. It is instructive to note that Admiral Zhang He was a Muslim and a eunuch, marking him a loyal personal servant of the Emperor and an outcast from the bureaucracy and the Chinese gentry. By contrast, Portugal, thrust out into the western seas and with a long coastline, made fishing and sea transport well-established activities. Further, in contrast to Admiral Zhang He, Prince Henry the Navigator, who promoted the Portuguese explorations, was a son of the Emperor, a protector of the Church, and financed by Lisbon merchants. In Portugal and Spain, Crown, Church, and merchants had built an alliance, first to wrest the peninsula from Islam, and then to continue that conquest to the seas. These institutional and geographical differences, far more than the technological differences, explain why the world is now a Western rather than a Chinese world.

For the next two centuries, the seas were used to begin to tie the world environment together into a single unit. A major product of this new integration was that the new crops from the Americas increased the carrying capacity of the earth in Asia, Africa, and Europe. Overall population growth rates rose to 0.18% in the sixteenth and seventeenth centuries, and to 0.39% in the eighteenth century. By 1800 the world's population was just under one billion. To raise growth rates to the higher modern levels, however, would require another form of energy.

Energy transformation II: Fossil fuels. It is the second energy transformation, to fossil fuels, that lies behind the rise of modern industrial society. This began slowly with the invention of the steam engine and the expansion of coal production at the end of the eighteenth century. It grew more rapidly with the invention of the internal combustion engine and the exploitation of oil and natural gas in the nineteenth century. It has now exploded into exponential growth of fossil fuel consumption in the twentieth century. Without coal and oil, steam and internal combustion engines, modern urban society as we know it would be quite impossible.

Even as late as 1700, the world's urban population accounted for less than 10% of the total population. There were some large cities, mostly in Asia, but the social organization of the human species was primarily rural and agrarian. Fossil fuels in transportation permitted high concentrations of populations in urban centers to be provided with food produced by others. Fossil fuels also permitted those urban populations to pro-

duce a surplus of goods that could be traded for food produced elsewhere. The use of fossil fuels would, however, increase the level of carbon dioxide and other greenhouse gases in the atmosphere, producing a marked human impact on the entire global environment.

Both of these energy revolutions stimulated increased population growth. The second has been especially important. It is considered doubtful that the world's population could have grown beyond one or two billion without the transformation to fossil fuels. If this is true, the link between population growth and environmental change is especially salient for today. The fossil fuel revolution produced massive increases in both human numbers and human production, and it is precisely through these numbers and productivity that the human population is having its remarkable, and destructive, impact on the environment.

Modern urban society and population growth. The Western World experienced rapid urbanization and industrialization in the nineteenth century. This was already evident in 1800, when London had a population of 865,000 and fully 10% of the population of England and Wales lived in cities of 100,000 or more; by 1900 this increased to 35%. For the world as a whole, the proportions in cities of 100,000 or more in 1800 was only 1.7%, rising to only 5.5% in 1900. England and Wales experienced the greatest spurt of urbanization between 1811 and 1851, with the U.S. following between 1820 and 1890. Thus by 1900 Europe and North America had become substantially urbanized, displacing Asia as the continent with the largest cities. Until 1800, for example, fifteen of the world's twenty-five largest cities were in Asia, with two more in the Middle East. In 1900, fourteen of the twenty-five largest were in Europe and North America (Chandler and Fox 1974).8

In the first half of the twentieth century, the economic growth and urbanization of the western world were spreading to Asia and Africa. By 1950 almost 30% of the world's 2.5 billion people lived in urban areas. In the more developed regions the level was 53%, and in the less developed world it was only 17%, or not much above the 10% that many societies had reached throughout history. By 2025, it is projected that over 60% of the world's population will live in urban areas, 80% in the more developed regions and almost 60% in the less developed.

While this massive transformation of the world community, the rise of urban industrial society, has been associated with the increase of population growth rates, it also contains conditions that lead to the slowing of population growth rates. To understand this phenomenon, we must turn to the major dynamic underlying modern population changes, the *demographic transition.*

The Demographic Transition: Past and Present

Figures 2 and 3 show the two variants of the *demographic transition*, or the move from high to low birth and death rates, that distinguish the more developed from the less developed countries. This can help us to understand some of the dynamics behind past and present population movements and can also serve as an introduction to the modern population policies that represent a revolutionary change from the past.

Figure 2 uses the experience of England and Wales to illustrate the demographic transition, which has now been completed in all of the industrialized countries. The transition began with high levels of mortality and fertility, which can be called the traditional condition of the human species throughout most of its earthly existence. Often death rates rose above birth rates to bring a period of absolute population decline. In the best of times, mortality declined and population increased, but this did not last long and overall the growth rates over long periods must have been only a little above zero.

In the early 1700s the death rate in England and Wales began a gradual and persistent decline, leveling out around ten per thousand in the early twentieth century. Fertility remained high until near the end of the nineteenth century, and then dropped rather rapidly to

Figure 2. Past demographic transition: England and Wales, 1700-1980

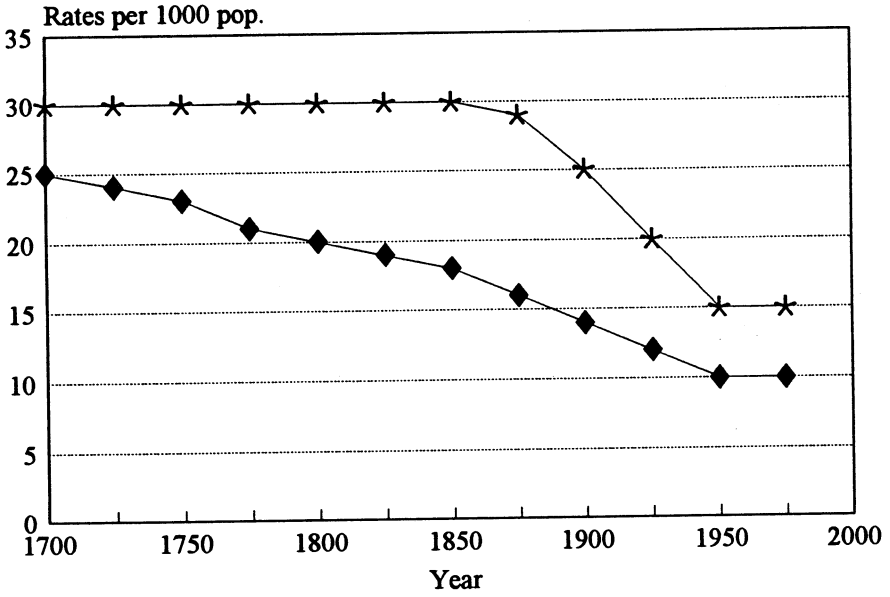
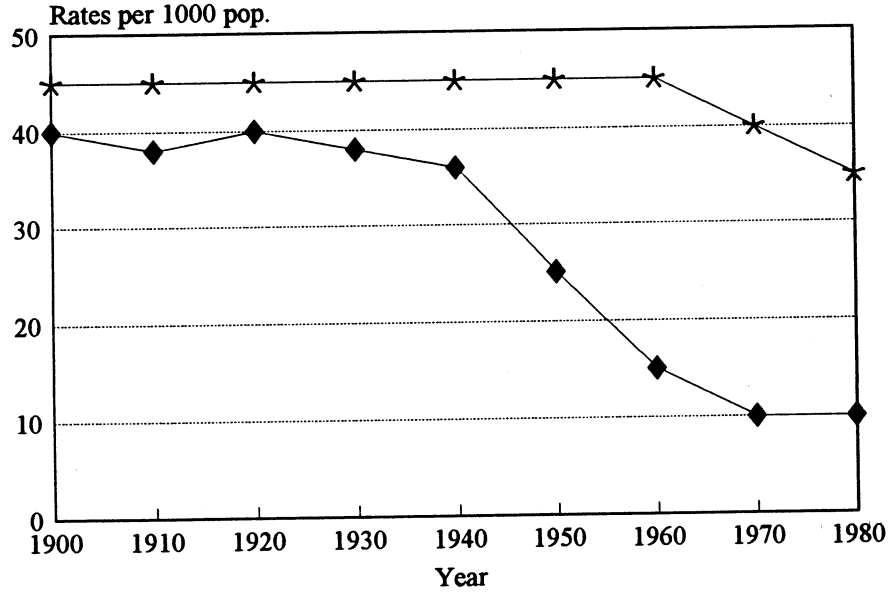


Figure 3. Present demographic transition: Africa, Asia, and Latin America



CBR = crude birth rate; CDR = crude death rate

CBR CDR

about fifteen, coming into line with low mortality. This transition, from high to low mortality and fertility, with an intervening period of rapid population growth, marked the transition from rural agrarian society to urban industrial society. While many details are obscured, the general pattern seems clear. Mortality declined through the combination of an epidemiological transition (McNeill 1976), a gradual rise in the earth's temperature (LeRoy Ladurie 1988), trade expansion through the seas, agricultural and industrial revolutions, and, to a far lesser extent, through improvements in medical technology. Only at the end of the nineteenth century did medical advances play much of a role in mortality declines.[9] Together these changes implied a slowly rising standard of living, or an increase in the carrying capacity of the land.

The decline in fertility came with the emergence and maturation of the new type of society: urban industrial society.[10] Perhaps the most important aspect of this transition involved the changing value of children and reproduction in what John Caldwell (1976) has called the transition from upward to downward net intergenerational capital flows. Children were transformed from economic assets to economic liabilities. This was, however, far from a simple change in the economic calculations made by individual families. It was, rather, a broad social and cultural change that moved rather quickly, after it began, through groups identified by language, culture or ethnicity. In the broadest sense, it was a change that we tend to call modernization.[11] With this change, fertility declined and came into line with low mortality rates. The demographic transition was completed. Every industrial society has now completed that transition, though there have been substantial differences in the timing and trajectories of the declines in birth and death rates.

That same transition appears to be taking place in the less developed countries of Asia, Africa, and Latin America (Figure 3), though there are considerable differences in the character of the change. First, the birth and death rates at the beginning of the transition were higher than those in Europe and North America.[12] Second, the recent decline of mortality has been much more rapid, and has been due to major advances in medical and public health technologies, which arose largely out of World War II. The development of antibiotic drugs, vaccines, pesticides, and fungicides all permitted new wide-spread health networks to reduce mortality from infectious diseases. Mortality declines that required a century or more in the past now took place in decades. Because of this rapid mortality decline, the population increase associated with this transition has been more rapid and of greater magnitude than that experienced in the past. Past transitions brought rates of 1 to 2% per year; current transitions have brought rates of growth of 3% and more.[13] Finally, the fertility declines that we now witness in the developing world are, in part, associated with a remarkable set of policy revolutions, from pro- to anti-natalism. In the industrialized world, past fertility declines often came *despite* the wishes and policy of government. Today, many governments in the less-developed world are *leading* the drive to fertility decline.

It is difficult to overemphasize the revolutionary character of these policy changes. Until 1952 virtually all governments throughout human history were pro-natalist. People were a resource, which translated into power. Governments taxed people, worked them, and sent them off to war. Thus governments have always tended to want more rather than fewer people. This led virtually all governments to be pro-natalist.[14]

This changed dramatically in 1952 when Japan and India became the first of the modern governments to announce official policies to limit population growth through limiting fertility. Since 1952 almost all developing country governments have followed. Throughout the world today, governments have launched, supported or permitted the formation of national family planning programs, to distribute the new contra-

ceptives and to disseminate the message of fertility control. There is no doubt that this combined technological and policy change is having a major impact on fertility reduction and population growth.[15]

Like the declines in mortality, both the policy changes and the current declines in fertility in the developing world have been greatly assisted by the development of a new contraceptive technology. It is highly unlikely that governments would have adopted wide-ranging fertility limitation programs, or that they could have been as successful as they have been, had there not been this technological innovation (Ness and Ando 1984). It is also important to note that the new fertility-limiting technology, like mortality-limiting technology, may be referred to as "bureaucratically portable." It can be set in the specialized hierarchic organizations that governments throughout the world have developed to administer their populations. This ties population environment interactions of the present closely to technology and human organization, especially to the rise and spread of modern bureaucratic organizations.

It seems quite likely that current fertility declines will continue, and will be driven by two major forces. One is the same urban-industrialization that in the past transformed children from assets to liabilities. This is often referred to as the "demand-side" (i.e., demand for fertility limitation) force in fertility decline. In addition, the expansion of national family planning programs, bringing a greater supply of the new contraceptive knowledge and methods, also works to depress fertility. There is considerable controversy over the relative impact of these "demand" and "supply" sides of the forces, but there is also agreement that the two together work more powerfully than either does alone.[16] The issue of policy implementation, specifically of the organization and management of modern family planning programs, has been dealt with extensively in the literature. It is evident that governments vary considerably in their willingness and ability to promote fertility limitation. This is related to something that can be called a political culture that greatly affects what a government can and cannot do (Ness and Ando 1984). Finally, there are powerful cultural forces that work directly through individual and family reproductive orientations, and these, too, profoundly affect both what governments can do and what individuals themselves will do to limit fertility.

Conclusion

In considering the impact of population and development on global environmental change, it is necessary to keep in mind the full range of global changes that are affected by human action. Population growth and economic development have resulted in massive increases in energy use, especially in fossil fuel consumption, and thus the increasing release of greenhouse gases into the atmosphere. They are also associated with massive deforestation and the destruction of many plant and animal species. This species destruction continues today, perhaps at increasing rates. The impact of this aspect of global change may be less readily apparent than the threat of global warming, and thus may have received less attention. In addition, urbanization and industrialization have the led to increased emission of toxic wastes in land, water and air. This aspect of environmental degradation has received more attention recently, but it has yet to become fully integrated into our views of global change. In effect, a wide range of human impacts on the environment must be more fully integrated into our views of global change if we are to understand the relation between population and environment. That integration is also necessary if we are to adjust our behavior sufficiently to ensure the continued survival of the human species, and perhaps of the entire global ecosystem as well.

We must recognize that population policies are some of the most conflictual we know of in the history of modern public policy. Population policies touch deeply held values of race and ethnic identity, human sexuality, gender roles, fundamental values of individual rights,

and of life itself. Wherever a state's population is ethnically divided, population policies will be faced with deep, primordial fears of population decline which accompany changing relative numbers of different ethnic groups. By contrast, many other environmental policies may be subject to at least some economically rational argument. Further, many environmental controversies can be resolved with scientific research and cost-benefit analyses. Many of the population controversies, however, are moral and ethical and cannot be resolved with scientific evidence or economic calculations. Although the world community as a whole has made massive strides in treating population issues with greater understanding, it still generates deep fears and conflicts. This situation will undoubtedly persist. Our task cannot be to provide the scientific evidence to resolve the population debates. It is, however, our task to provide the evidence and information that can make those moral and philosophical debates more fully informed.

Endnotes

1. Note this is *in the best of times.* Then, growth might have been as high as 0.5% per year, though usually only for relatively short periods. Even those growth rates implied a doubling time of 140 years, or about four generations (Coale and Watkins 1986, Cipolla 1974, Deevey 1960).
2. This is often known as the *epidemiological transition.*
3. This results from what is known as *population momentum.* When fertility and growth rates are high, many new babies will be born. Even if these new additions experience reduced fertility when they reach reproductive ages, their sheer numbers will keep population growing in total numbers.
4. McEvedy and Jones (1978) is used for these global figures to 1950, and the United Nations (1988) for the years 1950-2025. There is some dispute over the population of the Americas on the eve of the European conquest, which McEvedy and Jones place at 14 million. William McNeill (1976) places the number at 100 million. I am inclined to accept McNeill's figure, but have retained the McEvedy and Jones figure for consistency. There is more agreement after 1700 on the total numbers, but the implication of the difference concerns the extent of the demographic collapse of the American Indian population resulting from the European contact. It is not unreasonable to accept McNeill's judgment of a full decimation of the Amerindian population as a result of the impact of European diseases.
5. The term is J.H. Parry's (1974).
6. Boxer (1961) provides a succinct survey of the Portuguese expansion. Parry (1959) considers the broader European involvement.
7. Paul Kennedy (1987) has a good summary contrasting the Chinese and Western systems.
8. The five largest in 1900 were London, New York, Paris, Berlin, and Chicago.
9. The one major medical advance that precedes this is the discovery of a vaccination against smallpox that is dated about 1740. Until about 1800, however, the vaccination used smallpox itself, which often resulted in death, and was not widely accepted, especially in urban England and on the continent. At the turn of the century cowpox was used to vaccinate humans, with few serious side effects. This new form of vaccination then spread rather widely throughout the world during the 19th century.
10. See Coale and Watkins (1986) for a full review of the decline of fertility in Europe. This provides an exposition of the variety of economic, health, social, and cultural conditions that played a role in the fertility decline.
11. Cleland and Wilson (1987) make this point clearly for both past and present fertility declines. In both cases fertility declines tend to run along broad cultural, language, or ethnic lines rather than along clear class or income lines. The latter is more a part of the common perception and is also well articulated theoretically in what is called the new household economics of fertility. As Cleland and Wilson show, however, empirical support for this well-developed theory is weak or lacking altogether. Caldwell (1977, 1986, 1988) also makes this point for Africa and for comparisons with Asia and Africa.
12. This is probably related to differences in kinship patterns, but that discussion must be left to another time and place.
13. It may well be that the speed of mortality decline and the magnitude of population growth are the most powerful deleterious effects of the current transition. Ogawa and Suits, for example, have performed a simulation exercise for Japan's past 100 years of demographic transition. They simply assigned recent Asian mortality declines to Japan after 1870 and concluded that with the more rapid mortality decline and consequent higher population growth rates, Japan would not have been able to achieve the savings and investment rates necessary for its own economic take-off.
14. The logic of this statement requires a connecting argument. Governments that want more people can get them through conquest, encouraging immigration, and encouraging high fertility. All three have been

extensively used as government policies. Conquest has always been risky, however, and in the modern world promoting immigration also raises problems. In all societies, probably the safest and surest method of increasing, or sustaining population, is simply to encourage people to do what comes naturally—reproduce. Hence the near universality of pro-natalism as official government policy

15. It is also necessary, however, to note that the policy change is neither a sufficient or necessary condition for fertility decline. Policy changes have been made in Egypt, Kenya and the Philippines, for example, with little apparent impact on fertility. On the other hand, Brazil has had no real policy change, yet fertility has declined, largely because contraceptives and abortions have become much more widely available in that rapidly urbanizing society.

16. As in most discussions of current fertility decline, even this broad generalization requires some qualification. Bangladesh illustrates a case, especially in its experimental *Matlab* district, where fertility decline appears to come solely from contraceptive distribution, with no appreciable economic improvement. On the other hand, Brazil illustrates a case where economic development, and especially urbanization, have brought rapid declines in fertility in the near complete absence of any government efforts to distribute contraceptives. Burma also shows some fertility decline without economic development, and even with government attempts to limit the distribution of contraceptives. In this case, however, abortion appears to be the most generally used method of fertility limitation, usually with very high costs for women.

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Sharing the Earth: Case Studies on Population, Wildlife, and the Environment

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AS A MEMBER OF THE U.S. DELEGATION to the U.N. International Conference on Population and Development (ICPD) in Cairo, I carry a special responsibility to see that the viewpoint of other species is reflected in the planning and recommendations related to human population considerations. This is not an easy task. First, I presume to know what is best for other species. Second, we all presume to know what is best for all people. Third, there is an anthropocentric bias built into development from the beginning. And with the world's poor growing in numbers it is not surprising that this bias exists.

The National Audubon Society, with nearly a century of experience in protecting wildlife and its habitat, early on recognized the impact of human population growth on the natural environment and on Earth's resources. One of Audubon's goals is to ensure that sound population policies are established in the United States and overseas, policies that contribute to the health, well-being, and dignity of the individual human and protect non-human species and their habitat. One major program objective has been to demonstrate the interrelationship between population and environment and to actively pursue means of addressing these issues.

The classic J-curve of population, a chart of the growth of human numbers throughout history, tells an impressive story of human triumph over adversity. Current projections for 2020 place the world's population at 8.7 billion. The less-developed countries will make up 7 billion of that total. Thus, over three-quarters of the global population growth is occurring in those countries. The total human population could rise to 14 or even 20 billion before stabilizing.

But population is more than demography. Issues surrounding quality of life equalize people country by country. The economist and minister, Thomas Malthus, warned of the perils of population growth outpacing agricultural production. Equally of significance today is the neo-Malthusian crisis: people using more than their own share of resources. Today's population crisis is in two parts: *high numbers and high consumption.*

Although the predominant theme of the U.N. document for the ICPD is women's health and family planning, Chapter 3 of that document sets the stage for government action by discussing the role of economic growth, sustainable development, and the environment. Unsustainable patterns of consumption and production are very much a part of defining and correcting the problem.

However, this is not a new way of looking at the population and environment crisis for Audubon. Certainly every environmental activist understands the interplay among people and resources. Yet no one sees it as clearly, perhaps, as the wildlife biologist committed to caring for other species and their habitat.

The Population, Wildlife, and Environment Project

In 1988, Audubon's Population Program and its Sanctuary Department began to develop a joint project to look at the issues of human population growth and wildlife management. We sought to compare sites in the United States and overseas, presenting similarities and contrasts, and identifying actions necessary to change the course of humans struggling to balance their needs in a sustainable ecosystem.

Some of the objectives of this Population, Wildlife, and Environment Project were to:

- Explore examples of population pressures in the United States and overseas, including addressing the U.S. resource consumption issue;
- Explore examples of attempts to preserve plant and animal species against the pressures of population growth and economic development;
- Accumulate "lessons learned" from these examples;
- Connect habitat destruction and population growth;
- Formulate policy recommendations for national governments and international organizations;
- Formulate and promote an action agenda for local activists worldwide; and
- Introduce U.S. citizens to Third World citizens making a difference in protecting people and wildlife.

Out of 100 established Audubon wildlife sanctuaries, eight sites managed by wildlife biologists, wardens, or land managers were chosen. The basic criteria for selection of the U.S. sites included demonstrable direct or indirect pressures on the land from human activity, either in numbers or in resource consumption. These sites were then matched with eight sites in other countries which had an existing local or national management program of protection. Other criteria included the presence of similar biomes, species, or threats to the system.

The Audubon wildlife managers visited their partners' international settings and then hosted their counterparts at their own sanctuaries in the United States. All of the paired project sites involve water resources: three are coastal systems, two involve major rivers, and three relate to freshwater wetlands.

Coastal Systems

Tampa Bay Sanctuaries, Florida, and Wat Phai Lom, Wat Asokaram, and Ban Lung Jorm, Thailand. The colonial nesting birds islands of Tampa Bay, Florida, were matched with traditional nesting sites in and around Bangkok. Thailand, with 55 million people in an area somewhat smaller than the state of Texas, is growing at a rate of 1.5% annually and is home to 281 people per square mile. Florida, one-quarter the size of Thailand, and with a population now exceeding 12 million, has a density of 228 people per square mile and an annual growth rate of 2.8%. As the industrial economies of both areas grow, human needs increasingly conflict with those of wildlife.

In Thailand, the Buddhists have set aside wildlife sanctuaries within monastery grounds. As a result, the Thai bird colonies seem more secure than those of Tampa Bay. The environmental movement is just now becoming a force in Thailand, so most conservation efforts depend upon the commitment of individuals within the community. In Florida, the environmental movement has grown considerably over the past two decades and has produced a system of regulations and funding for habitat preservation and restoration. Both areas will need specific protection for their bird species, which requires the establishment of sanctuaries in the midst of human development.

Rookery Bay Sanctuary, Florida, and Pulau Rambut, Indonesia. The Indonesian archipelago accommodates 258 people in every square mile of its land mass. The state of Florida, smaller in total area, almost equals the population density of Indonesia. With 189 million people, Indonesia has a natural annual rate of increase of 1.8%, as opposed to Florida's 2.8%. Indonesia's rate of increase reflects the national birth rate, while Florida's largely reflects migration into the state. Among other things, the two share a concern for coastal management and wetland preservation.

In Indonesia, land is owned and protected by the government. It was a surprise for Indonesian officials to learn that a private organization such as Audubon owns and maintains a vast system of land and water. An Audubon warden patrols southwest Florida's Rookery Bay, and he has made it his business to be an official part of the community environmental planning process. Pulau Rambut, the Indonesian island in Jakarta Bay, which was matched with the Rookery Bay Sanctuary, is a public area, and there is insufficient government staff to patrol and protect it from human disturbance.

As a holiday site for the city of Jakarta, which has a 4% annual growth rate, Pulau Rambut does not have a bright future for its wildlife. Rookery Bay contains island resort communities which are growing as well. The closest city, Naples, is one of the fastest-growing metropolitan areas in the United States. Both sanctuaries must have more support for studying what exists in their resource base, how each sanctuary functions, and what the significance of each is in the broader ecosystem. Public education will be essential, as well.

Rainey Wildlife Sanctuary, Louisiana, and Rio Lagartos, Mexico. In increasing numbers, the human population is congregating along the seacoasts of the world. Two of these coastal sites are located in Louisiana and Mexico's Yucatan Peninsula. Louisiana's Rainey Sanctuary and the Rio Lagartos system of the Yucatan both shelter vast, rich wetlands which serve as the breeding grounds for spectacular gatherings of wildlife. But Louisiana is steadily losing its coastal wetlands at a rate of 130 square kilometers per year, the largest loss anywhere on Earth. The economic effects of this loss on the state's 4.4 million people are felt most acutely by the commercial fishermen.

Across the Gulf, Mexico, with a population of 88.6 million, is growing annually as a rate of 2.4%. Mexico's population density exceeds that of Louisiana. In the Yucatan, coastal wetlands remain intact even though they are subject to the same types of economic pressures as in Louisiana. It is because of a slower rate of economic development that the Yucatan has lost much less of its natural resource base than has the Louisiana coastal system. Yet both areas are subject, in the immediate future, to massive oil exploration and environmental impacts from the petroleum industry.

For Louisiana, coastal subsidence may now be inevitable. However, there are initiatives which can be implemented to take the pressure off the coastal wetlands. What is needed today is an effort of collaboration and coordination among agencies in and out of the government. Louisiana may not grow demographically in the future because of coastal problems, but the Yucatan will likely face enormous populations, as it did centuries ago during the ancient Mayan civilization. The challenge, once again, is to find a balance between the land and its people, so that this time both can survive in harmony.

River Systems

Sabal Palm Grove Sanctuary, Texas, and Biotopo del Manati, Guatemala. Guatemala has 9.2 million people and is growing at a rate of 3.1% per year. The state of Texas jumped from 14.2 million people in 1980 to 16.9 million in 1990, which indicates an overall annual rate of almost 2%. However, in the Rio Grande Valley the rates of growth are much higher. Biotopo del Manati and the Rio Grande's Sabal Palm Grove were matched because of their biological similarities and shared bird and animal species. Rapid population growth and development are threatening the survival of the respective rivers and the people and wildlife served by both.

Rapid population growth, poverty, cultural disparity, unplanned agricultural expansion, and unsustainable economic activities are all part of the pressures on these two river systems. Deforestation is a significant issue: in Guatemala the trees are disappearing at an alarming rate; in Texas, most of the trees are already gone. The local citizens in Texas are lobbying for a "wildlife corridor" along the Rio Grande to protect the river and the remaining vegetation. The Kekchi Indians in Guatemala are getting involved in reforestation and sanctuary protection.

The creation of demonstration water-quality projects on the two rivers is intended to provide safe water supplies and will also serve as learning laboratories in sustainable resource management. And while South Texas may now be suffering from the effects of tourism, controlled ecotourism may be part of the answer to preserving the biotopos of Guatemala. If nothing else, Guatemalans can at least learn from the mistakes made in South Texas.

Platte River, Nebraska, and Indus River, Pakistan. The state of Nebraska is home to 1.6 million people—a relatively small population in a critically important area involved in agricultural production. In the neighboring state of Wyoming, 500,000 people make up the smallest population of the fifty states. But the city of Denver, across the Nebraska border in Colorado, has over 1.8 million people and is anticipating further growth. All three states are linked by the precious flows of the Platte River, and the water needs of growing cities in this semi-arid region are competing with agriculture and wildlife for the rights to the last of the Platte's water.

Around the world, another river system is also under pressure from people. In Pakistan, the Indus River provides water for many of the 114.6 million people living there. Pakistan's population density, at 369 people per square mile, is over 15 times that of Nebraska, and Pakistan's human population is growing at the high rate of 3% per year. Like the rivers themselves, the scale of the population problems in these two regions may seem a world apart. Yet, in the challenges that growing or dense populations may bring to the preservation of an area for wildlife, the choice of the Platte and the Indus rivers for a case study turned out to be a perfect match.

Despite thousands of years of use, the Indus still maintains much of its pristine quality. The Platte, however, has been dammed and diverted almost beyond recognition. Technology and consumption have had more devastating effects on many of the Platte's resources than on most of the less-developed rivers of the world. The comparison of these two rivers is a microcosm of issues relating to water and its use around the world.

All of the participants from all around the world discovered that they had in common a deep commitment to preserving natural resources. The fast-growing developing countries have a challenge not to repeat the mistakes of industrialized countries in overstressing their own land and water systems. How-

ever, the wildlife managers of areas in Pakistan, Kenya, and Guatemala also realize that the poverty of their human populations must be addressed first.

The managers of sites in Florida and Texas saw the rapidly growing population base in and around their sanctuaries in a new light. The land of the prosperous United States is more degraded than in some of the poorest countries of the world.

Freshwater Wetlands

Corkscrew Swamp Sanctuary, Florida, and Lake Nakuru, Kenya. Florida and Kenya are experiencing some of the highest population growth rates in the world. Florida's human population grew 31% in the 1980s and reached nearly 13 million. Kenya experienced a 44% increase during that period, and now supports an estimated 25 million people. Florida's Corkscrew Swamp was matched with Lake Nakuru in Kenya because of similar high population growth rates.

The Corkscrew area's growth is caused by the migration of families into the region. Nakuru's growth is the result of a combination of migration, urbanization, and a very high birth rate. For Corkscrew, water-use regulatory processes and comprehensive growth-management laws are necessary to achieve a balance between human demands and resource protection. However, the economic forces that drive growth are powerful, and the long-term survival of Corkscrew will be a continuing struggle. At Nakuru, the challenges are even greater. There are immediate problems linked to basic human survival, such as soil erosion and fuelwood supply, which must be addressed even before comprehensive growth planning can be instituted. The long-term future of Lake Nakuru, like much of East Africa, is dependent in part on a substantial reduction in the human birth rate.

Alkali Lake Sanctuary, North Dakota, and Estancia Caiman, Brazil. North Dakota hardly ranks as a populated state, with a total population of 666,000 people spread out over 70,000 square miles. Brazil, in contrast, has 150 million people and encompasses over 3 million square miles. Brazil is also home to the fourth-largest city on the world, São Paulo, which grew from 6 million in 1965 to 17.2 million in 1990. The result of that growth has been a deterioration of the quality of life for its inhabitants.

The Prairie Potholes of North Dakota and the Pantanal of Brazil are both regions containing internationally important wetland habitats, and the major industries of both are agriculture and cattle ranching. Each of these areas supplies food primarily for markets outside of its ecosystem, and the economic pressures to do so are enormous.

For North Dakota, the environmental story is one of continuing loss of wetlands as the "potholes" where ducks breed are drained for agriculture. Brazil's Pantanal is one of the world's largest remaining contiguous wetlands. It is rich in wildlife, but faces the pressures of expanding human populations, intensified grazing, and logging. While North Dakota may depend on legislation to protect and restore wetland habitat, it is a slow process. At Estancia Caiman in the Pantanal, a private landowner is experimenting successfully with finding a balance among the competing interests of wildlife, cattle, and agriculture. Yet the survival of each of these sites will require substantial education and information for local farmers and other citizens, as well as formal protective measures such as international wetland site designation.

Initial Findings

The exchange project began with the assumption that there is a complex relationship between population and environmental degrada-

tion, recognizing that resource consumption is a key factor in the population equation. Most of the data available on these relationships is experiential and only recently is beginning to be supported by hard science. Therefore, the goal was to explore examples of human population pressures in the United States and overseas, not through detailed scientific research, but rather through a review of the issues, aimed at understanding each case in the broadest terms. The intent has been to highlight attempts to protect plant and animal species against the pressures of population growth and economic development and learn from one another's experiences in protecting the environment.

Some basic findings are as follows. First, wildlife managers and conservationists share common problems throughout the world, despite differences in geography, economy, and culture. Second, natural areas are being lost or degraded worldwide, and much of the habitat loss is related to human population pressures through either sheer numbers or how those numbers use Earth's resources. Third, in many cases, human technology and affluence have led to more rapid and extensive environmental degradation than have masses of humans living in poverty, yet the nature of the damage is similar, if not exactly the same.

In addition to the factors of human population growth and/or overconsumption, water, and wildlife, each study had in common the fundamental issue of economics and/or ethics and values. This is particularly important in underlining the complexity of the issues and the need to study them as a cyclical process with intervening variables rather than linear studies.

The Sharing the Earth Project

In 1991, Audubon began the Sharing the Earth Project as a follow-on project to the initial studies. Audubon has set up two centers of expertise, based in Nebraska and Texas, to continue exploration of human population, wildlife, and environment interrelationships.

The Nebraska project serves to further internationalize Audubon's commitment to the campaign to save the Platte River. In partnership with Pakistan, Nepal, and Russia, the project focuses on the establishment of "sister" sanctuaries, education and outreach to the surrounding "shareholding" human community, and exploring ways to deal with related economic issues.

This partnership has resulted in three international symposia on people, water, and wildlife; collaboration with Moscow State University on internships for Russia nature park managers; and co-sponsorship of an international conference which included participants from Russia, China, Korea, Japan, and the United States. The most recent event is the establishment of the Amur Conservation Education Project, which is designed to raise the level of community awareness on these issues along the Russia–China border.

The Texas project focuses on education, outreach, and involvement of the local "shareholding" human community, which is largely Spanish-speaking in South Texas. Also included is work with neighboring Mexico on population, environment, and trade issues. A partnership between teenagers in Brownsville and the Mexican city of Matamoros has been formed under the name of the International Youth Alliance. The youth have generated media attention, brought adults into important community meetings, and testified at public hearings.

With assistance from the University of Michigan's population and environment fellowship program, a two-year fellow has been placed in Matamoros to work with the project. A major task will be to collect data

on the health and population needs of the Matamoros community.

After Cairo

In November 1994, Audubon will host a post-Cairo population conference in Miami, Florida, to assess the accomplishments of the ICPD and to plan a strategy for addressing national and international population issues for the rest of the decade. The United States does not have a population policy. If we are to save people, wildlife, and habitat, we must have one. If we are to be credible to the rest of the world when we discuss population, the environment, and development, we must lead by example.

From the lessons we are learning through Sharing the Earth, we will continue to look for solutions to the problem of finding a balance between humans and other species. Most of all, we will continue to learn from the experiences of other biologists, scientists, and everyday people around the world, and to share what we are finding out as we pursue a sustainable future.

Linking Community Programs in Environment to Programs in Population: Towards Sustainable Communities that Sustain Sanctuaries

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Introduction

THROUGHOUT THE WORLD, GROWING HUMAN POPULATIONS live at the edges, and often within the borders, of ecosystem reserves and wildlife sanctuaries. The futures of humans and sanctuaries are inseparable—only when these populations live as environmentally sustainable communities will ecosystems, habitats, and species within nearby reserves be ensured their survival.

In developing countries, these communities have traditionally depended for their sustenance and livelihood on the natural resources that exist within sanctuary borders, and which those communities often regarded as their common property resources (CPRs). In many cases, as these communities have grown, their increasing needs for fuel, fodder, and cultivable land, often augmented by urban commercial demand, have unalterably modified habitats and wildlife populations (Harrison 1992, 1993, 1994). Sanctuary ecosystems within developing countries have suffered from a combination of factors, among them: insufficient financial support provided by national governments to protect park resources. Few successful initiatives that encourage managed use and protection by local people have thus far emerged (Hannah 1992, Wells and Brandon 1992).

In the developed world, a century of confrontation and litigation with potential users of sanctuary resources has institutionalized norms of preservation and appropriate use within park boundaries. Today protected ecosystems in developed countries face their greatest threats from changes in the quality and quantity of regional CPRs upon which they depend, but that circulate outside their boundaries (Strom 1992, 1993): namely, depletion of water supplies and degradation of the quality of both water and air. Much of the impact upon these CPRs is driven by an increase in regional human settlement (principally inmigration) in the form of urban growth and suburban sprawl.

Population matters. In fact, local environmental conservation efforts have no long-term significance unless both the growth of human population and their unsustainable patterns of resource use eventually cease. The discordant relationship between high population density and environmental sustainability arises from two major sources: population effects on the scale of the economy and on the institutions needed to sustainably manage CPRs. "Economic scale" is the rate at which resources are fed through the economy (Daly 1991)—the throughput level, the rate of consumption of resources. If a community desires to sustain itself, it must ultimately arrive at a scale sufficiently large to provide an "adequate" standard of living to all, yet sufficiently small to

permit environmentally sustainable management (zero net consumption of its natural capital). The larger the population size, the less each person can consume before reaching a non-sustainable scale. Second, the environment must be managed sustainably, i.e., harvest and waste generation must occur at rates that do not exceed those at which the productive and absorptive capacities of the environment are regenerated (Daly 1991). Strong institutionalized authority is often needed to sustainably regulate CPR harvest and waste—a difficult task under high population density because the presence of many users can increase protection costs beyond both the immediate value of natural resources and the capacity of institutional response.

Consequently, environmental non-governmental organizations (NGOs) have begun addressing the 'population component' in their environmental projects. Yet, many issues remain unclear. Where are the programmatic connections? What are the development implications? In fact, in a review of linked population and environment efforts, IUCN–The World Conservation Union was unable to find conclusive proof that combining environmental protection with programs to reduce population pressure was always feasible, or that conservation goals were more quickly achieved by this linkage (IUCN 1990).

The Population and Environment Nexus

During the 1970s, the environmental movement grew beyond its conservationist roots to tackle community issues. Over 20 years later, an agenda for the "sustainable community" is emerging from the programs of environmental NGOs that promotes: (a) environmental education and community awareness of local environmental quality; (b) the assumption of ethical and legal responsibilities of local communities for the long-term conservation of their resources; (c) equitable community participation in planning the use of those resources and obtaining the benefits; and (d) support of national and international agencies and organizations in the protection of environmental components important to national and global biodiversity.

In contrast to the environmental movement, the family planning movement, founded by Margaret Sanger prior to World War I, originated over a set of women's health issues. (Sanger was moved to organize and advocate for family planning as a nurse in New York City where she witnessed death and disabilities resulting from self-induced abortions.) Correspondingly, family planning organizations continue to provide services geared toward the development of families and individuals (Aramburú 1994), rather than locations and regions. Development, as it is envisioned by the environmental and family planning movements, seem, at first reading, divergent. Environmental NGOs appear fixed on environmental sustainability, a long-term community-level goal. Family planning NGOs are focused on interventions that have almost immediate implications for individual and family welfare. Nonetheless, these visions apparently can find some commonality—for in the field, family planning and environmental NGOs have begun to work side by side.

Objectives

In this paper, I briefly describe several programs among collaborating NGOs that have addressed both the population and environmental components of development; provide a conceptualization of how linked programs in population and environment are intended to work; and speculate on what such community-based efforts contribute to the ascending notion of a *sustainable community*. Representations of pop-

ulation-environment linkages should be considered my own conclusions based upon reports, field visits and interviews with fieldworkers, managers, and reviewers of these projects.

Advance knowledge of a few broad conclusions are useful in reading this review:

1. In *developing countries*, sanctuaries have little chance for survival unless surrounding human populations stabilize, and the economic and ecological relationships between people and sanctuary ecosystems can be modified to sustain them both (cf. Wells and Brandon 1993, Hannah 1992). I found that the population component of NGO projects entails the provision of family planning services–and "women's participation" creates the link to environmental remediation. This conclusion is not surprising given the multiplicity of women's roles in the developing world, often as principals in childrearing, agriculture, and harvesting CPRs (cf. Jacobson 1992).
2. In *developed countries*, sanctuaries have little chance for survival unless their resource needs are represented within regional planning. Chances for survival may be improved by creating a new set of relationships between community and the reserve. Because protection of wildlife populations has often been a source of conflict between sanctuary and productive interests beyond its boundaries (especially agriculture), community links may, in fact, be difficult to forge. I found that NGOs can create a new role for the sanctuary: as a facilitator for community participation in environmental debate, planning, and action. In the USA, the challenge for sanctuary managers lies in finding a place for reserved ecosystems and their biotic constituents within the idea of a sustainable community.

The Developing-Country Context

The project experience: Family planning and environmental NGO collaboration. Near Chiapas, Mexico, a Mexican conservation NGO, *Pronatura*, which owns a nearby nature reserve, provides land-management assistance and farming equipment to Indians who have been displaced from their own farmlands to settle nearby. Taking advantage of the cooperative relationship established between *Pronatura* and this new community, *Pathfinder International*, an international family planning NGO, has provided basic public health and family planning awareness training to both conservation professionals and Indian farmers (Aramburú 1994). Women in this community have been vocal in requesting that family planning become an integral part of the community's public health services.

On the other side of the world, The *Ranthambhore Foundation*, a local NGO working in 16 villages along the border of Ranthambhore National Park in Rajasthan, India (Ranthambhore Foundation, 1993), works with local farmers to create and manage alternative fuel and grazing resources outside the boundary of this world-famous tiger reserve. *Marie Stopes*, a public health and family planning NGO, has joined with the Ranthambhore Foundation to provide a mobile clinic for preventative health care focused on immunization, along with family planning counseling, referral, and some family planning services. Initial cooperation with villages was developed through agricultural, educational, dairying, and veterinary programs, spreading later to health and family planning. During the first four years since its start in 1989, this mobile health service treated upwards of 25,000 cases, and expects to work with between 8,000 to 10,000 cases per year. Presently,

a permanent village clinic is under construction. *Ranthambhore Foundation* efforts are part of a larger integrated conservation and development program within *Project Tiger* that includes resource management and educational projects conducted by two other Indian NGOs, the *Centre for Environment Education* and *World Wide Fund for Nature/India.*

Near Chautara in Nepal, potable water pours from a village spigot. Pipes have been laid down to the stream by a crew of farmers who received financial and technical assistance from international NGOs, *World Neighbors* and *Oxfam*, under the Baudha-Bahunipati Family Welfare Project (Hinrichsen 1994). Now that the need for walking long distances to fetch water has been eliminated, women find time to apply their energies to environmental projects and gardening. Families compost human and pig waste in underground digesters, generating both bio-gas for home fuel and fertilizer for their rice crops. In fact, the introduction of bio-gas technology has significantly reduced firewood consumption per capita in some villages. Effective contraception is also a component of the local development equation: a reduction in the need for infant care now frees women for greater participation in the village economy. About 33% of all families in the Chautara area participate in family planning services (a figure double the national average) provided by the *Family Planning Association of Nepal*, an NGO which initiated development work in the locality. Acceptance rates for family planning services are up to 50% in individual villages.

Family planning and environmentally sustainable technologies are brought together in Bla, Mali, where *CARE* and *Save the Children* worked together to construct and operate a solar-powered health facility, providing the means to support a high-quality clinical setting (Mojidi 1994) within which the *Center for Development and Population Activities (CEDPA)* supplies family planning services. Adding family planning has allowed more women to be involved in income-generating activities, including reclamation of land, waste management, and textiles. Many of the environmental activities in Bla also depend on the existence of this sustainable power source.

Family planning: Influencing women's lives. Fieldworkers and reviewers of these projects generally see family planning linked to environmental activities through women's time, labor and opportunity costs. The idea is not novel: social scientists have examined these as familial costs for children (cf. Lee and Bulatao 1983). The notion is also empirical–every parent experiences it. Children require of women both their time and their labor. When children are young they are generally most demanding of care, requiring less when they are older. Children cannot work when young, but may gradually assume tasks and earn as they mature. Because women accept opportunity costs (by definition) when they sacrifice a wage to perform child care, women's access to time-efficient technologies and productive occupations, as well as improvements to their education and status, can have important impacts on their desired fertility. More complexly, women's time diverted from childrearing can permit grown children to attend school, and additional earnings can support a child's education.

A three-loop decision model represents the basics of this simple notion (Figure 1): one loop considers the cost and benefits of infants and young children who generally are a *net drain* on women's time and labor; a second deals with children and adolescents, who can often make net contributions to family labor and ultimately to the security of parents (Cain 1983). Together, the two contribute to a perception of ideal family size. The third loop

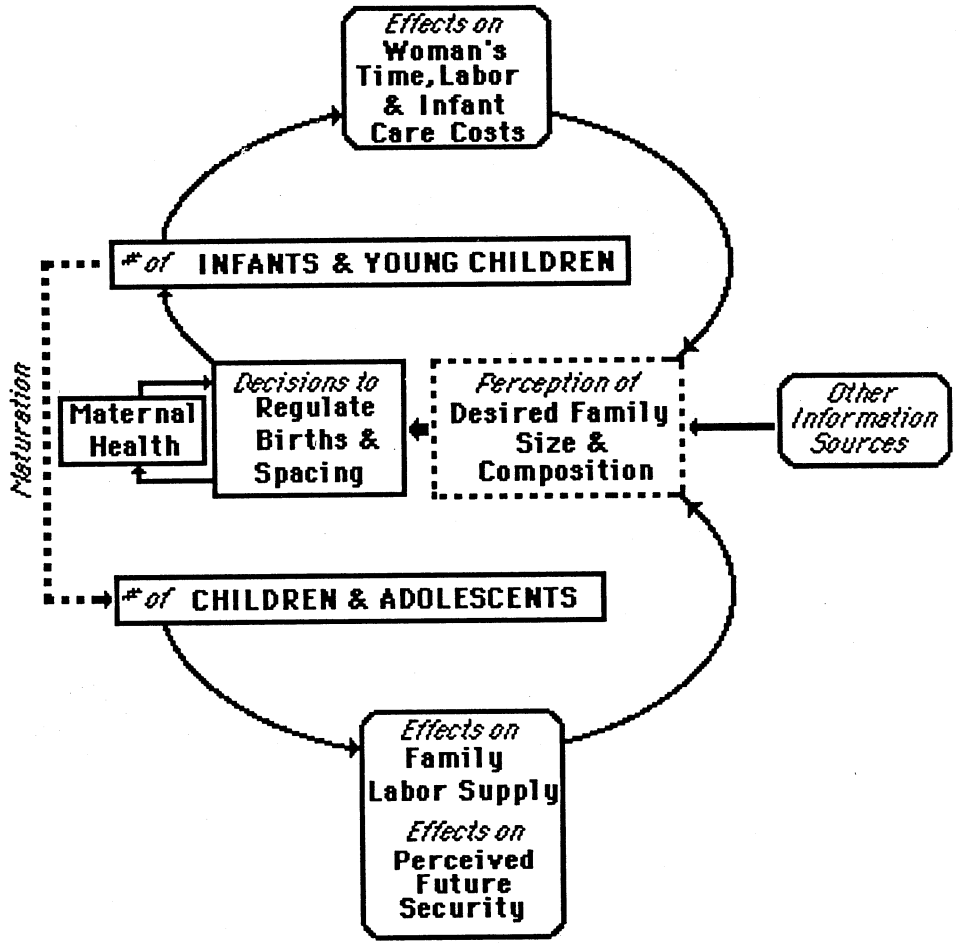

Figure 1. Conceptual model of decision-making, showing feedback processes recognized by fieldworkers: an *infant care loop* principally affecting and responding to women's time and labor, a *child and adolescent loop* concerned with labor and remittances from employable children; and a loop between *maternal health* and reproductive decision-making.

represents the interaction between maternal health and reproductive decision-making.

Decisions in childbearing and spacing lead to consequences that affect the time spent on infant care (note, in the figure, the top loop that pertains to infant care). Those same decisions, in later years, shape the composition of household labor supply (the second loop, pertaining to adolescents) and ultimately build parental security (Lindert 1978, 1980). The consequences of both loops, interacting with culture, observation, and information, continuously reshape people's perception of ideal family size, which influences their decisions on fertility. Additionally, maternal age at childbirth, birth spacing, and number of births are important factors in maternal and child health (cf. Population Reference Bureau 1991), and influence reproductive decision-making, especially when women have control over these decisions and have access to health information.

In general, fieldworkers suggest that when family planning NGOs work in parallel with environmental NGOs, there is a confluence of opportunities (Figure 2). Full access to family planning services (sex education, contraceptive information, and services) helps parents space and time childbirth, and achieve their desired family size, which, in developing countries, is significantly smaller than the family size they are likely to have with only limited access to modern contraceptive technologies (Sinding et al. 1994). Some technologies and programs offered by environmental NGOs appear to increase the demand for family planning by reducing household labor requirements for women, and increasing their spare time. These include water projects, wind-powered electricity generation, bio-gas generation, managed fuelwood plantations, and fodder banks. In addition, NGO programs often establish income-generating schemes (e.g., producer cooperatives, credit unions) in which women can participate in environmentally sustainable activities.

It is clear that there are several ways, locally, to enter into this development loop. If time- and labor-saving technologies and income-generating schemes are promoted for women, family planning is often requested soon after. Similarly, establishment of family planning services within a community has increasingly served as an entry point for NGO cooperation, as in the case of the Baudha-Bahunipati Family Welfare Project. However, it is just as clear that, whereas increases in available time and involvement in income-generating opportunities (as well as other socioeconomic improvements; see Bongaarts 1994) augment the demand for family planning services, they do not substitute for the service itself.

Conceptually, the model presented has narrow bounds: it does not provide for gender, i.e., differences in perspectives between male and female partners, the dominance of one partner in fertility decisions, and the perceived differences in value by decision-makers between girl and boy children. These are important considerations in understanding desired family size and fertility outcomes, but complex and beyond the scope of both my interviews and this discussion.

Population lessons learned by environmental NGOs. In each case, community development that links population and environmental concerns appears as a coupling of separate, disciplinary projects. Linkages are created by conscious efforts to refer households to other projects, and capitalize on each other's accomplishments. Family planning/health NGOs typically provide professionals, training, equipment, and commodities to a community in which trust and cooperation may already have been

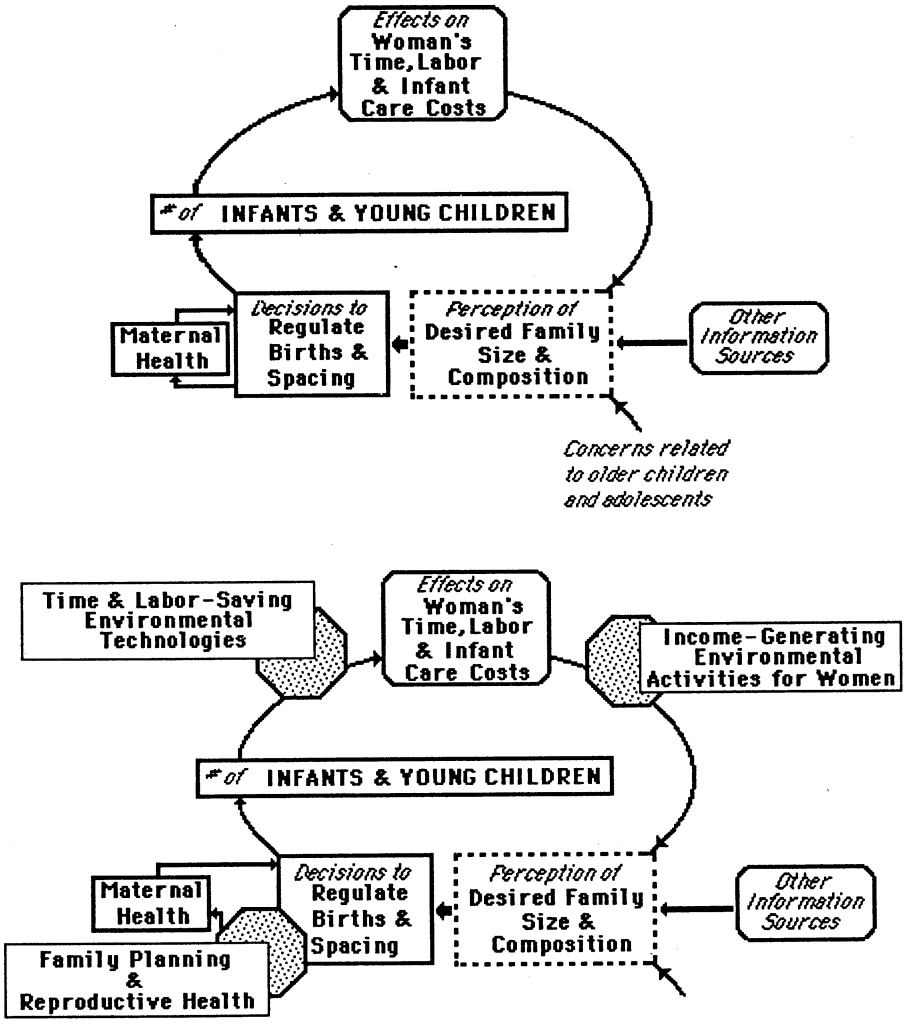

Figure 2. Family decision-making showing (above) the basic pattern of feedback concerned with infant care, and (below) feedback with environmentally sustainable development programs and family planning services added. Environmental NGOs often initiate sustainable energy and resource projects that save women's time and labor, and create opportunity costs among those women for additional childbearing and childcare. Thus, these environmental interventions often augment the demand for family planning services.

secured by other NGOs. Typically, environmental and agricultural NGOs establish an inter-community organizational infrastructure, such as producer cooperatives (e.g., dairy cooperatives in Bihar, India; Kak et al. 1994), which can be used to promote and introduce family planning education, training, and counseling.

From being closely connected to health NGOs that offer family planning programs, environmental NGOs are becoming tuned to a new set of complex realities that surround population as a field issue:

1. *The long-term environmental implications of demographics are critical at the national policy level, but they have little effect on households whose behavior responds to a short time horizon* (Aramburú 1994). The benefits of family planning services are embraced by individuals, especially women, and extend to family welfare in ways that will ultimately affect the community.
2. *Public health is an environmental issue.* Global society has entered a series of transitions toward a set of living conditions characterized by high human population density, mass technology, and high concentrations of waste (Drake 1993). Access to public health facilitates has become a human right of the 21st century, and access to voluntary family planning services is part of that right. Regardless of NGO commitment, it remains the responsibility of the state to provide adequate public health services for its citizens.
3. *While family planning addresses intrinsic population growth, it is only one of several important population-related processes that must be ameliorated if environmental sustainability is to be achieved.* Other population processes include migration, consumption of resources, efficiency and waste, population density and distribution, resource tenure, distribution and exposure to waste, and human-to-resource ratio. Most of these "sustainability issues" can only be addressed through progressive local governance and strong policy support at the national level.

Funding. NGOs have faced three major problems in funding initiatives that combine family planning and environmental remediation: (1) donor opposition to spending prioritized funds outside the disciplinary and sectorial scope of their priorities; (2) reluctance among family planning donors to spending funds in low-density rural locations as long as there remains unmet need for family planning services among dense urban populations; and (3) reluctance of environmental donors, who are interested in biodiversity conservation, to promote *attractive* public health services near sanctuaries. Opposition to integration occurs because program managers in donor agencies are disinclined to support mixed interventions unless that mixture is documented to produce synergies enhancing program efficiency. The second problem, where distant rural areas receive low family planning priority, occurs when rural costs per user are high, less costly urban family planning needs are still unmet, and program funds are limited—a situation that exists in most (if not all) developing countries. Finally, there are many advocates for biodiversity conservation who believe that the most successful conservation policies will ultimately be those that keep humans away from intact ecosystems. Thus, they are unwilling to promote services near those areas. In a world that is unlikely to stop growing before there are 11 billion inhabitants, trying to hide natural resources is a strategy that falls somewhere be-

tween the quixotic and the absurd.

Realistically, large donor agencies are most likely to maintain the "sectorial boundaries" that define their programs and associate them with a professional constituency. In general, sectorial programming provides a measure of cohesiveness to large programs that make them professionally, politically, and financially accountable. The pressures that make sectorial programming useful to managers and administrators are not about to dissolve. Whereas this may appear to be a bleak prophesy to some, there is, in fact, considerable movement toward broader programs among some development donors. For example, a broader expansion into select reproductive health interventions has been underway within USAID's family planning program (USAID 1994). In this case, few conceptual and programmatic barriers to integration exist: family planning and reproductive health are related concerns that can often be handled in a single visit to a clinic. Specific reproductive health interventions, such as those addressing the prevention and treatment of sexually transmitted diseases (e.g., HIV/AIDS), are known to augment the efficacy, quality of care, and acceptance of family planning programs.

However, it is this author's opinion that community development programs proposing both environmental and population components will continue to rely on (the often difficult task of) obtaining funding from several sources, then linking and coordinating those components in the field. Foundation funding may provide an exception: although they generally distribute less funds than government agencies, foundations tend to be less sectorial, and may be the most appropriate source for integrating small programs that cut across sectorial boundaries.

The Developed-Country Context

Developed-country projects in population and environment focus on the regional aspects of human population growth, generally the product of land development and in-migration, and its environmental impact. NGO projects stress the need for participatory environmental planning that sets limits on growth, and builds public concern over environmental quality, resource consumption, waste generation, and the need for an adequate public health infrastructure. In these projects, sanctuaries and reserved ecosystems are a focal point for community action and an indicator to the public of the extent to which regional growth has altered the capacity of ecosystems to sustain a diversity of life.

In the Rio Grande Valley near Brownsville, Texas, on the border between the USA and Mexico, *Sharing the Earth,* a project of the *National Audubon Society,* maps the spread of colonias: small shanty towns on both the US and Mexican sides of the river lacking adequate water, sewage, and access to public health services. Meanwhile, small factories, waste dumps, and incinerators continue to proliferate among slums on the Mexican side (Selcraig 1994). Local surveys show that the amount and quality of the valley's drinking water are declining rapidly to dangerous levels—the result of unplanned growth and exploitive environmental standards that have served land speculators and industrialists at the expense of poorer residents.

In addition to its effects on local people, unsustainable growth and development in the Rio Grande have negative impacts on nearby sanctuary ecosystems. For the Sabal Palm Grove Sanctuary, a 172-acre National Audubon Society reserve near Brownsville, Texas, future water volume and quality are, as well, critical issues. How these issues are resolved will ultimately decide the fate of the 32 acres of palm forest protected within the sanctuary—a

remnant of the 40,000 acres of dense palm groves that once bordered the Rio Grande (Farmer 1992). Staff members from the Sabal Palm Grove Sanctuary sponsor citizen-led soil- and water-monitoring projects. The project arms local people with the capacity to determine their community's environmental quality, and then helps them present the results of their investigations to the press. In addition, the project sponsors an active environmental youth group, and facilitates seminars conducted by public health and conservation organizations, including a Mexican Planned Parenthood affiliate.

Another *Sharing the Earth* program near Kearney, in the Platte River Valley of Nebraska, USA, involves local citizens in monitoring resource quality and drawing media attention to wildlife and supporting wetlands as indicators of the health of the river ecosystem. Aspects of this project are conducted in collaboration with newly established crane reserves in Pakistan and in Russia that experience comparatively light, but escalating human impacts upon their own river ecosystems and native crane populations. Press exposure (e.g., Kenworth 1994), comparative documentation, and exchange visits have attracted local and international attention to the problems of human population and economic growth, and the need to move quickly to eliminate present and future negative environmental impacts to the remnants of our natural capital.

Sierra Club, a US environmental advocacy group, has begun a "Local Carrying Capacity Initiative" which promotes community planning among North American cities—places of enormous sources of growth and resource consumption that threaten distant rural areas. The program extends a model represented in initiatives proposed or underway in several locations, including Lake Tahoe (*Tahoe Regional Planning Agency*), and proposals in Seattle (*Sustainable Seattle*) and Pittsburgh (*Pittsburgh Benchmarks*). Basically, these plans promote the establishment of measurable indicators of community well-being, whether social or environmental. Their objective is to arrive at indicators that are: (1) tests of sustainability, (2) easily understood and accepted by the community, (3) of interest and appeal to local media, and (4) statistically measurable (Sierra Club 1994). Indicators include considerations for regional natural resources, nearby wildlife habitat and wildlife populations. *Sierra Club* will be holding conferences in more than seven U.S. cities, mobilizing support for sustainable community programs in urban areas, promoting and developing planning and monitoring models, and raising awareness among local decision-makers.

Towards Sustainable Communities

What is a sustainable community? These projects do not provide a definition, but they certainly indicate that population size, environmental management, women's status, poverty alleviation, and access to public health facilities must be strong, interrelated components in any consideration of the fundamental parameters of a sustainable community. Most interesting, while there is a pervasive feeling that the transition to environmental sustainability will rely heavily upon technology and legal restrictions, these field projects, instead, rely on "rights of access," combining thinking from both public health and environmentalism. These include rights of access to environmental and public health information and decision-making, publicly owned environmental resources, and public health services.

When established, what relationship will exist between sustainable communities and nearby sanctuaries? In an environmentally sustain-

able community, rights of human access must be balanced with rights established to protect native species and their habitats, such as those rights implied by endangered species laws and international trade accords. Thus, sustainable communities would guarantee the protection of species and their habitats from extinction, and embrace accounting methods that recognize the long-term contribution of other species to quality of human life and culture, and to the stability, diversity, and productivity of the environment.

For the present in developing countries, the relationship between people and reserved ecosystems is strained but clear: these ecosystems provide vital environmental services such as water catchment, nutrient storage, energy, wildlife, and plant-material products to nearby communities. The challenge to sanctuary managers in the developing world is to move rapidly to create sustainable communities around reserves by encouraging good land-management practices, good governance, poverty eradication, stabilization of human population size, and a link between those populations and the sanctuary's future. In developed countries, reserved ecosystems are both physically and conceptually threatened: their ecosystem products are often insignificant when compared with the sheer size, mobility, and consumptive potential of regional human populations. The ability of industrial economies to import nutrients, energy, materials, and (to a lesser extent) water into human-dominated systems, and their massive reliance on non-renewable sources of these natural products, has opened an information gap separating people from an awareness of their environmental impact (see Postel 1994). In the industrial world, sanctuary managers can play an important role in filling that information gap, and thereby actively informing surrounding communities of their need to plan for a sustainable future.

Ed. note: This paper was presented at "Population, Health and Development: The Road to Cairo," the George Washington University Second International Health and Development Forum, 9 April 1994, Washington, D.C. The author is a AAAS Science, Engineering & Diplomacy Fellow at USAID. This fellowship, a program of the American Association for the Advancement of Science, sponsors academic fellows to provide scientific and technical advising within government agencies. Opinions expressed in this paper are the author's own, and not representative of U.S. government positions.

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- The *Local Carrying Capacity Campaign,* contact Mr. Brian R. Hinman, Sierra Club D.C., 408 C St., NE, Washington, DC 20002 USA.

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Population Growth, Demographic Change, and Cultural Landscapes

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Introduction

IN A RECENT ESSAY, GREEN (1993:11) DEFINES CULTURAL LANDSCAPES as the product of "spatial and temporal interaction of people with the environment." The work of Woodgate (1992; 1994) has focused on the linkages which connect socio-cultural and ecological sustainability, using the concept of agroecosystems to represent the productive interface between nature and society. As such, it is analogous with Green's definition of landscapes. This coincidence of concepts suggests that the academic disciplines which study these phenomena, namely agroecology and landscape ecology, may benefit from a little cross-fertilization. Therefore, this paper will attempt to bring some of the insights gained from agroecology to bear on the concern for the protection, preservation and management of cultural areas in the context of population growth and demographic change.

From Ecosystems to Cultural Landscapes

Although it is debatable whether or not natural ecosystems are truly cybernetic (Woodgate 1992:52-56), differences between natural and cultural landscapes are "introduced with human manipulation and alteration of the ecosystem" (Gliessman 1990:5) so that cultural landscapes can be considered as ecological systems modified by human beings in order to produce food and fibre products or aesthetic and wildlife values. In cultural landscapes, ecological processes such as competition, herbivory, and predation are overlaid and regulated by management practices such as cultivation, subsidy, control, harvesting, and marketing. Referring to agroecosystems, Conway (1987:96) suggests that "recognisable goals become apparent that are sought through human social and economic co-operation and competition." This gives cultural landscape boundaries a socioeconomic dimension.

The inclusion of both ecological and socioeconomic components within landscapes, and recognition of the complexity of organisation linking individual elements and subsystems within more inclusive landscape units, allows us to perceive the hierarchical character of landscape organisation, where each landscape unit forms an element of that at the next level in the hierarchy. The challenge then, is to find a research approach that takes account of this, conceptualising cultural landscapes as the product of interaction between society and nature, both in the past and the present.

Coevolution

One promising body of work that attempts to meet this challenge can be traced back to Richard Norgaard's (1984) paper "Coevolutionary Agricultural Development." Norgaard's work emphasises how people's "activities modify the ecosystem and how the ecosystem's responses provide cause for subsequent individual action and social organisation" (p. 525). Coevolution can be understood as the interactive synthesis of natural and social mechanisms of change (Woodgate 1992:87) that characterise

the relationship between social systems and ecosystems.

Conceptualising nature and society as complex, compound phenomena which are structured into a great variety of overlaid, interactive, arbitrarily delimited systems which coevolve across time and space, provides us with the key to understanding nature/society relationships. From this stand-point it is possible to focus on the idea that specific relationships not only exist between different social classes within specific social systems, but also between the social system and the natural system—what may be termed "socio-environmental relations."

This perspective highlights how the transition from natural ecosystems to cultural landscapes involves the transfer of certain maintenance and feedback functions from the natural to the social system. Indeed, "the idea that the social system frequently assumes the complementary activities and regulatory functions that were previously endogenous to the ecosystem or maintained by the individual farmer cannot be overstressed" (Norgaard 1984:529). Furthermore, in contrast to the classical view, which frequently attributes the high productivity of modern, capital-intensive economies to technological mastery over nature, the "coevolutionary perspective emphasises not only the increasing task specialisation and organisational complexity of maintaining feedback mechanisms between social actors and the environment" but also "between specialised social actors and the institutions themselves" (Norgaard 1984:530).

As industrialisation and specialisation have progressed, then, not only have socio-environmental relations become more complex, but social relations themselves have become more sophisticated. The increasing complexity of social organisation lengthens the chain of connections between society and nature so that the sustainability of highly industrialised societies becomes dependent not only on the maintenance of society/nature linkages but also on the upkeep of important linkages between individuals and institutions.

Bennett (1985:289) suggests that "[i]f we neglect the influence of humans and their institutions on the environment, rigorous knowledge of the way ecosystems work is of little use." We can illustrate the importance of this statement by referring to the case of agricultural development, in which we can see that demands for yields to increase exponentially have been met by increasing inputs of off-farm energy. "The rising costs of production however", says Bennett, "are concealed or charged to other institutional systems" (p. 292). Fossil hydrocarbons consumed in crop production, for example, are often charged to natural energy budgets or passed on to consumers. Thus, while improvements in fertilization, tillage and other agronomic techniques may appear to lower the environmental costs of agricultural production by maintaining soil and water productivity, they may in fact lead to increased environmental costs in some other sphere at some other time, such as the provision of clean drinking water in the future, for example.

What is perhaps even more important, but certainly less well understood, is that institutions and mechanisms, such as the market, often result in the negative impacts of production being transferred from one region to another. In other words, there are often spatial (as well as temporal) disjunctures between the causes and effects of environmental degradation. We shall return to this point in the next section of this paper where we examine the relationship between demographic factors and environmental change.

Population, Consumption, and Environmental Change

The relationship between population, consumption, and environmental change is increasingly recognised as a complex and ideologically polarised area of debate. This became apparent during the U.N. Conference on Environment and Development [UNCED, the "Earth Summit"] process where the South refused to accept discussion of population growth without it being linked to action on poverty alleviation, food security, and a reduction in levels of resource consumption in the North. For, notwithstanding the projected figures from U.N. sources that 90% of the expected 4.7 billion people that will be added to world population by 2050 will be born in the South, it is the industrialised countries that currently present the biggest threat to global environmental resources. Despite supporting only 24% of global population, the industrialised countries "consume 85 per cent of the world's metals, 92 per cent of its cars, 85 per cent of its chemicals, 81 per cent of its paper, 78 per cent of sawn wood, 72 per cent of milk and 48 per cent of cereals. They also consume 82 per cent of gasoline, 72 per cent of diesel, 85 per cent of gas and 82 per cent of electricity" (Parikh 1992).

Although it is necessary to take heed of global demographic dynamics, we do not intend to rehearse here the main historical-demographic trends and trajectories that characterise the major world regions (the topic is addressed, however, by Demeny (1990) amongst others). Rather, the purpose of this part of our paper is to explore some of the underlying features and dynamics of population change, relating these to aspects of wealth and poverty, and to questions of land-use and, thus, landscape change. Nevertheless, it is important to emphasise that the current, marked national diversity in demographic indicators is unparalleled in human history. Examples of such diversity include: natural growth rates of countries ranging from +4% to -0.2%; average family size from more than 8 to around 1.4; age structures that encompass the very youthful (half the population under 15 years) to the aged (less than 20% under 15); and levels of urbanization that range from 10% to 90% of total national populations. Given this extraordinary national diversity in demographic indicators—which are influenced by the complex interaction of environmental factors, economic activity, historical processes, social structures, and cultural traditions—we immediately become aware of an enormous variety of socio-environmental relationships.

A fresh conceptual approach to understanding the linkages between population and environment first requires that we address the issue of "carrying capacity" which, in our view, is problematic as it is entirely conditional on factors such as social structure, level of technology, and the consistency of climatic factors. Blaikie and Brookfield (1987) propose the concept "population pressure on resources" (PPR), which helpfully establishes a linkage without the need to specify critical thresholds embedded in the term "carrying capacity."

A second issue which deserves attention concerns the distinction between intensification and innovation. Intensification indicates increased output through the elimination of fallow and the use of inputs (capital and/or labour) per unit area. Innovation, on the other hand, embodies the qualitatively new ways in which the various factors of production are employed.

While intensification and innovation are certainly not mutually exclusive, where intensive systems are based on cheap and available labour, this may indeed inhibit innovation. Nevertheless, such labour-intensive production systems are

also able to contain the consequences of high levels of population pressure on resources, notably through the construction and maintenance of terracing and other forms of landesque capital. If labour is withdrawn from the maintenance of such systems, however, the consequences can be disastrous (Blaikie and Brookfield 1987, Woodgate 1994).

Clearly then, landscape degradation is not an inevitable outcome of population pressure on resources. Indeed many of the cultural landscapes that we cherish so deeply may have developed as a result of it, while their degradation and disappearance may, in fact, be a result of land abandonment. As Blaikie and Brookfield (1987:34) put it "degradation can occur under rising PPR, under declining PPR, and without PPR."

In common with many other treatments of the population/environment dynamic, the work of Blaikie and Brookfield focuses on resources use, treating the environment as a "supply depot." From this perspective, if we treat population as an independent variable, there are three general ways in which population growth can impact on the environment:

1. Population growth results in the expansion of the area under cultivation. Where the cultivated area expands into different ecological zones, in the absence of institutional and technological change, this may lead to inappropriate use of resources and, ultimately, environmental degradation.
2. Population growth results in the intensification of production, involving increasing investments of human, natural, and financial capital, and in innovation embodying the development of new technical means of production. While this technologically optimistic scenario represents the evolution of ever-more sophisticated land-management systems, non-sustainable outcomes may appear in the medium-to-longer term (e.g., groundwater pollution, declining soil fertility).
3. Population growth is neutral in terms of its impact on the local resource base, either through the importation of food from elsewhere (as in urban areas) or as excess population outmigrates from rural areas, resulting in no demographic pressures for local land-use change (Sage 1994:40).

While the third point may be true at the local level, the coevolutionary framework outlined above alerts us to the fact that the absence of local landscape change does not exclude the possibility of changes elsewhere: food imports are produced somewhere, and excess population must be accommodated somewhere. These are the spatial disjunctures to which we referred earlier. In addition, the coevolutionary perspective sensitises us to the notion that there may also be reverse effects of population growth through negative feedback loops, where changes in the productive potential of the environment, resulting from PPR, influence the determinants of population: fertility, mortality, and migration.

Although population dynamics clearly influence landscape changes then, they do so in association with at least two other socioeconomic variables: technological capacity and levels of consumption. Thus, in any given landscape, environmental impact (I) results from the interaction of at least three variables, population (P), per-capita consumption or affluence (A), and technology (T). This creates a useful shorthand expression, I=PAT, which is now widely used in the literature. Its appeal may stem from the way it diffuses the singular re-

sponsibility of population, enabling it to be applied equally in the industrialised countries of the North and the largely rural economies of the South. A critic of inappropriate technology such as Barry Commoner has used a variant of the I=PAT expression to calculate the total environmental impact of industrial pollution and to argue that it is primarily the technological factor rather than population which needs to be controlled (Commoner 1972). Yet, in much of the policy literature, one still detects more enthusiasm to isolate population as a factor for attention than to address either consumption and technology or uses of the environment other than its "supply depot" function. For example, "for any given type of technology, for any given level of consumption or waste, for any given level of poverty or inequality, the more people there are, the greater is the impact on the environment" (UNFPA 1990:10).

While this is strictly correct, it hardly seems fair or meaningful to hold all factors other than population constant. This point is made even more forcefully if we widen our consideration of human use of the environment beyond its function as a "supply depot" and incorporate its role as a `waste repository' and "living space": that is, if we look at what we add to the environment and how we change its appearance, as well as being concerned with what we take from it (Catton and Dunlap 1989, Redclift and Woodgate 1993).

In the context of the North, this extended focus makes it clear that changes in the factors of consumption (A) and technology (T) are likely to be more important than population levels *per se*. Research conducted by Ehrlich and Ehrlich (1990) supports this notion. Employing per capita use of commercial energy as a proxy measure for affluence and technology, they calculate that each baby born in the United States has an impact on the Earth's ecosystems three times that of one born in Italy, 13 times one born in Brazil, 35 times one in India, 140 times one in Bangladesh and 280 times one born in Chad, Rwanda, Haiti or Nepal.

By extending the scope of our model to incorporate the ways we add to and refashion the environment, we can also see that, in the largely industrial economies of the North, landscape change may derive from qualitative changes in our use of the local environment as well as quantitative increases in consumption. Examples might include the constant need to identify new landfill sites for the disposal of waste; the continuously increasing aspirations for personal mobility which involve road-building schemes; the ongoing suburbanisation of the countryside; and leisure interests, most spectacularly illustrated during recent years by the conversion of farm and other land into golf courses (Pleumarom 1992).

Rising per capita income, as part of a process of economic development, is a major variable of landscape change, as we have seen in relation to the I=PAT formula. Yet the impact of rising income will vary as a function of base levels of income and patterns of income distribution. This relationship is manifest in differences between the North and the South. In the North, where base levels of income are already relatively high, the income elasticity for food is low and approaching zero, whereas it is high and positive for goods and services such as housing and recreation (Pierce 1990). In the South, by contrast, average incomes are much lower, so that a rise initially stimulates relatively large increases in demand for basic food goods, although as incomes continue to rise and basic needs are met, the composition of demand is likely to change accordingly (Crosson 1986). Thus, traditional grains and tubers gradually give way to higher-protein diets and acquired

dietary tastes, such as livestock products, imported cereals, and processed foods. Consequently, it is through the changing effective demand for food that rising levels of income exert different pressures on landscapes.

The work of Bilsborrow and Geores (1990) reflects these differences between North and South. After suggesting that the two main factors responsible for increasing environmental degradation are increasing per capita incomes in the North and increasing populations in the South, they clarify their statement by saying:

> [W]ith per capita incomes in low-income countries one-tenth those of developed countries, even with four-fifths of the population residing in low-income countries the bulk of the growth in effective demand upon resources in low-income countries in recent decades is attributable to *increases in the high levels of consumption of developed countries* (Bilsborrow and Geores 1990:35, emphasis added).

This argument is underpinned by the Ehrlichs, who make reference to the Netherlands in developing their case about worldwide overpopulation. They argue that the Netherlands can support a population density of 1,031 people per square mile, "only because the rest of the world does not. In 1984-86, the Netherlands imported almost 4 million tons of cereals, 130,000 tons of oils, and 480,000 tons of pulses. It took some of these relatively inexpensive imports and used them to boost their production of expensive exports—330,000 tons of milk and 1.2 million tons of meat" (Ehrlich and Ehrlich 1990:39).

The relationship between rich and poor countries, as between classes within countries, is determined, ultimately, by superior economic power expressed in the market place which provides the necessary signals and incentives to the sphere of production. Supported by structural economic reforms to remove "distortions," the market has heralded a growing trend in many developing countries where basic food staples and valued cultural landscapes have given way to export crop and feed-grain production, often resulting in increasing environmental degradation.

The complexity of the linkages between demographic and landscape change demonstrates the vital importance of examining trends in the different categories of land use (which are fraught with definitional and measurement difficulties) and how these might correlate with demographic and economic indicators. Yet an exercise in complex data analysis should not preclude attention to other variables that mediate between population and the environment: technology most certainly, but also the socio-political structure of societies and the various cultural traditions that characterise different ethnic groups.

In the following section of this article, the framework and understanding developed in the preceding sections will be used in an analysis of landscape change in Britain, tracing the coevolution of society and environment from the end of the feudal era. In order to contrast this process comparisons will be made with continental Europe.

The Coevolution of Cultural Landscapes in Britain & Europe

The importance of the coevolutionary perspective to the task of preserving and managing cultural landscapes is at least two-fold. Firstly it provides an integrated socio-environmental analysis of why and where landscapes might be changing. Secondly, it forces us to confront some of the moral issues that our mission entails. We shall return to these ethical questions in our final discussion. Before that, let

us look at the example of cultural landscape change in Britain.

The work of Pretty (1990) attests to the high innate sustainability of feudal agriculture in Britain, suggesting that it was promoted by the "integrated nature of farming, the great diversity of produce, including wild resources, the diversity of livelihood strategies, the guaranteed source of labour, and the high degree of cooperation" (p. 1). Nevertheless, the classic unenclosed, stripcultivated, three-field system of manorial agriculture did decline in Britain, and eventually disappeared as a result of the agricultural restructuring brought about by the Parliamentary Enclosures (c. 1750-1850) to be replaced by a fully fledged capitalist agriculture by the middle of the nineteenth century.

The rationalising of land into viable holdings in Britain involved much displacement of labour, leaving discrete farm units and fewer farmers, giving rise to the distinctive pattern of small fields enclosed by hedgerows and stone walls that today we cherish so highly and regard as basic units of "traditional" lowland farming landscapes. The nature of these landscapes (the products of socio-environmental relations which no longer pertain) makes them very difficult to preserve. As we have already noted, economic growth which increases production and prosperity is not evenly distributed, and often seems to be linked to landscape change and social deprivation in rural communities. Despite the fact that the countryside accounts for by far the greater part of the land area and a substantial part of the population in European countries (80% of the land and over half of the population in the European Union (EU) as a whole), policy measures to address these issues have only recently begun to be developed. This is largely because the rural economy and countryside amenities have been seen as indissoluble from the practice of farming, indeed virtually as incidental by-products of agriculture. Rural policy has thus been essentially agricultural policy. In Britain this identity has been challenged over the last two decades and a rural policy independent of agriculture is now emerging. In other parts of Europe ties to agriculture are still very strong and they continue to dominate EU thinking and policy. To comprehend these different viewpoints more clearly we need to understand differences between the coevolutionary pathway that has unrolled in Britain and that which has transpired of much of mainland Europe.

With the repeal of the Corn Laws (1846), which had provided protection against cheap imports, British agriculture was alone in Europe in its exposure to the rigours of competition in an expanding world market. Initially, however, the landed classes were able to capitalise on the country's position at the forefront of the Industrial Revolution and, during the third quarter of the nineteenth century, British agriculture rose to a peak of activity, receiving large-scale investment and employing its highest-ever number of labourers. The nature of agricultural production was changing as a result of the new industrial inputs and advances in engineering techniques. High yields were being obtained through the use of fertilisers, improved livestock feeds, drainage, mechanisation, and investment in infrastructural capital. High-input farming was high-profit farming, and for a while at least everyone seemed to prosper.

The term "high farming" also denoted high status. During the mid-Victorian period it was still essential for a nobleman to be a landowner. Land possessed a symbolic importance far beyond its economic or political significance. National heroes who had been born commoners had to be provided with suitable estates if they were to be el-

evated to the peerage, such was the case with Nelson, Wellington, and Disraeli. Similarly, those who had made their fortunes in commerce and industry also searched for country seats to set the seal upon their aristocratic aspirations.

As industry and agriculture boomed, the nature and structure of village life was changing. The countryside was becoming "ruralised." The new systems of factory production were able to produce commodities which rendered much of the village-based, small-scale manufacture and craftwork obsolete. Many of what are now regarded as the best examples of traditional English villages were in fact medieval textile towns, which reverted to an agricultural status following the transfer of textile production to the North during the Industrial Revolution.

Even those villagers who did not work directly on the land were employed in ancillary trades such as milling, blacksmithing, and cartwrights' workshops. Because of this dependence on agriculture the village was becoming what we might call an "occupational community," whose whole existence was based on the fortunes of the farming industry. Today this occupational community is regarded as traditional, but in the mid-nineteenth century it was novel. Villagers then looked back to the more economically diverse communities which had existed prior to the enclosures and the onset of full commercialisation.

From 1875 until 1939, except for the period of the First World War, British agriculture fell into a chronic depression, characterised by falling product prices, reducing rents, increasing bankruptcies, and an unkempt countryside. The change from the prosperity of high farming was an abrupt one. The 1870s mark a turning point in English rural history, when the implications of the Industrial Revolution and the expansion of international trade became clear. It was a period in which farming ceased to be one of the country's major industries or even a major source of the nation's food supply.

Although other newly industrialising European countries sought to counter the effects of free trade with the imposition of import tariffs, England remained true to the principles of free trade. By 1851 the newly emerging industrial towns and cities had already attracted vast numbers of working people out of the countryside, making Britain the first nation to have the majority of its people residing in urban areas. To the country's urban majority, free trade meant cheap food and successive proposals for tariff reform consistently failed to win electoral support. Only during the First World War were the principles of *laissez-faire* set aside. During the rest of the period from 1846 until the Second World War, agriculture became secondary to industry, which required cheap food in order to keep down the cost of labour. If this resulted in agricultural decline, it was regarded as small price to pay for benefits promised by industrial growth.

With the decline in agricultural prosperity and the acceleration of industrial growth and development, the role of rural areas began to change and new socio-environmental relationships coevolved. Deprived of its productive importance, the countryside became more and more of an amenity, something to be appreciated and consumed. The period of agricultural decline saw the establishment of institutions such as the National Trust in 1895 and the Council for the Protection of Rural England (CPRE) in 1926.

Although the 1930s was a decade of depression, the social effects were by no means evenly distributed. Unemployment was concentrated in the highly industrialised areas of the North and West, but the South-east continued to grow, based largely on

the expansion of consumer goods manufacture. Among the goods that the relatively affluent employees of such industries began to consume was the countryside.

With increasing car ownership and housing development in the suburbs, the countryside became more accessible. Through the experience of their consumption of the countryside, the urbanites constructed a rural England almost completely at odds with the realities of the time. Appreciative of the aesthetics of rural landscape, the history of rural tradition, and the value of the natural environment, they were almost completely ignorant about agriculture and the economic basis of rural life.

The construction of the rural idyll and its increasing consumption brought with it problems, however. By the 1930s a recognisable preservation lobby had emerged and was pressing for constraints to be placed on the destruction of the rural arcadia. Bodies including the CPRE and individuals such as Patrick Abercrombie were pressing for the designation of National Parks, Green Belts, and a generalised system of Town and Country Planning. On the other side of the equation were those who were pressing for greater access. The Ramblers Association, founded in 1932, launched a campaign to open up the hills and moors of the North and West to public access. Matters were brought to a head in April 1932 with the mass trespass of Kinder Scout, one of the Duke of Devonshire's grouse moors, which eventually resulted in the passing of the Access to the Mountains Act of 1938.

Nevertheless, on the eve of World War II, thousands of hectares of arable land lay abandoned, agricultural bankruptcies were commonplace, thousands of farm workers were unemployed or underpaid, and rural communities had been sapped of their cultural vitality, presenting a very different picture from the still largely peasant-based agriculture of France. Between 1939 and 1945 much of this was transformed however.

One major factor can be identified as accountable for this transformation: state intervention, intervention which clearly transferred a great deal of decision-making power from the farmer to state agencies, thereby lengthening the chain of connections between society and nature. As external trade was once again threatened by the resumption of submarine warfare, farmers were offered an incentive to increase production through the medium of guaranteed prices.

The agencies responsible for translating policy into action were the county-based War Agricultural Executive Committees. They offered advice, issued cultivation orders for parcels of land, and allocated resources such as fertilisers, feedstuffs, and machinery. Cropping programmes were administered by distributing production quotas throughout their local areas. Their activities thus defined in precise detail the crop mix and husbandry techniques to be employed on virtually every piece of farmland in the country.

This intervention and loss of autonomous decision-making power was accepted by the farmers and landowners, principally because the same committees were also responsible for administering the subsidies and grant aid needed for investing in items of capital. The War Agricultural Executive Committees thus provided a model for state intervention which was maintained and built upon in the post-war period. Until 1979, the governments which followed were determined not to let agriculture slip back into the depressed conditions which had prevailed for over half a century prior to the 1940s.

As a result of the strategic status granted to agriculture, agricultural policy was allowed to become en-

tirely single-minded in its aims: the production of ever-increasing quantities of cheap food. In terms of the environment's supply depot function, the results were spectacular: yields increased by 300% over the next forty years and by 1983 Britain had become virtually self-sufficient in temperate foodstuffs.

The results of this policy direction can be seen not only in the economic status and prosperity of agriculture, but also in the social and ecological changes which have occurred in rural areas. The replacement of horses and people by tractors and combined harvesters has led to the loss of nearly two-thirds of the agricultural labour force over the years since 1945. The need to realise the potential economies of scale offered by mechanisation has resulted in a wholesale loss of woodlands, hedgerows, and small ponds. The introduction of increasingly toxic agricultural chemicals has compounded this loss of habitat and led to the near-extinction of numerous species of fauna and flora. The state regulation of agriculture has profoundly altered both the structure of the farming industry, the traditional character of life and work in the countryside, and, in the process, transformed the physical appearance and ecological status of the land.

Despite their small numbers (today less than 1% of the population), British farmers have exercised extraordinary control over agricultural/rural policy in the post-War period. However, since 1980, the revelation of agricultural over-production and the huge subsidies being paid by taxpayers and consumers, in what was supposedly a cheap food policy, has seriously weakened the political power of the farming community in Britain. Nevertheless, under the EU Common Agricultural Policy (CAP) British farmers have been protected (by the political power of their European, particularly French, colleagues) from the swinging cuts that have been the fate of other industries in overcapacity. In France, as in other parts of mainland Europe where agriculture remained ostensibly peasant-based until the post-War era, small farmers and traditional farming are seen as a vital part of the country's cultural heritage to be strongly protected—if necessary at considerable cost. This was a key factor behind the French intransigence which almost led to the breakdown of the 1994 GATT negotiations. Similar attitudes have also shaped the CAP, where maintaining farm livelihoods is a major concern, and EU rural policy, which sees the family farm as its very basis.

A European agriculture modelled on the USA with large reserves of land and few farmers has been rejected within the EU in favour of a farm-survival policy. The means for achieving this are farm diversification through support for: environmentally friendly farming systems, forestry, and tourism; the clustering of rural services and infrastructure into key villages; and integrated rural development programmes. Although these policies have met with some success in Britain, with more than 50% of European farmers aged over 55 and almost half of these lacking a successor, a continuing decline in the number of farmers seems inevitable.

In contrast to declining agricultural populations, aggregate rural populations are more buoyant as townspeople migrate to the countryside in search of their vision of a rural arcadia. Some take up part-time farming and aim to manage their holdings in environmentally friendly ways, but such people are newcomers who often contribute little to the maintenance of local culture, services, or infrastructure. Furthermore, by inflating house prices and using private transport to distant towns for shopping, schools, and other services, contributing to clo-

sure of local shops and schools, they may actively lower the living standards of less-wealthy local residents. In seeking to protect their chosen portion of rural Britain the "NIMBY" (Not in My Backyard) environmentalism of newcomers may also prevent the development of new job opportunities for locals displaced from agriculture. Thus, the identity of the environmental and social objectives of the farm-survival policy is questionable, as the new stimulation of farm diversification and development scattered into the very heart of the countryside raises fundamental questions of both its desirability and the ability of the planning system to cope with it.

Fears about farm diversification pale into insignificance, however, when compared to concern over land abandonment. The spectre of scrub and dereliction is seen as the alternative if agriculture-based livelihoods are not maintained. Even the weedy fields of short-term set-aside are an embarrassment to farmers grown used to the sterile, manicured countryside of intensive farm systems. The large scale withdrawal from agriculture which has occurred in countries like France is anathema to most mainland Europeans, while in Britain such migration is little more than a distant "folk memory."

In the mountain and Mediterranean regions where land abandonment has mostly taken place, substantial environmental problems can ensue. The growth of rank grass and scrub following the cessation of grazing in the mountains can lead to a greater incidence of avalanches and interfere with skiing. In arid Mediterranean climates the build up of biomass consequent to the succession from grass to scrub greatly increases the risk of devastating fires. The reasons for maintaining farm structures in mainland Europe thus seems incontrovertible, whether they can be maintained or even need to be maintained everywhere, however, bears some consideration.

Coevolution and the Preservation of Cultural Landscapes in a Global Context

In this final section we shall try to pull together some of the strands of thought that have been developed throughout this article. Cultural landscapes have been characterised as the product of coevolution between nature and society, and it was noted that the linkages between nature and society have become more complex as industrialisation has progressed. In reviewing the likely impacts of population growth and demographic change on landscapes, we suggested that the relationship between population dynamics and landscape change is:

- Conditioned by additional socioeconomic factors such as affluence and technology;
- Often characterised by disjunctures between cause and effect in both space and time;
- Only intelligible if we take account of our use of the environment as a waste repository and living space, as well as a supply depot.

By tracing the coevolution of nature and society in Britain and making comparisons with mainland Europe, we were able to see how distinctly different agroecosystems and landscapes have developed. With Britain's accession to the European Union, however, which introduced British agriculture to the influence of the Common Agricultural Policy, we have also recorded the subjection of British landscapes to the influence of policies designed to provide for the maintenance of an agricultural structure which has long since been transformed in Britain. Continental European and British perceptions of landscape and rural society are different and thus likely

to require different measures to ensure their survival. In searching for practical ways to address this situation we can draw on the participatory appraisal techniques that have been developed for the practice of agroecology (e.g., IIED/MYRADA 1992).

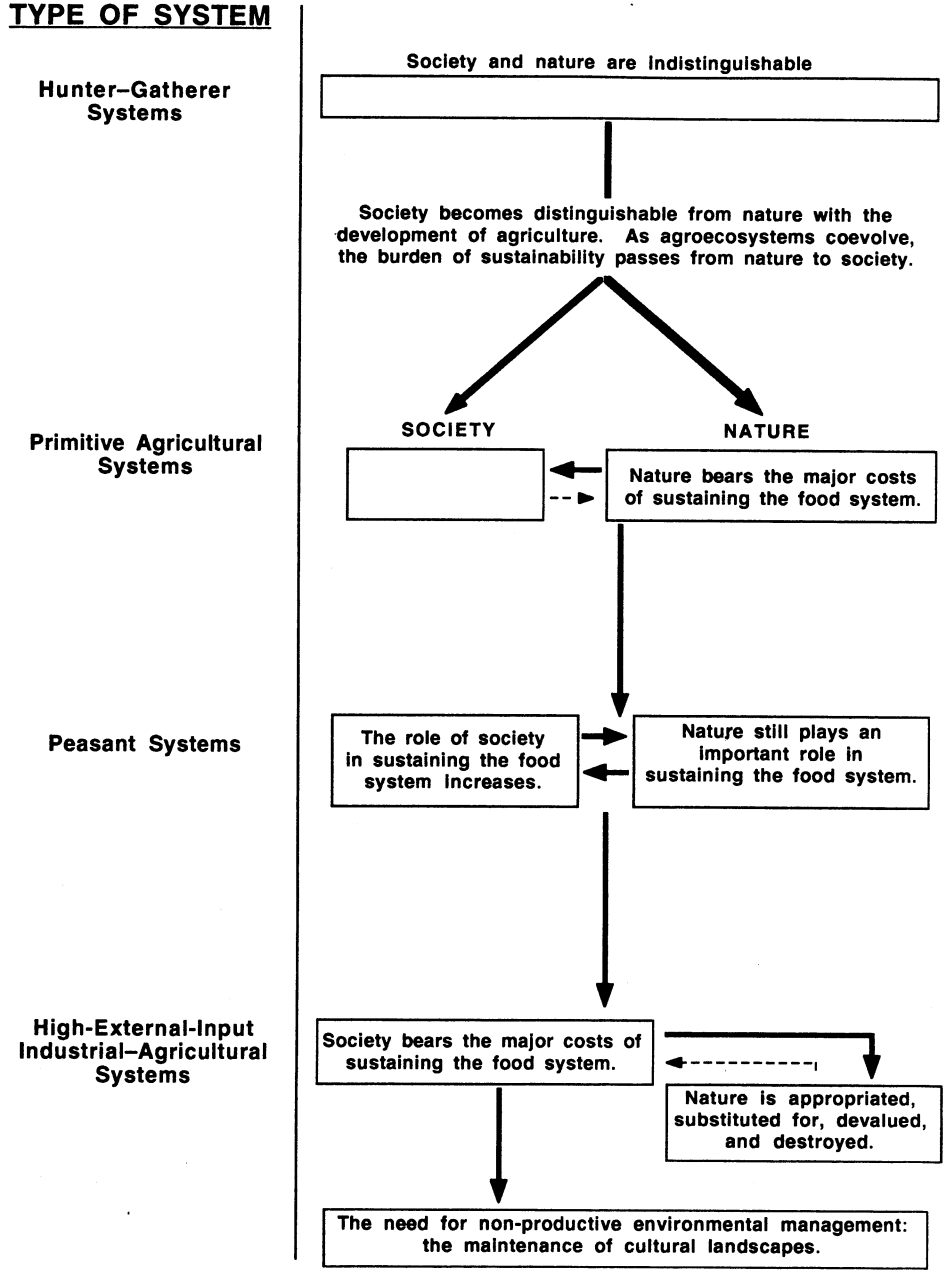
The process of coevolution between nature and society as it has unfolded in Britain is represented in diagrammatic form in Figure 1. What the diagram suggests is that, as industrialisation has progressed, society has taken on more and more of the maintenance and feedback functions that were previously either endogenous to ecosystems or carried out by individuals. Today, the burden of sustaining the food system depends on society rather than nature. In considering the coevolution of society and nature in Britain, we saw how agriculture initially incorporated industrial inputs into its production systems during the third quarter of the nineteenth century but was unable, in the long run, to compete with cheap imports from the colonies, going into decline until the Second World War. It was during this period, however, that demand for environmental goods other than food and fibre began to grow quickly and conflicts between the functions of supply depot, waste repository, and living space became evident. With the advent of war, Britain's lack of food self-sufficiency triggered state intervention with productivist policies which remained in force until the beginning of the 1980s and led to the development of what are termed high-external-input industrial–agricultural systems (see Figure 1).

The consequences of the productivist policies had become obvious by the end of the 1970s, demonstrated by the degradation of landscapes and ecosystems and the rapid decline of the agricultural population. The degradation of environment is explained in Figure 1 by referring to the appropriation, substitution and subsequent devaluation of nature. This refers to the process whereby crop species and ecological processes are abstracted from nature, taken into the laboratory, transformed by science, and then substituted for by the products of science (hybrid varieties, pesticides and fertilizers, and mechanical technologies). As a result, the original species and processes are devalued and, as with all things that are devalued, they are eventually destroyed. This destruction of nature is clearly linked to the destruction of local culture, a process which is unquestionably evident in much of the South today.

It is the visible destruction of cultural landscapes (which have their origins in socio-environmental relationships that are long since past), that prompts the need for non-productive environmental management, for only the material products of landscapes are valued in the marketplace. Although our quest to preserve these relicts of bygone times may stem from a desire to protect nature and maintain links with our rural heritage, notice should be taken of the problems that have been associated with attempts to maintain rural livelihoods that encompass socio-environmental relations that are an anachronism in the context of an ever-expanding global economy (Woodgate 1992).

More importantly, however, if our brief excursion into coevolutionary theory has highlighted one central problem, it is this: any attempts to preserve cultural landscapes "here and now" are likely to have implications for other landscapes somewhere else or at some other time. Thus, it is particularly important to ask ourselves what these implications are, or are likely to be in the future. As members of high-consumption societies, which depend upon imports of vast quantities of commodities from low-consumption societies, we need to face up to the question of whether or not

Figure 1. Coevolution between nature and society



Source: adapted from Redclift and Woodgate 1993

our ability to preserve cultural landscapes here and now is bought at the expense of landscapes elsewhere, particularly those of the South. Is there not a contradiction between our attitudes and behaviour when we condemn the devastation of the Brazilian Amazon, for example, while at the same time we are designating National Parks in our own backyards?

Acknowledgment

The authors are grateful to Professor Bryn Green, Head of the Environment Section at Wye College, for providing them with materials to draw upon in the writing of this article.

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Sustaining the Wild equals Sustaining the World

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THROUGHOUT THE WORLD, GOVERNMENTS AND PRIVATE CITIZENS alike expend a great deal of time and energy exploring and debating weighty issues such as war and peace, nuclear proliferation, the economy, education, poverty, international relations, the preservation of democratic institutions, health care, jobs, and many more, as they should. This is important stuff and it deserves constant attention.

But there is something far more important: the status of the habitat which sustains all plants and animals, including humans. The hard reality is that no war, revolution, or peril in history measures up in importance to the threat of continual, relentless, and pervasive environmental deterioration. The first order of human business must be to reverse that process.

The issue that can no longer be ignored or shunted aside is already visible on the horizon. It is identified under various titles such as "sustainability," "sustainable development," "environmentally sustainable society," "carrying capacity"—all referring to the same basic concept. A society that manages to meet its needs without compromising the ability of future generations to meet their own needs is described as a sustainable society.

At this point in history, no industrial nation has managed, either by design or accident, to evolve into a sustainable society—and that includes the United States. On the contrary, they are all pursuing a self-destructive course of fueling their economies by consuming their capital—that is to say, by degrading and depleting their resource base—and counting it on the profit side of the ledger. That, obviously, is not a sustainable situation over the long term.

It is interesting to note that capitalist and communist countries alike have quite happily and uncritically shared the same philosophy respecting the utilization of their resources. "Maximum exploitation of all resources with little or no consideration for the environmental consequences" has been the guiding ethic. Immeasurable damage has been done worldwide. It has been worse in those nations behind the Iron Curtain simply because there was no freedom for democratic protest, but the difference is a matter of degree only.

Though some positive change is underway, the degradation of life-sustaining ecosystems continues, ranging from modest to serious to disastrous throughout the industrial and developing world. As a species, human beings must revive in themselves that "intelligent humility toward our place in nature" that Aldo Leopold wrote about sixty years ago, a necessary humility that can best be expressed by how our species perceives and honors the wilderness that sustains us all. It was Leopold who also wrote that wilderness was the anvil on which the artifact called civilization was forged. It is wildness, with its biological diversity and complex systems of life, that nurtures all human enterprise still.

Worldwide, only 26% of Earth's land mass remains as wilderness, exclusive of Antarctica. Some of that is desert, reflected in the 54% of Botswana that is wilderness, the 42% of Egypt, and the 70% of Mauritania.

Some is icy wilderness near polar regions: 29% of Iceland is wilderness and much of the 64% of Canada that is wilderness is in the far north. The large deserts and the polar regions make up a large chunk of the world's remaining wilderness. Of the rest, a little wilderness is deliberately designated in lands selected for preservation purposes. Five percent of the total land in the United States, for example, is specifically designated as wilderness. The U.S. wilderness system consists of 591 separate areas covering 95 million acres and administered by the four federal land agencies. The rest is wilderness only because it has not yet been obliterated by the onslaught of human population growth and industrial development. Everywhere, the remaining wilderness is disappearing—rainforests are slashed, rivers dammed and polluted, grasslands eaten away, soils depleted, ecosystems that have taken million of years to evolve destroyed in the blink of an eye that is human history.

The question is often asked: Isn't there an inherent conflict between wilderness preservation and meeting the needs of the people? I turn that around and ask: Isn't there an inherent conflict between meeting the needs of the people and destroying the nature we need? Are we so sure we know how to meet the needs of the people that we will destroy, helter-skelter, the eons-old lab in which Nature has evolved its fascinating array of ecosystems, species, and landscapes? Nature tends toward a vast array of species and interactions, with wide variation within species. Human agriculture, on the other hand, for example, has tended toward monoculture, putting humans at increased risk of wide-scale disaster due to disease, infestation, or genetic breakdown in the food production chain. By assuming that open lands and wilderness must necessarily give way to human population growth and consumption patterns, we will destroy the very school to which we all should be dedicating our considerable intelligence and energy.

This year, representatives of most of the nations of the world will meet in Cairo at the International Conference on Population and Development. The discussion will focus on developing a global plan of action to address population growth, development needs, and the interaction of the two. Throughout the debate will be scattered references to "sustainability." It will be vital that the delegates recognize the no development, no economy, is sustainable unless it is environmentally sensitive and environmentally sound. Development is not sustainable if it destroys the home of the plants and the animals—and the plants and the animals need wilderness to survive.

Therefore, the bottom-line question is obvious and critical. Can we evolve into a sustainable society during the next three or four decades? That is to say, a sustainable society which we would view with approval. The answer is "yes"—*if* certain things happen. In the United States, two of those certain things are these: strong political leadership starting at the presidential level, and the support of an ecologically literate society imbued with a guiding environmental ethic. The evolution of such an ethic within our culture is happening right now at a rapidly accelerating pace.

The president has a key role. He must articulate the issue and outline a long-range program that will begin to lead us toward a sustainable society. An extended national educational dialogue is a necessary precedent to any action and the president must lead and invigorate the dialogue. A general understanding and consensus must evolve—an understanding that the basic wealth of our nation is our life-sustaining resource base. In short, our wealth is the air, water, soil, forests, minerals, rivers,

lakes, oceans, scenic beauty, wildlife habitats, and biodiversity. Take that resource base away and all that is left is a wasteland.

Dr. Lester Brown of The Worldwatch Institute states the same case in another way. As he puts it:

> Three biological systems—*croplands, forests, and grasslands*—support the world economy. Except for fossil fuels and minerals, they supply all the raw materials for industry; except for seafood, they provide all our food. Forests are the source of fuel, lumber, paper, and numerous other products. Grasslands provide meat, milk, leather, and wool. Croplands supply food, feed, and an endless array of raw materials for industry such as fiber and vegetable oils.

In short, that's all there is. That's the whole economy. That's where all the economic activity and all the jobs come from. These biological systems contain the wealth of the world accumulated over the ages. All around the planet these systems are under varying degrees of stress in almost all places, including the United States. The deterioration ranges from mild to disastrous. As we continue to degrade them we are consuming our capital. And, in the process, we erode living standards and compromise the quality of our habitat. It is a dangerous and slippery slope.

As these biological systems deteriorate, the capitalist system deteriorates with them because it is destroying itself by consuming the capital that sustains it. This process can be reversed if the political system and corporate community make a radical course change and embrace the concept of sustainability. If, in fact, the free enterprise system as we know it is to survive, capitalism must become an Earth-friendly enterprise. If it continues down the path of unrestrained resource depletion, it will simply self-destruct.

There are encouraging signs that many corporate leaders recognize that only an Earth-friendly capitalism can survive and prosper. The more quickly the Congress, the public, and the private sector recognize this simple reality, the more quickly we can begin to address the issue.

In a dramatic and sobering joint statement (made in 1992), the U.S. National Academy of Sciences and the Royal Society of London, two of the world's leading scientific bodies, addressed the state of the planet in the following words: "If current predictions of population growth prove accurate and patterns of human activity on the planet remain unchanged, science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world." Given the great prestige and the conservative bent of such scientific bodies, their shocking observation with its sweeping social, political, and economic implications cannot be brushed off as radical environmentalism or alarmist nonsense. Astonishingly, this remarkable statement received less notice in the press than last night's basketball game.

Lots of vexing issues will need to be addressed during this long process of forging a sustainable society. For one thing, what kind of sustainable society would we like to design and live in? The concept of sustainability or carrying capacity for the human species is flexible in the sense that it depends in part upon the standard at which we wish to live or would find acceptable. For example, China and the United States are just about the same size—3,600,000 square miles. The United States has a population of 260 million and China 1.1 billion. I would guess the United States could support 1.1 billion people at the Chinese standard of living and their quality of life and with many of their

restraints on mobility and freedom. But who among us would want that?

As part of the necessary national education process in this country, I hope appropriate committees of Congress can be persuaded to undertake a series of hearings on sustainability. What is it? Can we achieve it? How? Can anyone think of anything more important for us as a society to understand than what must be done to achieve a sustainable society? Congressional hearings on sustainability would inform the public, the Congress, and the president. It would give recognition to this vital issue and help force it onto our national political agenda.

When experts are asked to list the most critical environmental problems they are practically unanimous in ranking at the top of the list the calamitous consequences of continued exponential population growth. Even by the most optimistic scenarios, world population will increase from 5.3 billion to 6.3 billion during this decade. Does anyone really believe this will be a better world with a billion more people in the year 2000 and better still when world population doubles in a few more decades, or that the United States will be a better country with 150 or 250 million more people, or that New York, Miami, Chicago, Detroit, and Los Angeles are better cities now than when they were half the size and will be better still when half again as large? The answer to these questions is obvious. Indeed, the population of the United States already exceeds its carrying capacity—that is to say, its current population is being sustained by continued erosion of its resource base. This is not a sustainable situation over the long term. It is the road to bankruptcy. It is irrational to continue to travel that road when forging an alternative is feasible.

The concept of exponential population growth comes home to me rather dramatically when I contemplate that the population of the world was only 1.7 billion in 1916, the year I was born. It was 3.7 billion when I organized Earth Day in 1970, and will be about 6.3 billion in the year 2000. Since 1916 U.S. population has rapidly expanded from under 98 million to 260 million and still growing. The numbers boggle the mind—a net increase in world population of 95 million per year—260,000 a day or 10,800 an hour.

With a growing population has come a growing pressure on wilderness, with visitation going so high as to necessitate the use of reservation or permit systems in some wilderness areas. Indian Peaks, Colorado, and San Gorgonio Wilderness Area, California, are two examples, with much of the visitation coming from the nearby population centers of Denver and Los Angeles. In addition, the wilderness character of other federal public lands is under attack. The National Park System had just 358 thousand visitors in 1916, jumping to 33 million in 1950, 172 million in 1970, and over 270 million last year. So many cars now line up to enter Yosemite National Park that the wait just to get in the gate can be several hours long. Great Smoky Mountains National Park, a World Heritage Site, is within driving distance of about 150 million people and experienced a 10% jump in visitors in the 1980s. The parking lots at Yellowstone National Park are full by mid-May, early in the tourist season, and park visitation jumped by nearly 50% during the last decade. Many national forests and wildlife refuges suffer the same sort of visitation pressure.

The rising population also puts pressure on the federal public lands with its rising demand for natural resources. The demand for oil is threatening wilderness areas in Alaska and Montana. Timbering has forever altered the wild character of the national forests in the Rocky Mountains, the Pacific Northwest, and New England, and

threatens the remaining ancient forests. Air pollution from metropolitan and power-producing regions escapes regional boundaries and corrupts the air over such parks as Grand Canyon and Sequoia and wilderness areas scattered from the Appalachians to the Sierras.

After population, the experts list such vital matters as the threat of global warming, pollution of the oceans, declining biodiversity, groundwater pollution, hazardous wastes, and many more. All of these issues would rank high on any list. Ironically, however, an issue at least of equal importance to population is rarely noted or mentioned anywhere. Yet it is the key to our environmental future. The absence of a pervasive, guiding conservation ethic in our culture is the issue and the problem. Society's answer must be to focus its attention and energies on nurturing a conservation generation imbued with a conservation ethic. Without such a guiding cultural ethic society will not have the understanding, motivation, conviction, or political will to persist in addressing the truly hard questions that will confront us in the decades to come.

When we find educated and distinguished citizens like Professor Julian Simon and Ben Wattenberg arguing that population isn't a problem, that more is better, a closer examination inevitably reveals that they are economists. No biologist or ecologist would make that argument.

Mainstream economists think the health of the economy and the wealth of the nation are measured by the simplistic exercise of adding up the annual production of goods and services without factoring in the accumulated environmental deficit or the annual cost of environmental deterioration. Whereas the economics profession should be at the cutting edge of the drive to forge a sustainable economy, they are instead an intellectual and political impediment to the process. Thus, except for a relatively small number of resource economists, the profession has made itself irrelevant to the central issue of our time. The extent of their irrelevancy was aptly put by Amory Lovins when he said, "Economists are those people who lie awake nights worrying about whether what actually works in the real world could conceivably work in theory."

Often lost in the economic discussion of development, species preservation, scientific, and agricultural research, is the equally important but unquantifiable aesthetic and spiritual importance of wilderness, parks, forests, coastlines, and other open areas. The technological and economic vistas in our minds should not be allowed to obscure the beautiful vistas of our lands. I cannot imagine a more poverty-stricken world than one in which there are no mountains or forests to gaze across without the eye running into angular concrete and mirror windows; a world in which the rivers are sterile and restricted to straight concrete beds and there are no bubbling brooks or leaping trout and salmon; a world where the beaches are no longer scattered with the detritus of nature—surf-smoothed stones, sea shells, strands of kelp—and are instead covered with the detritus of "civilization": cigarette butts, abandoned plastic toys, beer cans, and wadded paper. For our mental elbow room to be big enough to save our environmental elbow room, a conservation ethic must be widespread.

Is it elitist to want to preserve nature and revive an "intelligent humility toward nature"? I think not. Before being visited by the consumer way of Western life, many local cultures around the world preserved just such an intelligent humility, farming in environmentally sensitive ways, looking to nature for cures to their ailments, and thanking

their gods for the sheer beauty of their surroundings.

Fortunately, there are encouraging signs that human societies in many parts of the world are beginning to recognize their obligation to and dependence upon the whole community of life. The U.S. is beginning to develop a conservation ethic that will ultimately flower into a powerful social, political, and economic force. The sooner this happens, the better.

A committed conservation generation is crucial to the political process through which we will do or fail to do what is necessary to forge an environmentally sustainable economy in the next three or four decades. It cannot be said too often—education and more education is the key to it all. We already have extensive experience in environmental education in hundreds of schools across the nation. The state of Wisconsin, for instance, has become the first to mandate environmental education in every school, from kindergarten through 12th grade.

A well-designed environmental education program will produce an informed and committed conservation generation that will provide the moral and political support necessary to move the nation to a sustainable economy. Ecological literacy is the only foundation on which a successful long-term program can be built and sustained. Indeed, ecology is the defining study, the revolutionary science of our time. It is a science that must become a part of the common knowledge of the general public. For the first time in history we have a science that needs to be understood by the man on the street if it is to serve its purpose.

While the science of ecology with its endless ramifications may be the most complicated of all disciplines, the fundamental guiding principles underlying the science of ecology are quite simple and easily understood by children in grade school. *Everything is connected to everything else; and all creatures are sustained by the same ecosystem.* That is all one has to understand. Once we have nurtured a generation that understands the basic nature and functioning of our life-sustaining ecosystem, a generation that recognizes that all creatures, including humans, are sustained by the same ecosystem, a generation that appreciates its role and impact on that system, from that, of necessity, will evolve a guiding environmental ethic.

We are dealing with a social, ecological, and economic challenge unlike any other in human history. It is a challenge that begs for the kind of dedicated, inspirational leadership provided by Franklin Roosevelt and Winston Churchill in their pursuit of victory in the Second World War. This challenge is far more serious than the military threat to the democratic west in World War II. Nations can recover from lost wars—witness Germany and Japan—but there is no recovery from destroyed ecosystems.

The opportunity for a gradual but complete break with our destructive environmental history and a new beginning is at hand.

The Soviet superpower has disintegrated, the Communist menace has dissolved, and the Cold War is over. Still, the United States has yet to find a unifying theme, a moral cause to replace what Winston Churchill called "the peace of mutual terror," that fear that bound so many nations together in a common cause and shaped our own society for nearly two generations. This, despite the fact that a monumental moral cause is near at hand and a far more serious challenge than the Cold War ever was. It is the war against the planet. How do we bring it to an end and where do we start? It must start in the United States. We must, in fact, be conscious that not only do we need to preserve our own resource base, but we are responsible for the consumption of the resource base of many other

countries—their minerals, water, food production, timber.

The U.S. cannot and should not wait for the rest of the world to develop a consensus on sustainability. That means the process must start with the president. He is the one person who can bring it all together; the one person who can lay out a new environmental course for the nation to pursue over the next thirty or forty years; and, clearly, he is the only one who can command the necessary attention to force the issue of sustainability into the political dialogue of the country and onto the national political agenda.

Whatever else the president may do during his time in office—including balancing the budget, reducing the national debt, and establishing a workable long-term health care plan—these dramatic successes would be little noted in history compared with the mark he would leave if he became the president who successfully set the United States on a course toward an environmentally sustainable economy. Our three greatest presidents achieved their rank in history because they successfully rose to lead the nation and meet the grave challenges of their time. The historical events confronting Washington, Lincoln, and Franklin Roosevelt were less important than the environmental challenge is today. That is so because the status of our environment will determine for all time the viability and the quality of life on the planet for all creatures. With U.S. leadership showing the way, other world leaders must increase the call for population stabilization and more sustainable resource use in their own countries.

The bottom line is this—a sustainable existence at some bare subsistence level will ultimately evolve even if human societies simply do nothing. Unfortunately, at that stage we will end up debating over Earth-friendly solutions to scarcity.

All of this will be enormously complicated and controversial far beyond anything ever before attempted and will extend over a period of many years. The debate and controversy are vital to the process of developing public understanding and support for making the hard decisions and the right decisions. And if we humans fail to make such decisions, nature will make them for us and for all future generations.

Protected Area Deforestation in South Sumatra, Indonesia

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Introduction

THE PURPOSE OF THIS PAPER IS TO EXPLORE THE RELATIONSHIPS between population and the environment at the local level.[1] Empirically, we attempt to determine why small-scale coffee farmers have deforested large portions of established protected areas (i.e., designated "protection forests" and wildlife reserves) within the district of Lahat, South Sumatra, Indonesia. The relationships between population and the environment tend to be complex, fluid, and mediated by a number of additional factors. The relationships between farmers and protected forests in Lahat are no different. This more complicated notion of the relationship between population and the environment, however, is frequently overlooked in the literature.[2] Since these are forest areas under a managerial regime, it follows that politico-administrative factors must have contributed to their deforestation. But how important are other factors? And, are they related to changes in population? Finally, from a policy perspective, can we gain any insight from our research into how to best correct local population-environment imbalances?

Tropical Deforestation and Protected Area Status

Deforestation of the world's tropical forests is a major international issue that needs little introduction. Environmentalists and others are concerned about the loss of biological diversity, possible climatic change, the replacement of forests with unsustainable agricultural activities, flooding, erosion, loss of hydrological functions, and more (WRI 1990; Global Coalition 1990; Gradwohl and Greenberg 1988). The pace of tropical deforestation is alarming. The World Resources Institute has estimated the rate of tropical deforestation at approximately 20.4 million hectares per year (WRI 1990:102). This latest estimate almost doubles the U.N. Food and Agricultural Organization's 1980 estimate of 11.4 million hectares per year (WRI 1988).

From the latest figures on tropical deforestation, Indonesia is ranked third among all countries in annual forest loss, losing an estimated 900,000 hectares of tropical forests each year, a rate of 0.8% per year (WRI 1990:102). Throughout the tropical countries, including Indonesia, the principal forces behind the deforestation of tropical forests are said to be agricultural expansion (largely due to increasing population) and unsustainable commercial logging. However, both these factors can usually be traced to governmental policies of one form or another (WRI 1988, 1990; Repetto 1988), as well as to other issues such as the technologies being employed and cultural practices. Specifically, in Indonesia, slash-and-burn farming causes about 50% of the country's deforestation; the government's resettlement program, 40%; and commercial logging, 10% (Repetto and Gillis 1988). Consequently, when attempting to control tropical deforestation in Indonesia, understanding the behavior of rural people and the pressures they face become essential tasks.

Parks and other protected areas throughout the world, likewise, are seriously affected by events originating outside their borders. They include: industrial pollution, excessive tourism, shrinking or nonexistent budgets, land fragmentation, economic development pressures, growing rural populations seeking arable land, and angry residents (Machlis and Tichnell 1985; Meganck and Goebel 1979; Brechin and West 1990; West and Brechin 1991a). Once again the problems facing our world's parks and protected areas can certainly be traced to a number of causes including population growth pressures, economic development activities, changes in lifestyles, poverty, lack of economic alternatives, and short-sighted governmental policies.

In Indonesia, it has been estimated that 17% of the country's protected forest areas (i.e., forests that are not to be cut) have either been logged or cultivated by farmers (Vatikiotis 1989). Although there has been some international work to investigate the effect of population factors such as growth and migration on tropical deforestation in general, it has not generally extended to their effects on specific protected areas (Allen and Barnes 1985; Vayda and Sahur 1985; Whitten 1987; Potter 1988; Rudel 1989; and Cruz and Cruz 1990). Likewise, in the study of protected areas, numerous publications have noted the problem of farmers and others encroaching on protected areas (Vogt 1946; Wetterberg 1974; Meganck and Goebel 1979; Machlis and Tichnell 1985; West and Brechin 1991a). Few, however, have looked at the population-environment dynamics of farmer encroachment in any detail. This case study investigates the socio-political causes of farmer-based tropical deforestation and its effects on conservation management efforts.

Description of Study Site and Methods

South Sumatra is a vast (109,254 square kilometers) province of Indonesia, on Sumatra, one of the country's major outer islands (Figure 1). The

Figure 1. Lahat District of South Sumatra

province was home to about 6.3 million people in 1990, and contains a variety of ethnic groups, 80% of whom live in rural areas (1990 Census; unpublished information from Sriwijaya University). South Sumatra is blessed with natural resources such as forests, oil, gas, coal, and other minerals, and produces many agricultural products. Its capital, Palembang, is a national center for the chemical and cement industries. Ecologically, the province consists mostly of lowlands and coastal wetlands. The exception is a mountainous region in the extreme western portion of the province, including its highest point, the volcano Mt. Dempo, at 3,159 meters (10,425 feet). Mt. Dempo is the climax of a larger mountain range, known as Bukit Barisan, which runs north to south along the western edge of Sumatra.

The study area is located in the Kabupaten (district) of Lahat, which is in the western highlands. A rich agricultural region, Lahat is a major center for the coffee which is cultivated throughout the higher elevations. Within Lahat there are protected areas under several different management categories (conservation/national parks, protection forests, limited-production forests, and regular-production forests), which, after their expansion in 1982, cover about 290,600 hectares. Consequently, about 41.4% of Lahat is officially deemed to be under forest management (Surapaty et al. 1991).[3] Such a large protected area has placed considerable pressure on available land resources. Nearly 80% of Lahat's protected areas are non-commercial conservation areas (protected forests and wildlife reserves), not meant for harvesting (Table 1).

The study, to date, has concentrated only on five southern kecamatans (subdistricts) within Lahat: Pagar Alam, Jarai, Kota Agung, Pulau Pinang, and Tanjung Sakti. These were selected because: (1) their deforestation of protected areas is relatively high and thus they have received considerable attention from the government; (2) the people found in these kecamatans share a common language, Pasemah;[4] (3) coffee is widely grown there; and (4) it is home

Table 1. Protected forests in Lahat

TYPE	SIZE (HA)	PERCENT TOTAL
Conservation/National Parks (Hutan Suaka Alam)	79,500	27.3
Protection Forests (Hutan Lindung)	149,600	51.5
Limited Production Forests (Hutan Produksi Terbatas)	21,750	7.5
Regular Production Forests (Hutan Produksi Tetap)	39,750	13.7
TOTAL (ALL TYPES)	290,600	100

Source: Lahat Forestry Department; Surapaty et al. 1991

to many of the illegal farmers. Data are still being collected for this study, but research teams have made field visits in July 1989, August 1990, January 1991, and May 1991. Information has been collected from a number of sources. In-depth, conversational-style interviews with farmers, political officials, and former traditional leaders have been conducted. Secondary data on population, economics, agriculture, and forestry have been obtained from subdistrict, district, and provincial governmental agencies, including forestry departments, development planning boards, statistical offices, and trade associations, and from published literature.5

Probable Causes of Deforestation

The problem of illegal farming in the protected forests of Lahat appears to have begun in the mid-1970s. The movement of farmers, which began as a trickle, became a steady stream by the mid-1980s. Satellite images clearly show dramatic loss of forest cover between 1982 and 1989 and even between 1982 and 1985. In 1988, a government report concluded that illegal farmers in Lahat were responsible for deforesting 29,399 hectares (or about 18%) of the district's protected areas (see Tempo 1990; Surapaty et al 1991).6 (See Table 2.)

The environmental consequences have been locally and provincially signif-

Table 2. Protected area deforestation by forest name and subdistrict (unexpanded area, 1988)

FOREST NAME	SUBDISTRICT	AREA (HA)	DEFORESTATION AREA (HA)
Gunung Dempo I	Pagar Alam, Ulu Musi	3,750	100
Gunung Dempo II	Pagar Alam, Tanjung Sakti	8,500	200
Bukit Dingin	Tanjung Sakti, Pagar Alam, Ulu Musi	34,300	1,000
Bukit Runcing	Merapi	8,640	500
Gunung Patah	Pagar Alam, Tanjung Sakti, Kota Agung	33,775	3,000
Bukit Raja Mendaro	Pagar Alam, Jarai	7,450	1,200
Bukit Hitam	Pagar Alam, Jarai	4,460	400
Isau-Isau Pasemah	Pagar Alam, Jarai	3,276	50
Gumai Pasemah	Lahat, Jarai, Tebing Tinggi, Ulu Musi	12,810	4,000
Isau-Isau Lematang Ulu	Kota Agung	2,286	714.5
Gumai Lematang Ulu	Tebing Tinggi, Ulu Musi, Pagar Alam, Lahat	29,210	17,526
Gumai Tebing Tinggi	Lahat, Tebing Tinggi, Ulu Musi, Pagar Alam	3,863	650
Bukit Balai	Tebing Tinggi	13,585	58.5
TOTAL		165,905	29,399

Source: Lahat Regional Forestry Department

icant. Complaints from villagers at the foot of these mountains have grown in recent years. In particular, villagers are noting formerly uncommon problems such as floods during the rainy season and lack of water in the dry. Irregular water flow has disrupted village life, bringing increased health problems, silting of the traditional irrigation systems used for rice cultivation, and even some deaths (1991 Field Notes, Tempo 1990).7 Soil erosion throughout the region appears to be clogging important natural waterways. For example, provincial authorities noted that the Musi River, the area's largest, is rapidly silting up, affecting both commercial water traffic and the river's fisheries (1989 Field Notes, Donner 1987).

In a month-long operation from August 1990, government personnel with police escorts used helicopters to forcibly remove all illegal farmers from a number of protected forest areas, including Mt. Dempo, Gumai Pasemah, Mt. Patah, Isau-Isau Pasemah, and Isau-Isau Lematang Ulu, and at the mountains near Kota Agung. A number of the farmers, along with a local official, were jailed. At a few locations coffee trees and farmers' temporary houses were burned (Sriwijaya Post 1990a, 1990b; Tempo 1990; 1991 Field Notes). This has frightened illegal farmers sufficiently to keep them out of the mountains so far. In so far as the government is concerned, the era of illegal coffee farming in Lahat has come to a close.8

From our research there appear to be several factors that have encouraged certain farmers to continue to illegally cultivate coffee in the protection forests. They include: population density pressures from natural growth and in-migration; the coffee production cycle, including the traditional shifting cultivation practices of local coffee farmers; inadequate protected area management practices; and economic incentives created by changes in the international coffee market.

Population Pressure Factors

Numbers and density. A critical issue of this research concerns the possible impact population pressures may have had on the area's land resources, especially the forests. Increases in Lahat's population size and density over time may have resulted in farmers eventually overwhelming the available arable land for coffee and other types of cultivation. Deforestation of the area's protected forests and nature reserves could be, then, the result of farmers being forced to cultivate the steeper slopes of the protected areas, possibly the only available lands left for cultivation. Indeed, support for this notion comes from population data which compares Lahat with South Sumatra (Table 3).

Table 3. Population figures for South Sumatra by district: 1961, 1971, 1980, 1990

No.	District	Numbers 1961	1971	1980	1990	%Population Change 61-71	71-80	80-90
1.	Kodya Palembang	474,971	582,581	786,607	1,139,926	2.27	3.50	4.49
2.	Kodya Pangkal Pinang	60,283	74,733	90,068	113,163	2.40	2.05	2.56
3.	Musi Banyuasin	296,226	374,876	591,074	883,719	2.66	5.77	4.95
4.	Ogan Komering Ilir	378,260	445,788	564,031	771,463	1.79	2.65	3.68
5.	Ogan Komering Ulu	381,524	538,575	750,763	963,794	4.12	3.94	2.84
6.	Muara Enim	332,456	363,769	430,827	586,075	.94	1.84	3.60
7.	Lahat	310,035	372,821	484,814	599,347	2.03	3.00	2.36
8.	Musi Rawas	185,693	252,420	366,081	512,077	3.59	4.50	3.99
9.	Bangka	251,639	303,804	399,855	513,946	2.07	3.16	2.85
10.	Belitung	102,375	128,694	163,599	192,972	2.57	2.71	1.80
	Total	2,773,462	3,438,061	4,672,719	6,276,482	2.40	3.46	3.56

Source: 1990 Census
Population Change (61-71) defined by (population 71-population 61)/(population 61)*100 %)/10 years

Table 3 clearly demonstrates the level of population increases for Lahat and South Sumatra. From 1961 to 1990 Lahat increased from 310,035 individuals to 599,347, an increase of about 93%. During the same period, the South Sumatra province grew from approximately 2.8 million to about 6.3 million, an increase of about 125%. Although Lahat's population has nearly doubled over the last thirty years, it rose considerably less than the average of all the districts. It is not understood why this is the case.

Although population size is commonly linked with discussion about environmental impacts, population density is a more useful indicator for gauging land pressure (Table 4). It is quite clear that, after excluding the urban areas of Palembang and Pangkal Pinang, Lahat is the second most densely populated district within South Sumatra. This tends to support the possibility that farmers in search of new land were forced up the mountains. A number of those interviewed indicated that farm land began becoming noticeably scarce in the 1970s.9

Table 5 lists the population density of our study area in 1990, adjusted for the

Table 4. Population density in South Sumatra by district: 1961, 1971, 1980, 1990

NO. DISTRICT	AREA (KM^2)	1961	1971	1980	1990
1. Kodya Palembang	244	1,946.60	2,387.63	3.223.80	4.671.83
2. Kodya Pangkal Pinang	32	1,883.84	2,335.41	2,814.62	3,536.34
3. Musi Banyuasin	25,669	11.54	14.60	23.03	34.43
4. Ogan Komering Ilir	21,658	17.47	20.58	26.04	35.62
5. Ogan Komering Ulu	10,408	36.66	51.75	72.13	92.60
6. Muara Enim	9,575	34.72	37.99	44.99	61.21
7. Lahat	7,014	44.20	53.15	69.12	85.45
8. Musi Rawas	21,513	8.63	11.73	17.02	23.80
9. Bangka	11,614	21.67	26.16	34.43	44.25
10. Belitung	4.532	22.59	28.40	36.10	42.58

Source: 1990 Census
Population density defined by population in the year divided by land area (People/Square Kilometers)

land area under protection status. When the protected areas are subtracted from the total land area, the population density of Lahat and our study area increased significantly. Table 5 demonstrates that the subdistricts of Jarai and Pagar Alam are relatively much more densely settled than the other subdistricts of the study area. Jarai, at 315 people/square km (1990), is near the density of Bali in 1961 (320 people/square km) (Biro Pusat Statistik 1987), which is not an insignificant level. It is important to point out, as well, that most of the protected area deforestation within this study area is found in these two subdistricts.

In comparing the amount of deforestation the number of illegal farmers, and the density levels (all by subdistrict), a series of striking correlations emerge. When evaluating subdistricts, those with low-to-high amounts of deforestation correspond exactly to those with low-to-high numbers of illegal farmers, and again with those with low-to-high population densities. These numbers are given in Table 6.10 The figures obviously suggest a strong relationship between population density and deforestation.

Migration: Transmigrants or local migrants. The existence of a relatively high population density, however, tells little about how the area became that way or where the illegal farmers come from. Inmigration is a likely possibility. In addition to the natural rate of increase (i.e., population growth resulting from number of births exceeding number of deaths) of 2.38% per year, South Sumatra, including Lahat, has experienced significant in-migration. The province has, for some time, been a major designation site for the government's transmigration program (Romsan 1989; Whitten 1987). Romsan (1989:54) estimates that between 1934 and 1988, 741,425 persons were relocated to South Sumatra from

Table 5. Population density of study area (and other subdistricts in Lahat), 1990

NO.	DISTRICT/ SUBDIST.	AREA (KM^2)	PROTECTED FOREST (KM^2)	POPULATION 1990	DENSITY (POP/KM^2)
	LAHAT DISTRICT	7,014.23	2,906.00	599,347	146
1.	Pulau Pinang	344.57	169.65	21,612	124
2.	Kota Agung	436.82	167.20	31,179	116
3.	Pagar Alam	586.79	161.50	106,075	249
4.	Jarai	391.86	250.00	44,686	315
5.	Tanjung Sakti	482.71	193.50	24,865	86
6.	Merapi	677.18	228.75	32,659	73
7.	Pendopo	269.83	100.00	41,538	245
8.	Ulu Musi	750.68	399.15	45,360	129
9.	Muara Pinang	441.91	287.85	51,256	333
10.	Tebing Tinggi	703.05	233.95	52,813	113
11.	Kikim	1,215.05	426.65	53,657	68
12.	Kota Lahat	713.78	287.80	93,627	220

Note: Population density= Size of land area of district/Subdistrict minus amount of forest protection area, divided by population size, 1990.
Source: Office of Statistics, South Sumatra and 1990 Census

Java and the other densely populated inner islands of Indonesia. Although most of these families were sent to lowland areas, a number of transmigrants were relocated to areas within Kabupaten Lahat as well.

This influx of migrants may well be a possible source of illegal farmers. There are stories throughout Indonesia of failed relocation projects, forcing the transmigrants to seek livelihoods elsewhere (Secrett 1986; Whitten 1987; Hanson 1981). There have also been cases of transmigrants invading the protected forests of Indonesia (Whitten 1987 suggests it is a minor problem, while Secrett 1986 suggests it is major). Romsan (1989; Romsan, per. comm. 1991) has found transmigrants to be important sources of forest destruction in some parts of South Sumatra. Table 7 gives the transmigration numbers for South Sumatra and Lahat from 1980 to 1987.

Table 6. Relationships between the amount of deforestation, number of illegal farmers, and population density by study area subdistricts

Subdistrict (STUDY AREA)	Amount of Deforestation (HECTARES)	Ilegal Farmers (NUMBERS)	Density (POP/KM^2)
Jarai	722.25	1782	315
Pagar Alam	559.50	1142	249
Kota Agung	295.25	1034	116
Pulau Pinang	256.50	744	124

Source: BAPPEDA Office, Lahat District

Table 7. Transmigration in South Sumatra and Lahat, 1980-1987

Year	South Sumatra	Lahat	Percent Within Lahat
1980-1981	67,167	9.014	13.42
1981-1982	103,472	6,851	6.62
1982-1983	50,896	3,600	7.07
1983-1984	17,847	2,012	11.27
1984-1985	20,039	2,764	13.79
1985-1986	4,844	2,872	59.29
1986-1987	32,510	4,815	14.81
TOTAL	296,775	31,928	10.76

Source: Statistical Office of South Sumatra Province

Table 7 shows that 31,928 of the transmigrants to South Sumatra, about 11% of the total, settled in Lahat. Although transmigrants only represent about 5.3% of Lahat's total population in 1990, this is not an insignificant number. The arrival of thousands of people needing land could have directly or indirectly encouraged the deforestation of the area's protected forests. In addition, the greatest deforestation appears to have occurred during this same time in the mid-to-late 1980s.

Based upon the interviews with officials and farmers, however, it appears that illegal farmers are not from ill-fated transmigration projects. Rather, the illegal farmers tend to be local migrants, i.e., from other local areas (kecamatans or subdistricts) within Lahat, from an adjacent Kabupaten, or from Bengkulu, a neighboring province. This finding tends to support the conclusion of Whitten (1987) rather than those of Secrett (1986) and Romsan (1989). It is likely, however, that in-migration has indirectly encouraged protected area deforestation by reducing the amount of unused arable land, as reflected in the relatively high density rates.

According to the field research, there appear to be four different groups of illegal coffee farmers in Lahat's protected areas:

- *Tanjung Sakti*. Many illegal farmers are from this area. They are local people from the Lahat District (from the Kecamatan Tanjung Sakti).
- *Semendo*. These illegal farmers are from an adjacent Kabupaten, Muara Enim. They are then outsiders to Lahat, but not to South Sumatra. They have their own native land, but arable land is very limited. Many young families are in search of new farms.
- *Manna*. Outsiders to Lahat from Bengkulu, an adjacent province directly west of South Sumatra. They share a common ancestry with the Pasemah peoples centered in Pagar Alam and believe they have some claim to the land there.
- *Javanese/Suhdahese*. Only a relatively small number of illegal farmers are from Java. Those that are in Lahat are not from failed transmigration projects, but have come in search of adventure or for employment. They tend to serve as laborers for the more wealthy local illegal farmers, such as the Tanjung Sakti.

The Semendo are traditionally rice farmers from the low-lying subdistrict of Muara Enim. Their system of inheritance is "tunggu tubang," in which the oldest daughter, when married, acquires the parent's property. This arrangement forces the remaining family members to find new agricultural land elsewhere. Some have found themselves growing coffee in highland areas. The Manna are more traditional coffee farmers (i.e., practicing farming as a way of life) and generally farm a plot of one or two hectares. The third and apparently largest group, the Tanjung Sakti, are very aggressive farmers who cultivate coffee as a short-term means to acquire wealth. Their goal is to save enough money to move to the urban areas to pursue other occupations while maintaining coffee farms in the hills. The Tanjung Sakti frequently establish several farms and hire Javanese "interns" as tenant farmers to occupy one site while they move on to establish another (Heydir et al. 1990; 1991 Field Notes).

There also appears to be a unique combination of illegal farmers in each subdistrict of the study area. Table 8 shows estimated breakdown (by percentage) of illegal farmers by ethnic group (or home area) in each kecamatan of the study area. From the interviews, it appears that the arriving individuals sent home news of their success which encouraged others to come (1991 Field Notes). This appears to be particularly true of the Tanjung Sakti who tended to illegally farm the wildlife reserve (Gumai Pasemah) north of the towns of Jarai and Pagar Alam.

Coffee Production Factors

Coffee is not native to Indonesia. It was introduced by the Dutch colonialists around 1699 as a cash crop (Heydir et al. 1990) and in South Sumatra some time later. Today, coffee is produced in 13 of

Table 8. Percentage of illegal farmers by ethnic group or origin for each study area subdistrict

SUBDISTRICT	GROUP	PERCENT
Pulau Pinang	Tanjung Sakti	50
	Pagar Alam	15
	Jarai	10
	Javanese	5
	Locals/Others	20
Pagar Alam	Manna	90
	Semendo	10
Jarai	Tanjung Sakti	90
	Javanese	10
Kota Agung	Semendo	40
	Pagar Alam	20
	Javanese	10
	Locals	30

Source: Field Notes 1991

Indonesia's 27 provinces. In 1989, 369,667 tons of coffee were produced nationwide with approximately two-thirds of it exported, mostly to Japan (26%), Germany (23%), Netherlands (16%), and the United States (11%). Twenty-five percent of all Indonesian coffee comes from South Sumatra alone, the most of any province (Biro Pusat Statistik 1989). Within South Sumatra, the district of Lahat supplies nearly 60% of the province's coffee production (information from Coffee Export Association, Palembang; 1991 Field Notes; Heydir et al 1990:4). In short, coffee is clearly an important crop in our study area.

Protected area deforestation is likely caused, in part, by the way coffee is produced. In Lahat, at least, coffee farmers have traditionally been shifting cultivators. New ground is broken and coffee trees planted. Fruit is not harvested until usually the third year. Harvesting takes place once a year, extended over about a four-month period, usually May through August. At their peak in productivity, trees yield an average of two to three tons per hectare. After about eight years, the coffee yield declines significantly. In anticipation of the decline, the farmers move on to seek new land, thereby restarting the cycle after only the third or fourth year (1991 Field Notes; Heydir 1990:34)

The shifting cultivation cycle of coffee farmers is significant for at least four reasons. First, established tradition makes opening up new land for cultivation an understandable practice. Shifting cultivation can, of course, be a sustainable practice under conditions of low population density (Dove 1985). It is also a behavior that might not be easily changed. Second, because of the long lead time required to establish new coffee crops, it is ideal to open new land while other land is in production. This type of cultivation practice obviously doubles the strain on land resources. Third, farmers who practice shifting cultivation have traditionally had little incentive to cultivate intensively, which would ease the pressure on the land. Finally, under conditions of growing population density, local farmers as well as newcomers looking for land would most likely be

pushed farther up the mountains in the direction of protected forests, the only unoccupied lands left.

Conservation Management Factors

Because these forests are under a managerial regime, their invasion by farmers obviously suggests an administrative failure of one sort or another. Of some interest is the history of these forests. Far from being products of modern conservation efforts, a significant part of these areas was established centuries ago by local authority structures (marga) as forests to serve a combination of woodstock reserves and watershed protection functions (Ayek Tulung) (1989, 1990, and 1991 Field Notes; Heydir et al. 1990; Brechin et al. 1990).

The Dutch Colonialists made their way to South Sumatra in 1859. In 1874 they initiated Domein Verklaring, in which all unclaimed land came under state rule. Traditional marga systems, while under Dutch control, managed their own lands, including forests. Although marga officials still actively helped regulate their use, the Dutch in 1916 formally incorporated the marga forests into their forest areas and collectively called them "Bosch Wezen," or registered forests. In 1967 (well after independence), the Indonesian government continued this arrangement under Forestry Principle #5. As under the Dutch, the Pasirah, or marga head, with his council, regulated their forest use through traditional law or "adat." This arrangement ended in 1983 when the marga system in South Sumatra was completely dismantled by the central government and replaced with the desa, or village system. Presently the country's forests are under the jurisdiction of the Ministry of Forestry and are administered in an hierarchical manner from the central government to province to district level.

From our research, it seems that under national government control, the managerial regime existed mostly on paper—lines on maps with little actual initial enforcement. Whitten (1987) found the same for other parts of Indonesia as well. Government control of protected area boundaries became a post-hoc matter, years after they were initially invaded. It appears the forests were more tightly controlled under Dutch rule. There are reports that illegal farmers were occasionally shot (Heydir et al. 1990). When national independence came just after World War II, the supervision of forests fell dramatically due to tight budgets and limited personnel. It was reported that during the 1970s supervision became even weaker. Even today there is only, on average, one forester for every three Kecamatans (1991 Field Notes).

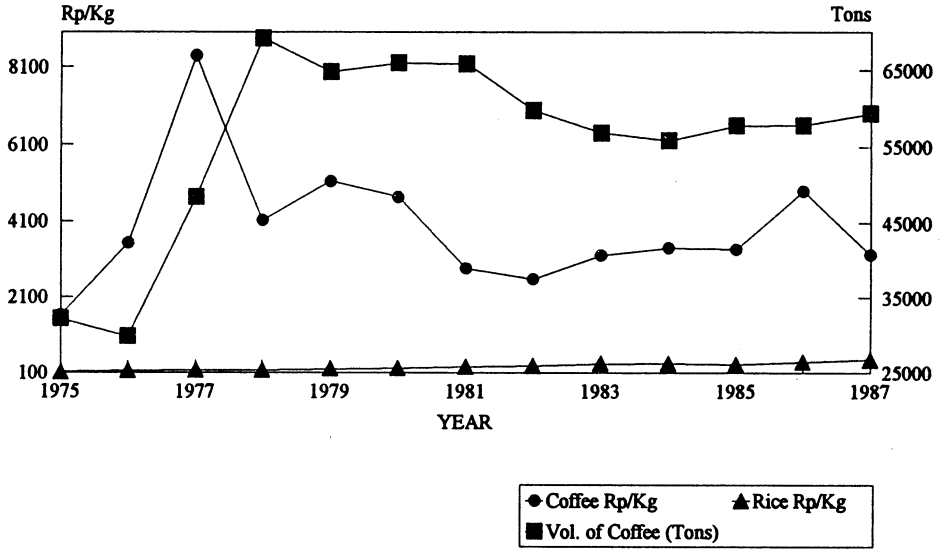
Unlike the Dutch foresters, the Indonesian foresters in Lahat today, except for a special police force, are unarmed. They also have no vehicles, i.e., they are completely on foot, and walk alone through the forests. Their tasks in the protection and other non-commercial forests are to observe local situations and report boundary violations to their superiors at the district level (1991 Field Notes). Under this system, subdistrict administrative officials, including the head (Camat), have no direct authority over the local forestry officials or their activities[11] (1991 Field Notes). There are obvious drawbacks to this supervisory system, including the lack of coverage, but also the creation of an atmosphere of intimidation and corruption, which is discussed later.

Economic Factors: Coffee Prices

For farmers, coffee has been a relatively lucrative cash crop. And most coffee farmers are considered fairly wealthy by local standards. Until recently, coffee generally held a domestic price advantage of 7:1 to 13:1 over paddy rice, a major staple crop.[12] In 1976 and 1977, however, the price of coffee skyrocketed due to coffee crop failures in Brazil (1991 Field Notes; National Coffee Association (New York), per. comm. 1991; deGraaff 1986). This created a price shock wave throughout the international coffee markets. For Indonesian coffee farmers the domestic price differential between coffee and rice rose to 53:1 in 1977 (1991 Field Notes).[13] Figure 2 shows coffee and rice prices, as well as coffee produc-

tion levels over time. The decline in coffee's advantage over rice reached its lowest mark in at least fifteen years in 1987.

Figure 2. South Sumatra coffee and rice prices, with coffee export volume, 1975-1987



Rp/Kg = rupiah per kilogram
Source: South Sumatra Commerce Department

Discussion

In summary, the protected area deforestation within the study area appears to have been the result of a complicated set of factors, including population pressures, the coffee production cycle, inadequate protected area enforcement, and a rise in international coffee prices.

The illegal farmers responsible for this deforestation tended to be local migrants, who were lured to the protected forests by the usually high price for coffee, caused by a series of severe frosts in Brazil during the mid 1970s. They were not members of unsuccessful transmigration projects. As local lands were occupied, the protected forests were, in effect, the only lands available for cultivation. The farmers' entry into the protected forests was facilitated by the initial lack of boundary enforcement from forestry officials, a little corruption, and some confusion as to the precise location of the boundaries.

This study found two groups of illegal farmers. In fact, there are many more families within the second group than the first. The first group is those who more or less purposefully invaded the protected forests to cultivate coffee; these have been the focus of the study. The second and much larger group is the farmers whose holdings became illegal as a consequence of the government's 1982 decision to substantially expand the size of many protected areas by redrawing boundaries. Thus, a distant governmental decision has

transformed many rural families into illegal occupants of state-owned protected areas.

The second group is noteworthy for several reasons. Most important, the government, by its efforts to correct perceived deficiencies in its conservation program, has unwittingly but significantly increased the population density of the region by decreasing the amount of available land. This has greatly complicated the situation and will make solutions that much more difficult to achieve. Second, in its treatment of the matter, the government is making little distinction between the two groups of illegal farmers.

Of considerable interest is the fact that the protected areas under central government control were deforested first. Although all protected forest areas were technically under the control of the Ministry of Forestry, many of the areas included former marga forests which effectively remained under the local control of the marga head, the Pasirah, and regulated by adat, or customary law. Local control of the forest areas seems to have been quite effective up until the traditional marga system was dismantled entirely in 1983 (1989, 1990, 1991 Field Notes; Romsan 1989; Heydir et al. 1990; Poffenberger 1990a). After 1983, farmers began to invade these parts of the protected forests as well (1991 Field Notes).

From a farmer's perspective, the uncertainty regarding the precise location of the areas' boundaries has further complicated the situation. Many markers are missing or have been moved numerous times, both legally and illegally, to the point that no one is certain of the boundaries' correct location. In some cases, it was noted that certain forestry officials had changed boundary markers for a price. Even more honest forestry officials, however, would be powerless to stop a large influx of farmers into the forests. In short, an unarmed, solitary forester on foot is no match for a group of machete-wielding farmers. In one area there are reports of collusion among local government officials who sold protected land to unsuspecting farmers eager to grow coffee. This greatly complicated the situation, with illegal farmers being able to provide documents of ownership (Tempo 1990; 1991 Field Notes). Also of interest, several officials commented that enforcement of the protected area seemed to lessen precisely at the time the coffee prices rose dramatically (1991 Field Notes). This may only be coincidence or the result of more conscious action by powerful figures in more central positions with economic ties to coffee markets. In a similar vein, corrective action is presently taking place at time when coffee's price advantage over other crops, such as rice, is at a fifteen-year low point (Figure 2).

It seems that, since independence, the protected forests of South Sumatra have undergone three expansions: in 1971, 1975, and 1982. A fourth change took place in 1986, but it only reorganized the classification of existing protected areas; new areas were not added. Significant change occurred in 1982. This was the result of a decision to change the criteria used for defining protected areas and determining their classification (1991 Field Notes). The former criteria consisted of forests with elevation greater than 700 meters and slope of 45% or greater. The new criteria was a formula which took into account slope, soil type, and rainfall.[14] The result was nearly a 350% increase (from 1,562,783 to 5,214,700 hectares) in the size of protected areas in South Sumatra. Many villages and residents are now, in the government's view, illegally occupying protected areas and are expected to be relocated. In Lahat, it appears the extent of protected forests rose from approximately 165,000 to 290,600 hectares, an increase of about 76% (Lahat Forestry Department; Surapaty et al. 1991).

In attempting to understand the relationships between population and environment from the case study, each of the four factors (population pressure, coffee production cycle, conservation management practices, and rising coffee prices) appear to have collectively contributed to the deforestation. The most powerful factor, however, in determining the amount of deforestation seems to be

population density. As was noted above in Table 6, the most densely populated areas were the sites of greatest deforestation.

The four factors, however, are interrelated. For example, the high population density surrounding the protected region encouraged farmers to seek out the protected forests as the only remaining unoccupied lands. However, these farmers could have been stopped from entering the forests given better resource management efforts. The lack of a substantive conservation management regime allowed farmers unimpeded access to the forests, at least initially. This may help explain why population density appears to be highly correlated with the amount of deforestation. More effective boundary enforcement may have forced some other dynamic. The fact the marga forests remained intact when the system was still operating, while the state-regulated protected forests were invaded, suggests that certain control mechanisms might have worked.15

Similarly, the dramatic rise in coffee prices alone is an insufficient cause. Coffee prices created tremendous incentives for cultivation. Again, this became a factor due to the lack of alternative arable lands, and was compounded by the tradition of shifting cultivation among the coffee growers and the weak enforcement structures. The increase in demand for more coffee cultivation might have been met by utilizing unused agricultural lands or intensified use of existing lands. A host of other likely scenarios could be conjured up using different dimensions of these same factors.

From the case study, it is obvious that the relationships between population and environment must consider the impact of other variables. The dynamic is not unilaterally determined. Rather, it is actually the result of the confluence of a number of factors occurring at different scales and at different times. For example, the poor weather that destroyed much of the coffee crop in several high-production states in Brazil contributed to the deforestation of specific protected areas in Southeast Asia. The obvious link is international market mechanisms. Other factors may be more controllable, such as the character and effectiveness of state conservation management policy. Still others may depend on local customs, such as the shifting cultivation of coffee farmers and the effectiveness of the marga system. These may be so ingrained in everyday life as to be extremely difficult to change without creating other problems. Clearly, though, effective state policies and implementation could have greatly reduced the impact of the exogenous influence of market forces and the movement of people. But from a population perspective, given the uniform lack of enforcement across the study area, the increased land pressure through population increases, as reflected in density, certainly appears to be the single most powerful factor in determining the amount of deforestation in each subdistrict of the study site (Table 6).16

Possible Policy Directions

It is difficult to predict what will happen to the farmers and forests of Lahat. The future will be determined, in large part, by the implementation of specific governmental policies.

The main policy currently being pursued by the government is the relocation of illegal farmers. This includes both types of illegal farmers discussed above. Here, illegal farmers include those individuals who were the subject of our investigation and those villagers who are now considered illegal because of the government's decision to expand the boundaries of protected areas. Some 1,167 families (or 4,720 individuals) are in this group (Surapaty et al 1991; 1989, 1990, 1991 Field Notes). Because of the number of families involved and the lack of suitable relocation sites, however, it is unlikely this program will be very successful. Little concrete action has been taken so far due to the lack of capital and alternative lands.17

In the summer of 1991 most of these illegal farmers were biding their time in the local towns such as Pagar Alam, and harvesting existing crops. The government has agreed to allow illegal farmers

to harvest the 1991 crop only if they don't clear any additional land. After this harvest, they are not to return to the protected areas (Tempo 1990; 1991 Field Notes). They are also waiting to see if the whole affair will blow over so they can return to their lucrative enterprise. Thus, this may be only a hiatus in the deforestation of Lahat's protected areas. Relocation by itself is not the answer to the problem. The government has yet to institute any changes in regard to its resource management policies. It appears content with using dramatic means when it becomes necessary to enforce protected area boundaries, some time after they have been violated.

Clearly, if the government is to respond effectively to issues involving population–environment relationships, a more integrated, or at least comprehensive, multi-sectoral approach is required. Piecemeal solutions to complex, interrelated problems will likely succeed only in creating more problems. Likewise, a more integrated monitoring system is required to observe the many varied connections that compose this affair. Some elements of a comprehensive policy could consist of the following.

Revised conservation protection policies and administration. As was discussed in the chapter above, one of the main reasons for the invasion of protected forests was the lack of immediate control over their boundaries. Consequently, tighter control over important forest areas is desperately needed to eliminate similar problems in the future. This is especially true for those farmers who illegally invaded the forests at the higher elevations to plant coffee on the steeper slopes, and, as a result, caused most of the environmental damage. More personnel, better equipped and supervised, would be an important first step to implementing such a policy. Another option would be to return control of forests to more traditional governmental systems. Before they were dismantled, the margas were fairly effective in regulating forest use. Empowering traditional governmental authorities with local resource management responsibilities is an option that is gaining some support in the recent literature (Poffenberger 1990a; Brokensha and Riley 1989; Uphoff 1986). Although this type of action would presently contradict existing government policies, we believe it could be quite fruitful for the government environmental protection efforts. By finding ways to resurrect selected traditional enforcement structures and integrate them with the new national governmental structures, more effective regulatory mechanisms could possibly be created.

There may be a need to simultaneously revise existing conservation policies that require the automatic removal of resident people from protected areas. This refers specifically to the class of farmers declared illegal due to the expansion of protected area boundaries. This concern ties in with the relocation option discussed below. Instead of automatically removing residents, perhaps other options could be initiated that would help to achieve the conservation objective but not require moving large numbers of people. Various alternatives that regulate certain land uses or initiate preventative measures may be far more appropriate, especially when alternative lands are scarce (West and Brechin 1991b.) Conservation zones, for example, are widely used throughout the world. In addition, perhaps certain types of agroforestry practices could be established to help encourage more sound and sustainable agricultural activities. This would require substantial changes in the way the Ministry of Forestry is presently pursuing forestry practices in South Sumatra.[18]

Reforestation activities. As of yet, the government has failed to initiate any program to reforest the damaged protected areas. Flooding and silting of irrigation systems will undoubtedly continue for some time to come, especially in those areas where coffee trees have been destroyed. The government should take active steps to replant trees where needed and to stabilize soil and water resources of the region. An opportunity exists to constructively include local people in these useful conservation activities (see Dani and Campbell 1986).

Population control. Although Indonesia in general remains a model of effective population control through voluntary family planning programs, rural South Sumatra's fertility rate still remains relatively high. Presently South Sumatra has an annual growth rate of 3.09% compared with an average of 1.98% for all of Indonesia (Biro Pusat Statistik 1990). More active population programs in this region can be beneficial in reducing the population dimension of future population–environment relationships in the region. This suggests policies geared toward limiting fertility through family planning programs, limiting in-migration to the area, or relocating some farmers to less-densely-populated areas if appropriate areas can be found. If relocation is to be pursued and equity maintained, effort will be required to make important distinctions among the two types of illegal farmers.

Agricultural intensification. On a positive note, the government, as part of its general development program, is promoting intensive cultivation practices throughout Indonesia. In Lahat, there appears to be some limited success with coffee. Of course, with little in the way of alternative land, most coffee farmers have been forced to stop their more traditional practice of shifting cultivation. In one community, the village head has been actively working with other local farmers and encouraging them to cultivate intensively by using coffee plant waste as fertilizer (1991 Field Notes). To be more effective, however, agricultural intensification needs greater local emphasis, with special attention to coffee cultivation.

Creation of economic alternatives. Given the relatively high density of the rural highlands, another option would be to create greater economic opportunities in the urban areas and sectors. Urban pull may help to draw excess populations from the hinterlands where they practice unsustainable agriculture because they are forced to cultivate the more marginal lands. Another option would be to pursue the development of alternative but equally lucrative crops that could be grown in the less-densely-populated lowland areas. This last option usually requires the development of infrastructure, such as roads, as well as markets. Both options are difficult and would have to be included as part of larger development agendas.

Relocation. West and Brechin (1991b), in their review of "parks and people" issues, note that relocating residents from protected areas should be an option of last resort. In many countries, relocation tends to be the first and only option considered. In locations where population density is relatively high and pressure on existing land severe, relocation is likely only to substitute one set of problems for another. This would probably be the case in Lahat. Unless the authorities are prepared to move the illegal residents outside the district, relocating several thousand farm families successfully to alternative sites nearby will be extremely difficult because of the lack of available land.

If it becomes necessary to determine who should remain and who should go, authorities may want to review carefully the characteristics of the various groups of illegal farmers, who may be classified as "intentional" and "inadvertent." In addition, there are important differences among the intentional group. Some are impoverished people who out of necessity farm one- or two-hectare plots for subsistence. By contrast, most of the environmental destruction caused by the intentional group came from commercially oriented farmers who frequently cultivated several plots of two to three hectares for profit. Greater compassion should also be directed toward those farmers who are inadvertent victims of changes in resource management regimes and for those who are truly impoverished.

Finally, several important governmental officials expressed the need to more strongly regulate the movement of local migrants (i.e., that by individuals and families within the same District which is not recorded presently) (1991 Field Notes). It was their feeling that the problem of illegal farmers stemmed largely from the government's inability to control the movement of its citizens. Al-

though there is a logic to their thinking, the problem of illegal farmers could have been managed without reducing further the personal liberties of its citizens through, among other things, more sophisticated resource management personnel and practices. In addition to the preservation of personal freedoms, a stronger resource management administrative system could provide other benefits as well. Such a system would be in a better position to re-weave conservation practices into everyday village life, sustaining productive livelihoods for future generations. It would also reduce the occurrence of serious environmental problems and destruction. In addition, if conservation measures could be adopted by more rural people, the need for drastic measures, including arrests and relocation, and the expense (social, fiscal, administrative, and environmental) that it entails, could be avoided for the greater benefit of all.

Endnotes

1. The information presented here is from an on-going collaborative research effort between The University of Michigan, Ann Arbor, Michigan, USA; Princeton University, Princeton, New Jersey, USA; and Sriwijaya University, Palembang, South Sumatra, Indonesia. The authors would like to thank Professors Stephen Siebert and Jill Belsky, and the University of Michigan Press' reviewers, for their useful comments.
2. In his review of the population-environment literature related to development concerns, Myers (1991) is amazed at how little actual research has been conducted on the interrelationships of these two important variables. In applying this same observation to a specific resource, the Overseas Development Administration of the United Kingdom makes note of strikingly few systematic studies on the links between population and tropical deforestation (ODA 1991).
3. For forest management purposes, Indonesia uses a classification system of: Conservation/National Parks; Protection Forest; Limited Production Forest; Continuous Production Forest; and Conversion Forest. Percentage of forest protection area is based on Lahat land area of 7,014.23 square kilometers; see Table 4.
4. There are three other languages in Lahat area: Lematang, Kikim, and Lintang (1991 Field Notes).
5. We must note that due to the formality of the Indonesian government, all data collection activities have to be formally approved and are monitored. Before field research begins, colleagues at Sriwijaya University obtain written approval from the Provincial Governor in Palembang. This written approval is hand-delivered to the Bupati (the administrative head of District) in Lahat. After his approval, a representative of the district office, usually a planning officer, accompanies the research team to the field. The accompanying official serves essential functions as a local guide and is a formal point of contact to local-level officials, which is essential for obtaining their cooperation. Still, this official is present during all interviews and may even participate in the discussion. Our sense is that the official did not significantly influence the answers we obtained. Still, this possibility needs to be considered.
6. The 18% figure is based on the amount of protected area (165,900 hectares) that existed prior to the 1982 expansion.
7. The Environment Research Center at Sriwijaya University with funding from the Ford Foundation has been studying some of these consequences. See also Naning et al. 1988.
8. These matters are delicate indeed. In 1989, violence broke out in which a number of people were killed when governmental authorities and farmers clashed over, among other issues, the removal of illegal farms from protected areas in Lampung Province (south of South Sumatra) (1989, 1990 Field Notes).

9. It should be noted that there are no government or private plantations or other large land holdings in the study area. Of course, the establishment of these types of land uses would place greater strain on remaining lands.
10. The only minor exception concerns the inverse order of density between the two lowest subdistricts, Pulau Pinang and Kota Agung. This slight anomaly, however, seems to have an explanation. In Kota Agung, residents and officials alike said that many farmers have not been cultivating all of their land holdings. Instead, many have been "saving" parcels for future use. Although physically more land exists, socially it is unavailable. Those interviewed considered the practice to be selfish and inequitable, noting that some people didn't have land to farm. The result has been a *de facto* increase in density, but the physical availability of the land would tend to decrease the density in the actual figures.
11. One Camat we interviewed complained about his lack of control over forestry officials. He noted that subdistrict officials have nothing to say about where they go or what they do. He complained that it was eight months after he arrived as the new Camat before he met the local forestry official (1991 Field Notes).
12. This information is from South Sumatra Commerce Department, the Lahat Statistical Office; and Coffee Export Association, Palembang. Prices were in Rupiah per Kilogram.
13. The numbers presented above are based upon national-level data collected on coffee and rice prices noted above from the South Sumatra Commerce Department. Although no hard figures were collected from the field, local farmers and officials consistently noted a 10:1 coffee price advantage over rice. This probably reflects local prices paid to farmers (1991 Field Notes; Heydir et al. 1990).
14. The formula was (Slope x 20 + Soil x 15 + Rainfall x 10). Total score determined the designation. For example, areas rated at a total score of 175 or more were designated protection forests; 124-174, limited-production forests; <124, regular-production forests (South Sumatra Provincial Forestry Department, Palembang).
15. In many situations within developing countries, resource management problems seem to develop when control is shifted from local to state levels. The effectiveness of some local institutions in regulating forestry use in developing countries has become well documented (Uphoff 1986; Brokensha and Riley 1989).
16. This is supported by the data collected so far from four subdistricts within the study site. Obviously more data from similar additional sites, which would allow for statistical tests, are required before we could confidently substantiate this claim.
17. One exception is the village of Semidang Alas (Kecamatan Pagar Alam). Villagers are presently being relocated to a site at lower elevation, called Padang Muara Dua. The site is one of only a handful of unoccupied lands left in the District (government-owned). At 650 hectares, the site will provide land for about 200-250 families, which is slightly more than the present size of Semidang Alas. At a lower elevation within Lahat, the soil and climate are not ideal for coffee. They will be required to cultivate rubber trees, a crop with which they have no experience, nor one as financially lucrative as coffee (Heydir et al. 1990).
18. For examples of alternative approaches, see Poffenberger 1990b, 1990c; and Peluso and Poffenberger 1989.

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The Mexico–USA Border Region: The Filling of an Empty Land

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TO EARLY SPANISH EXPLORERS, MOST OF TODAY'S BORDERLAND between Mexico and the United States was "el despoblado," the uninhabited place. The vast expanses of hot, arid Sonoran and Chihuahuan desert required long, suffering journeys to cross, and the lands held little attraction for Spanish colonists seeking fortune and promising settlement. A 1728 map of the provinces of New Mexico reveals the consequences of this condition and the priorities of the colonial government in Mexico City: the Spanish settlements and presidios in the northern provinces are few and small.

Nevertheless, continued growth of both the United States and Mexico brought inevitable claims for the region and armed conflict from 1846 and 1848 over territorial rights to the land. The 1848 Treaty of Guadalupe Hidalgo, which ended the Mexican-American War, defined most of the international border that exists today between the two nations. Since then, the growth of this border region has been shaped by its international status and the policies, economies, and population growth of the two nations.

Today, a distinguishing feature of the border is the pattern of paired cities—often derived from military forts or ranchos. For example, with the Rio Grande (the Rio Bravo of Mexico) serving as the new border between the nations, Brownsville, Texas, began to grow around Fort Brown, opposite the older Matamoros, Mexico. Some residents of Laredo, Texas, loyal to Mexico, crossed the river after the Mexican-American War and established Nuevo Laredo. Reynosa, Mexico, appeared opposite McAllen, Texas, and El Paso, Texas, began to grow opposite the village of El Paso del Norte, today's Cuidad Juarez. Nogales, Mexico, and Nogales, Arizona, grew into villages opposite one another, as did Tijuana, Mexico, and San Diego, California. This pattern, with cities socially and economically intertwined, is even more pronounced today. About 98% of the border population—within the 25 U.S. counties and 39 Mexican municipios contiguous with the border—is concentrated in twin cities.

Although the United States had no strategy for development of the border region, its population in the region grew with the development of agriculture, energy and service industries, military bases, and the migration of retirees. Much earlier, Mexico saw the region as important to its future. Mexico lost half its territory in the treaty of 1848, and apprehension of further U.S. expansion prompted the government to encourage migration into the region. Likewise, the Bracero Program of the 1940s, '50s, and early '60s, promoting the use of Mexican nationals in the United States for agricultural field work, encouraged migration from southern to northern Mexico, as did Mexico's Border Industrialization Program.

But the systemic force driving population increases in the border region has been the sustained level of high fertility throughout Mexico. During the first half of the twentieth century, the total fertility rate exceeded six children per woman. In

spite of relatively high mortality rates, Mexico's population grew to 28 million by 1950 and to 89 million by 1990. As the population has grown disproportionately younger, and agricultural lands have become less available, the Mexican economy has been unable to absorb the swelling numbers trying to enter the work force. Thus, for decades, the border region has held promise to those in the interior of Mexico. The plight has been described by Professor Juan Castañeda of the National University of Mexico: "The consequences of not creating nearly 15 million jobs in the next 15 years are unthinkable. The youths who do not find them will have only three options: the United States, the streets or revolution." "For every two rural Mexicans who migrate to the city," reports the United Nations Population Fund, "one now crosses the border into the United States."

The consequences are evident in the census records for the border region for 1930, 1960, and 1990, as noted in Table 1. More revealing are Figures 1-3. The border population grew to 1.1 million in 1930, to 4 million in 1960, and to 9.3 million in 1990—an increase of 830% in sixty years. For each U.S. Border resident in 1930, there were 6.2 in 1990. For each Mexican border resident in 1930, there were 14.4 in 1990. This population, essentially 500 years in the making, will double again in 22 years. If the fertility rate in Mexico continues at 3.2 children per woman, the population of the region will likely reach 20 million in 2010. If it can be brought down to 2.0 children per woman, an unlikely prospect, the border population in 2010 will still grow to 16 million people. The exponential effect of compound population growth is clear.

Other variables, including the North American Free Trade Agreement (NAFTA) and the growth of the maquiladora industries, will influence the rate of population increase. The forecasts are sobering. El Paso County is projected to have a population of 940,000 in 2010. Its twin city of Cuidad Juarez is projected to hold 2,250,000 residents—creating an urban metropolis of 3,190,000. Nogales, Mexico, not long ago a village, is officially forecast to have a population of 498,700 in 2012. The "unofficial" estimate from officials of Nogales is 932,300 residents in 2012.

Recognizing the problems caused by such growth, in 1974 Mexico instituted a General Law of Population. In 1977 it defined the national objective of reducing its growth rate from 3.2% per year to 1.0 % per year by the year 2000. In 1984, Mexico's General Health Law gave priority to family planning. Among the efforts toward this end, the Secretary de Salud instituted public health extension services to those rural communities with 500 to 2,500 residents.

But population changes, generations in the making, require generations to correct. There is no quick fix. The biological reality is that of "braking distance." Even if fertility rates decline to replacement levels (2.1 children per woman), two to three generations are required for a population to level out. Because of the growing population, a nation can continue to increase at the same numerical rate, even if it has a decline or leveling-off of fertility rates because of the large percentage of reproductive-age women. All the while, any rate of increase results in an inevitable doubling of a population. The current population growth rate of 3.2% in Mexico translates into a doubling of the population in 22 years. Even a seemingly innocuous growth rate of 1% per year will double a population every 72 years. Although the fertility rate is 2.5 children per woman for the border region, its growth continues to exceed the national growth of Mexico due to migration.

To manage for the needs of the growing population in this arid re-

Table 1. Population of Mexico-USA border municipios and counties: 1930, 1960, 1990 (in thousands)

Municipio/County (State)	1930	1960	1990
Tijuana (Baja California)	11.3	165.7	742.7
Tecate (Baja California)	–	8.2	51.9
Mexicali (Baja California)	30.0	281.3	602.4
Ensenada (Baja California)	7.1	64.9	260.9
San Luis R.C. (Sonora)	–	42.1	111.5
Puerto Penasco (Sonora)	–	5.7	35.9
Caborca (Sonora)	4.9	12.4	58.5
Altar (Sonora)	2.2	3.0	6.4
Saric (Sonora)	1.9	1.8	2.1
Nogales (Sonora)	15.6	39.8	107.1
Santa Cruz (Sonora)	1.0	1.3	1.5
Cananea (Sonora)	16.7	21.0	27.0
Naco (Sonora)	–	3.6	4.6
Agua Prieta (Sonora)	6.7	17.2	39.0
Janos (Chihuahua)	2.2	4.4	11.1
Ascencion (Chihuahua)	2.8	6.0	16.6
Juarez (Chihuahua)	43.1	277.0	797.7
P.G. Guerrero (Chihuahua)	5.6	6.5	8.4
Guadalupe (Chihuahua)	4.9	9.1	9.1
Ojinaga (Chihuahua)	12.0	20.4	23.9
M. Benavides (Chihuahua)	–	4.6	2.8
Ocampo (Coahuila)	4.0	8.3	8.0
Acuna (Coahuila)	7.1	22.3	56.7
Jimenez (Coahuila)	6.5	7.1	7.9
Nava (Coahuila)	3.3	4.4	16.9
Pied Negras (Coahuila)	19.1	48.4	98.2
Guerrero (Coahuila)	3.3	3.4	2.4
Hildago (Coahuila)	0.6	1.0	1.2
Anahuac (Nueva Leon)	0.5	18.5	17.2
Nueva Laredo (Tamaulipas)	23.1	96.0	217.9
Guerrero (Tamaulipas)	3.2	4.2	4.3
Mier (Tamaulipas)	0.8	5.2	6.0
Miguel Aleman (Tamaulipas)	–	12.9	21.1
Camargo (Tamaulipas)	9.9	29.3	15.0
G. Diaz Ordaz (Tamaulipas)	–	–	17.6
Reynosa (Tamaulipas)	12.3	134.9	281.6
Rio Bravo (Tamaulipas)	–	–	93.9
Valle Hermosa (Tamaulipas)	–	43.0	51.3
Matamoros (Tamaulipas)	25.0	143.0	303.4
Total, municipios	**286.7**	**1,577.9**	**4,141.7**
San Diego (California)	209.7	1,033.0	2,498.0
Imperial (California)	60.9	72.1	109.3
Yuma (Arizona)	17.8	46.2	106.9
Pima (Arizona)	55.7	265.7	666.9
Santa Cruz (Arizona)	9.7	10.8	29.7

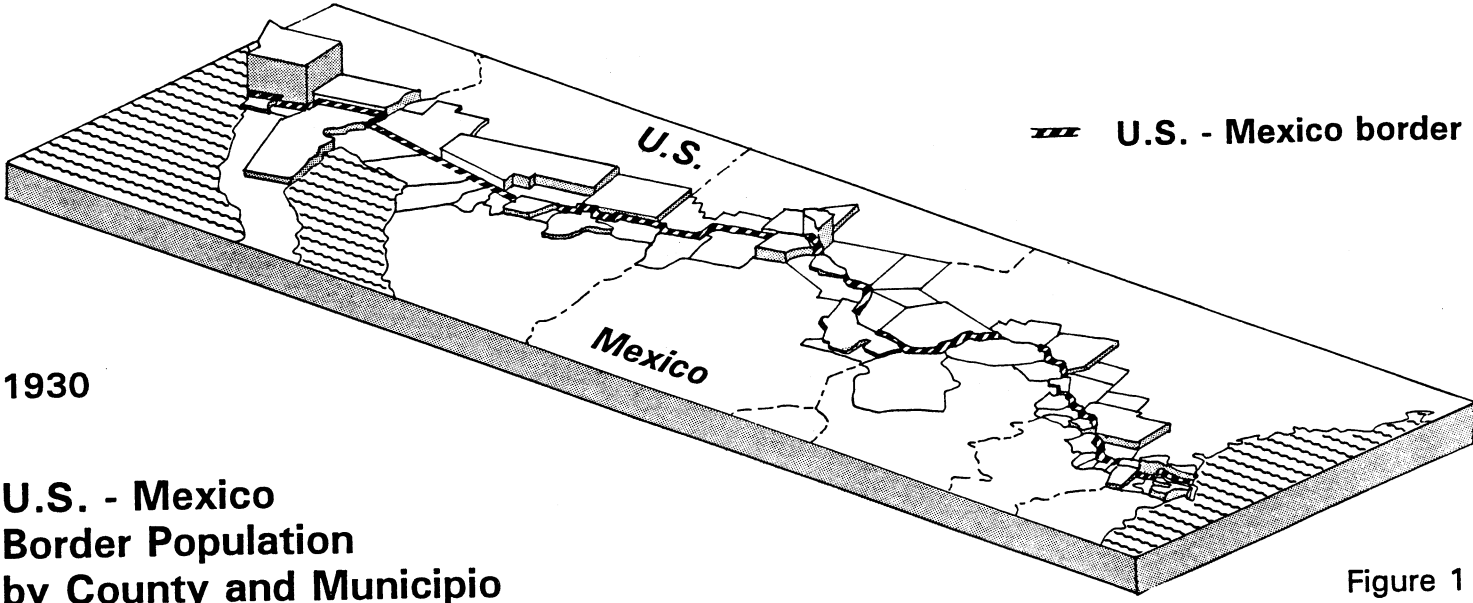
Table 1 (continued)

Cochise (Arizona)	41.0	55.0	97.6
Hildago (New Mexico)	5.0	5.0	6.0
Luna (New Mexico)	6.2	9.8	18.1
Dona Ana (New Mexico)	27.5	59.9	135.5
El Paso (Texas)	131.6	314.1	591.6
Hudspeth (Texas)	3.7	3.3	2.9
Culberson (Texas)	1.2	2.8	3.4
Jeff Davis (Texas)	1.8	1.6	1.9
Presidio (Texas)	10.2	5.5	6.6
Brewster (Texas)	6.6	6.4	8.7
Terrell (Texas)	2.7	2.6	1.4
Val Verde (Texas)	14.9	24.5	38.7
Kinney (Texas)	4.0	2.5	3.1
Maverick (Texas)	6.1	14.5	36.4
Dimmit (Texas)	8.8	10.1	10.4
Webb (Texas)	42.1	64.8	133.2
Zapata (Texas)	2.9	4.4	9.3
Starr (Texas)	11.4	17.1	40.5
Hildago (Texas)	77.0	180.9	383.5
Cameron (Texas)	77.5	151.1	260.1
Total, counties	**836.1**	**2,363.7**	**5,199.9**
BORDER REGIONAL TOTAL	**1,122.8**	**3,941.6**	**9,341.6**

gion, the United States and Mexico began apportionment of transboundary surface waters in 1899. In 1944, the two nations further defined their obligations and management with the Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande. Water diversions and impoundments proliferated, as did allocations of water for agricultural, municipal, and industrial use. Today all of the Colorado and Rio Grande waters are over-allocated beyond average stream flows, and water consumption of both rivers is more than 40% of stream flow.

The collective effect of the assortment of impoundments, water withdrawals, and degradations of water returned to the rivers has been profound. The activities have reduced flows, altered historic flow patterns, altered estuarine ecosystems and reduced stream productivity, impeded sediment transport, increased stream erosion, and caused flooding of resources. They have degraded water quality by reducing oxygen levels, altering temperatures, and introducing nutrients, toxic wastes, and pathogens hazardous to people. For example, there is still no wastewater treatment along the Mexico side of the border between Nuevo Laredo and the Gulf of Mexico, although Mexico and the United States have jointly funded a $70 million project for Nuevo Laredo. A detailed description of the multitude of impacts is beyond the scope of this paper, but highlights of impacts to water, land, and air are worth noting.

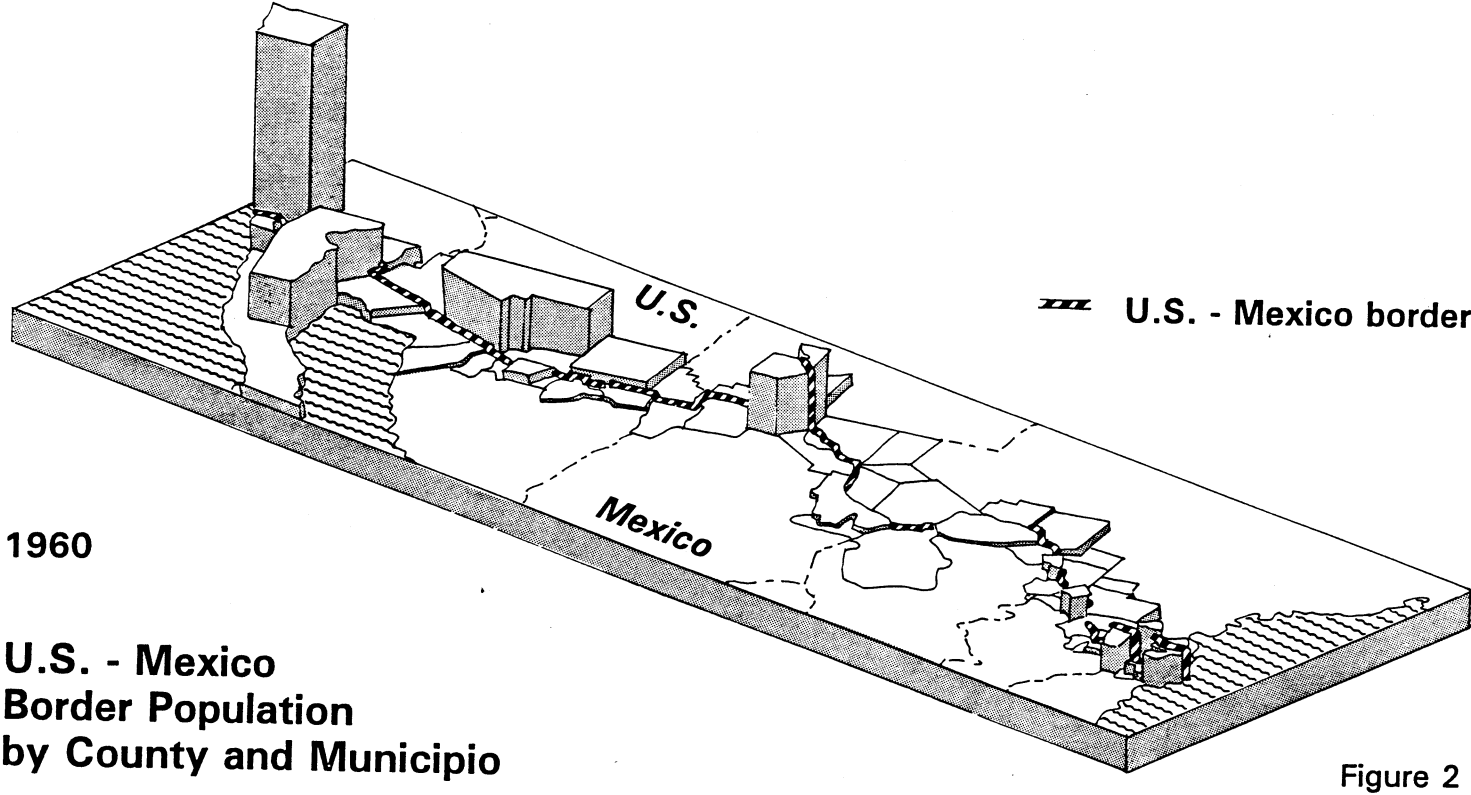
Only in the wettest of years does Colorado River water reach the Gulf of California. The Rio Grande, passing by Chamizal National Memorial in El Paso, Texas, is concrete-lined. Below El Paso, the Rio Grande river bed is bone dry most of every year. Only during years of peak precipita-



1930

U.S. - Mexico Border Population by County and Municipio

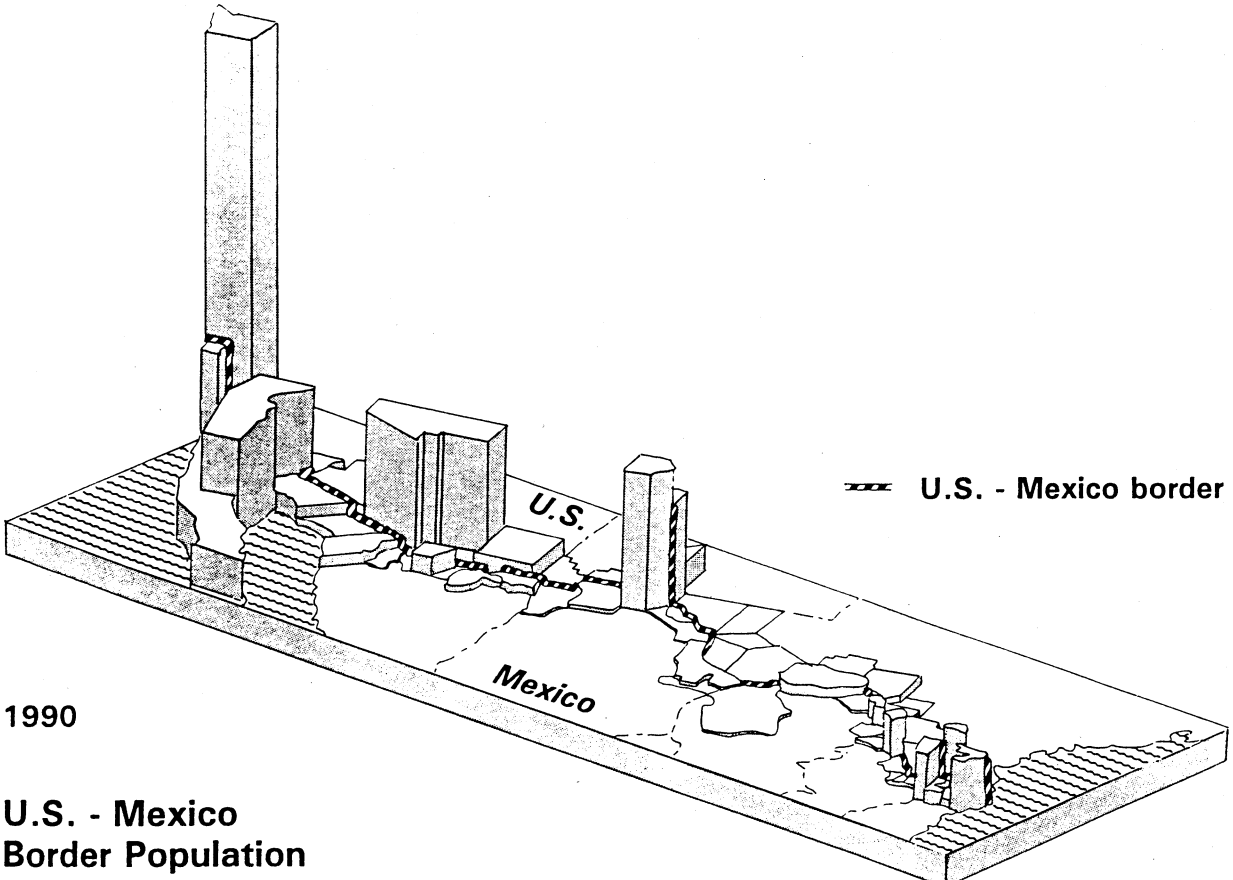
Figure 1



1960

U.S. - Mexico Border Population by County and Municipio

Figure 2



1990

U.S. - Mexico Border Population by County and Municipio

Figure 3

tion is water released to flow in this section between El Paso and Presidio, Texas. Sediments are intercepted by all impounding structures, but in the Rio Grande particularly by the major impoundments of Elephant Butte Dam, New Mexico; Amistad Dam, Texas-Mexico; and Falcon Dam, Texas-Mexico. As a result, the riparian systems of both rivers have lost their upstream sources of sediment and riverbanks and sandbars continue to erode away for lack of nourishment. Without the flooding of earlier years, the riparian systems, particularly the cottonwood "bosques," are moving toward extinction.

Salinization has increased with water withdrawals and the return of irrigation water to the Rio Grande, allowing the silverside, *Menidia beryllina,* to move upstream from the river mouth. In 1853, 18 species of native fish were noted in the area of Matamoros, Mexico; none of these remained in 1982. Changing water quality and the degradation of river habitat has resulted thus far in the loss of at least six fish species within the lower Rio Grande; other species are threatened. In its lower reaches, the Rio Grande has lost 85% of its original volume.

Rio Grande stream flows have been profoundly reduced through Big Bend National Park, reducing the season for river rafting and diminishing the wilderness and wild river experience. Large unseasonal releases from dams in Mexico also complicate the recreational use of the river and are profoundly changing stream flows and river channels. Further diminishment of the Rio Grande through Big Bend is certain, as 80% of the stream flow at this point is derived from the Rio Conchos of Mexico. Within the Rio Conchos watershed, continuing deforestation and water development to meet population needs are drying up springs and streams. Inevitably, the Rio Grande within Big Bend will be a trickle or disappear for part of the year.

Impacts extend upstream and down. At Amistad Reservoir, archeological sites at the confluence of the Rio Grande and Pecos River are flooded. Padre Island National Seashore, no longer nourished by sediment emerging from the Rio Grande, is eroding at its southern end at the rate of about six inches each year.

Unfortunately, the international agreements for water management have not yet extended to groundwater and the three great aquifers that straddle the United States-Mexico border. To meet the needs of the El Paso-Cuidad Juarez population, the Hueco Bolson aquifer, some 3,000 square miles in area, is being pumped at a rate that could exhaust it in 35 years. In this world of high evaporation, what water is returned is increasingly saline. The City of El Paso is already planning to pipe water from Elephant Butte Reservoir upstream to meet its needs.

Extensive withdrawals have also commenced on the 7,450-square-mile Mesilla Bolson aquifer between Chihuahua and New Mexico, and the 3,000-square-mile Mesa de San Luis aquifer beneath the Baja California-Sonora and California-Arizona region. However, the two nations have not even begun negotiations to manage these essentially finite resources. At Organ Pipe Cactus National Monument in southern Arizona, water withdrawal from the aquifer was two and a half times the recharge rate when agricultural irrigation was tried on the Mexico side of the border. Monitoring wells within the monument have shown a drop in the water table.

The once pristine air of the border region has also profoundly changed. Air pollution emissions from the industrial areas in northern Mexico have been shown to be substantial contributors to visibility impairment in the southwestern U.S., as have sources along the Texas

Gulf Coast. The 1,200-megawatt coal-fired power plant known as Carbon I, 125 air miles from Big Bend National Park in Rio Escondido, Coahuila, is soon to be joined by Carbon II, a 1,400-megawatt plant, in order to meet the growing power demand of the region. Neither the existing nor the new units of these power plants have air pollution controls for sulfur dioxide. Carbon I and II meet international and Mexican emission standards, but do not meet U.S. emission standards for sulfur dioxide, particulates, or nitrogen oxides. When the last of the four Carbon II units comes on line in early 1996, sulfur dioxide emissions from the two plants will range between 190,000 and 260,000 tons per year, ranking them as one of the largest carbon dioxide sources in the U.S. Based upon preliminary USNPS estimates, the already-degraded air quality at Big Bend, designated as a Class I area under the U.S. Clean Air Act, will experience as much as a 60% reduction in visibility on the cleanest days as a result of the Carbon II emissions alone.

Beyond their extensive record on water management, the governments of the United States and Mexico have numerous other multilateral agreements dealing with natural resources. The two nations signed the Convention for the Protection of Migratory Birds and Game Mammals in 1936, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere in 1940, the International Plant Protection Convention in 1951, and the Convention on Wetlands of International Importance Especially as Waterfowl Habitat in 1971.

Also in place are the La Paz Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area, signed in 1983, a Memorandum of Understanding on Cooperation in the Management and Protection of National Parks and other Protected Natural and Cultural Heritage, signed in 1988, and a recent Integral Binational Plan for the Improvement and Protection of the Environment in the Border Area. The North American Free Trade Agreement of 1993 also includes millions for clean-up of toxic wastes, to enforce air pollution standards, and to fund construction of sewage treatment plants in Mexican twin cities. To enhance cooperation in the region of the Organ Pipe Cactus National Monument, an International Sonoran Desert Alliance now involves federal and state land managers on both sides of the border, the O'odham Indian Nation, conservationists, residents, and business leaders. A similar coordinating council is being developed for the Trans-Pecos region of southwest Texas.

But still, the exponential growth of the human population in this terribly arid region is causing the extraction of resources and impacts on an unprecedented scale. The once-isolated national parks and monuments of the border region are no longer immune to change and impacts of the growing wave of humanity. Resource managers will be challenged as never before. Working with institutions external to the parks will be demanded as never before.

"You won't have any trouble in your country as long as you have few people and much land," Thomas Carlyle penned more than a century ago, "but when you have many people and little land, your trials will begin."

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Protected Lands, Population Growth, and Women's Lives: A Proposed Agenda for Action

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Introduction

WITHIN THE SCIENTIFIC AND ENVIRONMENTAL COMMUNITIES, prominent biologists and wildlife conservationists have long been leaders among those arguing that the ongoing growth of human population poses daunting risks to the preservation of nature and the natural environment. One thinks of Paul Ehrlich, of course, but also of such effective thinkers and communicators as Edward O. Wilson, Peter Raven, Peter Vitousek, and Michael Soulé.

The connection of population growth to conservation remains, however, poorly or seldom articulated, for understandable reasons. First, the topic is extremely complex and historically vulnerable to oversimplification. Perhaps more importantly, few experts in wildlife and wildlands conservation are well versed in demography, let alone in population policy. Even more forbidding is the realm of possible prescriptions to slow the expansion of population pressures on protected lands and natural systems. Laden as it is with questions of sexuality, reproductive anatomy, abortion, and private decisions and behavior, the difficult and sensitive question of what (if anything) to *do* about population growth has generally puzzled even environmentalists and scientists who relate human population dynamics to the loss of nature.

More than four decades after the first national population program was established in India, the very idea of "population policy" remains a sensitive topic to the general public and to many in the scientific community. The common but unfortunate phrase "population control," with its intimation of attempted control by someone over someone else's behavior, casts a subtle shadow over the field.

Many who hear this phrase conclude that the wealthy, the powerful, the industrialized, and even the environmentally concerned seek to convince or force the poor, the powerless, the "underdeveloped" or the environmentally uninformed—and most especially the female—to have fewer children than they want. It is not a pretty image, and it is no surprise that there is little enthusiasm within the conservation community (or many other communities) for a fuller exploration of potential ways to influence demographic futures. It is easier, perhaps, to bemoan the impact of the expansion of human numbers on species and ecosystems—and then apply the non-demographic strategies one can understand and with which one is ethically and practically comfortable.

The population-control image is not entirely a misperception. The history of the field includes some programs and policies based on a controlling, "top-down" approach to women's fertility that quite often were more interested in ends than means. In some cases, those means included—in a few cases still include—pressure on or financial incentives for women and men to undergo sterilization or use specific forms of birth control without sufficient informa-

tion or alternative choices. It is not surprising that many developing-country organizations and activists concerned with health, environment, and women's rights resent the idea that greater efforts to control population growth will pay off in an improved environment. It doesn't help that many wealthier countries with relatively low rates of population growth—the United States, for example—are taking few effective steps to reduce consumption of fossil fuels and other resources that contribute to global environmental degradation.

Given these sensitivities and disagreements, can we say anything about a policy agenda conservationists and scientists could support, and even promote, that would ease demographic pressures threatening protected lands and ecosystems? The key to such an agenda, this article will argue, is to move from the idea of "controlling" population growth per se to that of supporting the cause of women worldwide who seek to escape the control of others over their bodies and their lives.

The Cairo Consensus: A Framework for Slowing Population Growth

The emerging reality is that the most effective population policies are precisely those most consistent with human development generally. This is not a restatement of the old, and inaccurate, slogan that "development is the best contraceptive." Economic development was the issue there, and paradoxically the available evidence is equivocal about the capacity of economic development, by itself, to reduce fertility or otherwise slow population growth. Other aspects of human development are far more important.

When couples, and especially women, have access to a menu of family planning options, primary health care, a decent education, and some prospects of a reasonable income, they have fewer children. Moreover, they tend to give birth later in life and establish "birth spacing" patterns that independently slow the growth of population. This has been amply demonstrated on every continent.

It is not economic growth per se that brings down rates of average fertility and population growth. (The U.S. baby boom of the post-World War II era should be sufficient refutation of that idea, but there is also the example of wealthy Middle Eastern oil potentates to consider.) In fact the evidence is solid that more than any other single factor, it is ensuring widespread access to good-quality family planning services that is most effective in causing fertility rates to drop. One of the best examples of this is Bangladesh, where the educational and economic status of women has barely budged in recent years but where fertility rates have fallen by more than a fifth, from 7 children per woman on average in 1970 to 5.5 children in 1991. What caused this decline? It's impossible to isolate a single cause in such situations, but the most logical primary candidate is a major commitment by the Bangladesh government and an array of non-governmental organizations over the past two decades to make a variety of family planning options available to all couples in the country who want to use them.

Such programs, while often facing indifference or hostility at first, rapidly generate their own demand among the women and men they serve. In Bangladesh, the prevalence of contraception soared from 3% to 40% in the period mentioned above. The evidence is also strong that population programs are most effective when they provide good information and counseling, a wide variety of contraceptive options and associated services that can help women keep themselves and their children healthy. In short, such programs work best when they meet the expressed needs of their clients, rather than focusing on specific demographic targets of reduced rates of

population growth or specific proportions of people using contraception.

Ironically, then—and this is a key point for conservationists and others brought to population issues largely by an interest in preserving ecosystems—the history of family planning demonstrates that the programs most effective in reducing fertility are precisely those that respond at the service-delivery level to people's needs. These programs enable the delivery of wanted babies in good health, rather than directly attacking high fertility per se. Such programs, along with the foreign assistance from industrialized countries that helps pay for many of them, deserve the active support of conservationists.

A total fertility rate of 5.5, of course, will not stabilize Bangladesh's population. Nor would similar rates—the average in developing nations is about 4 children per woman—erase the pressure of expanding populations on protected ecosystems and lands around the world. Simply meeting the unmet demand for contraception from the 120 million or more couples and women who would like to postpone or stop childbearing would reduce fertility rates in the developing world from 4 to 3 children per woman, about halfway to the needed "replacement fertility" level of 2 children.

This question of what to do in addition to family planning to promote fertility reductions is at the core of a new consensus forming in advance of the upcoming International Conference on Population and Development, to take place September 1994 in Cairo. Much of the news media attention has focused on a public disagreement related to Pope John Paul II's "deep anxiety" that the official document of the conference promotes abortion and undermines the family. In reality the document does neither. What it does do is much more remarkable: It sets out for the first time a broad international consensus that human development programs aimed at empowering and elevating the status of women should sit alongside family planning at the center of population policy.

Specifically, the document notes that women who have gone to school, ideally through secondary school, are far less likely to have many children than those women who have received little or no schooling. In Peru, a woman who has completed 10 years of education typically has two or three children. A woman who has never seen a classroom has seven or eight. In 23 developing nations, a woman with a secondary school education has her first child three and a half years later in life than a woman with no schooling. Like smaller families, such delays in first births exert a powerful brake on population growth. (It's important to stress while making this point, however, that this influence of education on fertility is strong only where women have access to family planning services. Education *alone* is not an effective contraceptive—especially if, as often happens, women who have been in classrooms forego breastfeeding, post-partum abstinence, and other traditional practices that discouraged high fertility and closely spaced childbirths.)

The same sorts of relationships almost certainly apply to other aspects of human development, although they are less studied and hence less well documented. Simple logic and considerable evidence at least suggest that when women can gain access to credit to start small businesses, their thinking about childbearing shifts along with the relative merits of having few or many children. When women have access to primary health care for themselves and their children, it is logical this will make it seem possible to assure good health to a few children, rather than have as many as possible in the hopes some will survive childhood.

Intriguingly, population growth can be slowed considerably, even in the absence of fertility decline, simply by changes in the timing of child-

births. As Population Council demographer John Bongaarts has demonstrated, much of the population growth the world is projected to experience over the next two decades–amounting to nearly 2 billion additional human beings–stems from "population momentum," a kind of demographic inertia that carries forward population growth at high rates even after women reduce childbearing. The source of population momentum is the age structure of a population; specifically, the fact that at any given time the world's population has a certain proportion of children and adolescents heading for or already in their childbearing years. When this proportion is high relative to other age groups, as it is today, growth in population size is virtually guaranteed even if average family size were to approach or reach "replacement fertility" of two children per woman.

As Bongaarts has shown, however, population momentum can be weakened significantly, regardless of a population's age structure, by delaying the average age of a woman's first childbirth, and by increasing birth spacing, the time intervals between that and subsequent childbirths. Simply by stretching out a woman's childbearing, in other words, population growth rates are reduced even if women continue having the same number of children. Bongaarts calculated that if the average age of first childbirth could be raised 5 years in developing countries, world population in 2100 would be lower by 1.2 billion people than would otherwise be the case, with fertility rates averaging two children per women in both cases. Increasing the spacing between childbirths could similarly weaken population momentum. Discouraging early and frequent childbirths is not merely a good demographic policy but a good public health policy as well, since early and frequent childbirths are well demonstrated to threaten the health and lives of both mothers and their children.

Obviously, the most effective population policies would be those that take advantage of all of these opportunities, informed by the realization that they are mutually reinforcing. Guaranteeing universal access to good-quality, multiple-choice family planning options is the essential first step to a range of human development policies that will especially benefit women–and make it much more likely they will use the contraceptive services available to them. The explicit goal of these policies is that women the world over will gain knowledge about and power over the major decisions of their own lives, including when to give birth. The evidence is strong that if this goal can be realized population growth will slow dramatically, pointing to a stabilized population early in the next century, at considerably less than the doubling of current population that is often projected.

The Realities of Field Experience

The idea that sound human development policies will slow population growth while improving individual and family well-being sounds convenient, even uplifting. But will it work in the real world? In particular, will it work in the small slices of the real world that happen to lie just outside of protected ecosystems?

Before answering this question, it's worth asking ourselves whether it is appropriate on ethical grounds. Is our motivation acceptable if our support for improving women's lives has another "real" objective, namely slowed population growth and eventual stabilization of population size around areas of land we seek to protect for the value of their non-human life?

Ultimately, this question must be answered based on individual human values. So long as the neither the means nor the ends are immoral, harmful to people or to non-human species, nor antithetical to human development, it seems that a rigid argument that those who seek im-

provements in other people's lives must have no other interests beyond pure altruism. It is even possible that a better understanding between the two seemingly unrelated issues—quality of human life and the survival of non-human life—will open up new awareness of the value of human well-being among many who have spent little time pondering that side of the equation.

A more practical question is whether women in rural areas actually want to limit their childbearing. The evidence on this is equivocal, and it is undoubtedly impossible to generalize across continents, nations, and cultures. Certainly protected lands are often far from urban areas, and thus far from good health facilities and, often, family planning distribution networks. Personally regulating fertility can be a concept that has not yet caught on in inhabited but remote communities near parks and other protected lands. Moreover, demographic literature is replete with examples of rural communities where large families are prized in part because children provide labor in farm work and child care, and more children increase the odds that at least one will grow up to draw an income sufficient to take care of elderly parents.

J. Mayonne Stycos of Cornell University and Isis Duarte of the Population and Development Studies Institute of Santo Domingo recently surveyed four communities bordering Los Haitises National Park in the Dominican Republic, all of them subject to a presidential decree ordering the park cleared of people and cattle. Even the women surveyed in this area, Stycos and Duarte found, favored rapid population growth and large families, despite a general awareness of the need to conserve the forest. Significantly, however, 65% of women under 30 years old had used a contraceptive method, compared to 41% of women aged 31-44 and just 10% of women over 44.

G. T. Agyepong, a geographer with the University of Ghana, found a high awareness of the impact of population growth on natural resources in eight communities on the outskirts of protected "sacred groves" in northern Ghana. Indeed population growth was cited far more often than any other single factor (such as modernization or construction) as a "factor of change" in resource deterioration. Nonetheless, most men in these communities expressed a desire to have as many children as possible, a rather stark reflection of Garrett Hardin's "tragedy of the commons." Men in these communities invest little in childraising and benefit directly from their own children's labor, while suffering only collectively from any environmental degradation to which their families might contribute. Agyepong did not ask women how many children they hoped to have, but the answer might not have been much different. In communities where family planning is unavailable and women have little education, demographic literature suggests, women often are not accustomed even to contemplating what their own interests might be in separation from those of their husbands, not to mention the possibility of regulating their own fertility against the husbands' wishes.

These social patterns, however, are changing as more information about the outside world reaches rural communities, as knowledge of modern contraception spreads, as opportunities beyond motherhood open up for women and—tragically—as environmental degradation proceeds in many countries. Use of contraception is increasing and fertility rates decreasing even in such mostly rural sub-Saharan African nations as Kenya, Nigeria, Zimbabwe, and Botswana. Moreover, some private organizations have had surprising success in recent years in introducing reproductive health care along with resource conservation in rural areas

of South Asia, Central America, and several sub-Saharan African nations.

Such integrated projects are a critical innovation in resource conservation, and they offer models that could be more widely applied to areas on the borders of protected lands and ecosystems. The key to relating family planning to resource conservation seems to be seeing the health of a community as a continuum that stretches from the health of the individual—especially the health of a woman and her child—through the health of the family to the environmental health of the neighborhood, province, nation, and planet. There really is no sharp dividing line between human and environmental health, and people in every culture are brought more easily to the latter when it is related closely to the former. In this continuum, family planning and reproductive health care become services that women (and, increasingly, men) often request themselves when given an opportunity to express their own needs and desires. The more services are provided—and the higher their quality and the degree of choice offered—the more they will be used.

Those people who live on the margins—whether geographically in the case of protected areas, or economically in society at large—are not ignorant of the links between their family size and the resources they need for survival. In his book *The Third Revolution,* British author Paul Harrison relates the childhood memories of a farmer in Burkina Faso of a "forest too thick to penetrate or cultivate" and "wild animals too many to count" in his childhood, now destroyed by modern-day deforestation and desertification. Wanga Mumba, director of the Environment and Population Centre in Lusaka, Zambia, tells of tribal chiefs who have literally reached the end of the line of land succession: The land inheritances that satisfied the sons of chiefs for generations back to pre-colonial times have simply been subdivided too many times to support even a single family. "If I could do it over again today I would have fewer sons," one chief told her.

For women there is a tension, Ms. Mumba believes, between attention to their children and attention to their environment and natural resource base. Women do most of the subsistence farming in Africa and are responsible for water throughout the developing world. Those who regulate their own fertility and opt to have fewer children, in Ms. Mumba's experience, are able to devote more time to tending their soil and the trees that hold the soil. "The environment," she says, "is the environment of the woman."

In the land surrounding the Taï National Park, a World Heritage and Biosphere Reserve in southwestern Côte d'Ivoire, the population has increased from 3,200 in 1971 to 57,000 in 1991, reflecting migration from the nearby Sahel as well as rapid natural increase. Reforestation plans have had slim success, reflected in a local saying, "I have a weight (baby) on my back; I have no strength left for planting many trees."

Is it possible that population growth, by increasing the competition for the means of mere survival, is also one of the factors most responsible for severing human ties to nature? In Zambia, Ms. Mumba relates, "Human beings have become so self-centered that they have no more concern for animals, they have become enemies instead. Now every man who has a gun will shoot anything. Human beings will stand against nature. We think no other living being should be seen in this world." Sacred trees that are reputed to house the souls of ancestors, she adds, are now cut down in desperation for fuelwood. Is this new lack of concern driven by the increasing competition for survival brought on, at least in part, by continuing population growth beyond critical thresholds a healthy environment can sustain?

Clearly, the size and consumption practices of local populations are not the only determinants of the survival of protected areas. The population dynamics and consumption patterns of the broader public enters into the relationship as well, determining demand for tropical woods or cattle, for example, or the trade needs and debt constraints of a nation. But at least to the extent that local communities press upon the resources of protected lands, the provision of reproductive health services and other policies related to population growth can contribute to the preservation of ecosystems.

An especially intriguing example of a positive population-resource awareness is offered by a case study of the CAMPFIRE (Communal Areas Management Programme for Indigenous Resources) program associated with the national parks of Zimbabwe. Through the program, communities share some of the revenue generated by the presence of large-mammal wildlife, especially elephants, in protected areas. Prior to inauguration of the program, some of these communities actively sought new settlers to increase their political clout in obtaining government services from the national government in Harare. Once "household dividends" from wildlife revenue began to be distributed, however, "the community began to ask whether it wanted new settlers," one observer reports. "It is clear to local villagers that if human numbers rise, wildlife benefits will erode on two fronts: through less available habitat and more shareholders."

This anecdote relates less to fertility as a demographic determinant than to migration, a critical topic for protected areas that deserves more exploration than can be offered here. But the story does suggest an added population strategy for protected areas: Where possible, give people a stake in the preservation of the area. Eco-tourism is one obvious approach, but where that is not feasible or desirable, methods of sustainable resource development or extraction associated with protected lands may be possible.

"The whole thrust of conservation in the past 10 years has been to make economic improvement—especially in the poorest parts of the world—consistent with conservation," Edward O. Wilson has noted. "A great many studies and pilot experiments around the world have shown that it is possible to greatly improve the social and economic welfare of very poor people at quite low cost while improving the conservation of local ecosystems. And in fact, the two can sometimes be joined into a single enterprise by learning to make fuller use of wildlands on a sustainable basis."

Ultimately, people come to an understanding of the connection between protected land and their own long-term well-being. Often the roots of the problem lie not only in population growth but, as Wilson notes, in poverty, which leads to desperate exploitation of natural resources. What is needed are policies aiming both at the alleviation of poverty and a slowing of population growth based on the spontaneous childbearing decisions of couples and individuals. Improving access to family planning, related health services, and education—especially for women—lie at the heart of such policies. With the 1994 International Conference on Population and Development about to begin, we have the knowledge we need to spur both sustainable development and population stabilization in the communities that surround protected lands.

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The Future of Protected Areas in a Crowded World

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ARE THERE TOO MANY PEOPLE? This is the critical question of our age. Not just for those concerned with parks and other protected areas, or with conservation and the environment, but for everyone. It is a question which cannot be answered solely through empirical analysis because the answer ultimately depends on what kind of world, what kind of natural and social environment, the species *Homo sapiens* wants—or is willing to tolerate. This is so precisely because it is within our capacity to not only control, but to direct our reproductive patterns, as well as to shape (to some extent) our environment's carrying capacity. Moreover, questions of social status, gender inequality, the educational status of women, poverty, materialism and consumerism, the balance of political power, and cultural and religious beliefs are vital components of any sophisticated analysis of population issues. So in fact the question is not just one of numbers of people, but of how people live.

Thus immediately we enter a thicket of qualifications. In fact, it is more like a luxuriant jungle of uncertainty, subjectivity, and controversy. The population debate is certainly not short on controversy. All the contentious issues that have roiled up at one time or another—abortion, the status of women, contraceptive use, gender selection by amniocentesis, state sovereignty, imperialism, North-South inequity, coercion, genocide—are vitally important to sorting out what is, after all, the most momentous issue in human history. Yet, for better or worse, all the controversy has cast something of a pall of censoriousness over the debate. There are those who would rule out any assertion, however judicious, about whether there are too many people because they impute an ulterior motive to those making it.

We think one ought to be free to offer a direct answer, supported by reason and responsibly qualified, to the basic question. Our view is that there are already too many people for the world's environment and its social structures to support *in a humane way given today's economic and political conditions.* It is hardly necessary to recount the overwhelming body of evidence that supports this statement, all of it pointing to unprecedented environmental degradation and human suffering. Never before have billions of people lived in poverty, consumed polluted water, or breathed fouled air—simply because never before have there been billions of people. Many of the problems facing the world today are age-old, but their magnitude is brand-new.

Since there is no chance of reducing the overall global population anytime soon, the only option left is to try to bring about a societal transformation that will lead to a decline in fertility and, eventually, a stabilized world population. Only when that is achieved will it become possible to talk seriously about reducing the global population in a hu-

mane, non-coercive way. Such a transformation is not a pipe dream; in fact, there are signs of it already in countries around the world. It happens that the necessary changes can be coupled with others that will encourage more support for protected areas (and the natural and cultural environment in general). In short, the most promising solution to the overpopulation–overconsumption crisis is a move toward a sustainable society.

It is not our purpose here to survey the field of thought on population–environment interactions, which has a lineage stretching back to Malthus and beyond in Western thought and to Confucius in the East. However, let us outline the boundaries of speculation by giving the extreme views. One is that humans are like cancer in both the way we multiply and our effects on the planet (an analogy first suggested in Gregg 1955 and summarized in Forencich 1992). Light-years away, so to speak, are pro-natalist "cornucopians" who believe that the human mind is "the ultimate resource" because our ingenuity will always allow us to think our way out of any environmental or social problem, and that there is no practical limit to the number of people the earth can support. Therefore, the more humans there are, the better, because there is more of the "raw material" of potential ingenuity (a view exemplified in Simon 1981).

The two extremes, one misanthropic and the other naïve, are not entirely without merit for our aims: at least they indicate the far reaches of the two ideologies that have informed the protected area movement since its beginnings in the 19th century. For many years the prevailing (if unspoken) view among the creators of national parks and wildlife reserves was that people are a problem to be kept at bay outside of (or strictly controlled within) well-delineated boundaries by enforcing exclusionary laws and policies. This reflects the classical Yellowstone-style concept of what a protected area should be. Over the past twenty years or so there has been a remarkable shift away from this concept in reaction to its perceived failure to meet modern conservation and social needs, particularly but not exclusively in the developing world. What might be called a "second wave" of protected areas has come about. These new kinds of protected areas (such as biosphere reserves, co-managed areas, protected landscapes, and extractive reserves) are designed to treat people as partners and potential sources of answers to conservation problems.

The Current Situation

Table 1 gives crude demographic and protected area information for most of the principal political divisions of the world. The columns are as follows.

- **Column A** gives the 1990 population and **Column B** the national population density as of 1993. These data can be used to compare relative size and crowdedness.
- **Column C** gives the average annual percentage change in the size of the population over the period 1985-90. Speaking very roughly (and subjectively), a figure of 0-1% indicates a pattern of near-stability or slight growth, a figure of 1-2% moderate growth, a figure of 2-3% vigorous growth, and a figure over 3% very rapid growth. Figures in parentheses indicate declines. The national figures take into account the effects of migration, but of course the global figure, 1.75%, represents a net average annual increase over the period. (The same holds true for Column D.) For the sake of comparison, keep in mind that between 1000 and 1750 the annual global population growth rate was something on the order of

Table 1. Basic demographic and protected area data

	{A} Population, 1990 (millions)	{B} Population Density, 1993 (per 1,000 ha)	{C} Average Annual Population Change, 1985-90 (%)	{D} Average Annual Population Increment, 1985-90 (1,000s)	{E} Percentage of Population <15 / ≥65, 1992	{F} Gov't View of Fertility, 1992 (H too high S satisf'c'y L too low)	{G} Per Capita GNP, 1991 (US$)	{H} Number of Terrestrial Protected Areas, 1993	{I} Extent of Terrestrial Protected Areas, 1993 (1,000 ha)	{J} Percentage of Land Protected, 1993	{K} Number of Marine & Coastal Protected Areas, 1993	{L} Extent of Marine & Coastal Protected Areas, 1993 (1,000 ha)
WORLD	**5,295.30**	**427**	**1.75**	**81,538**	**33 / 6**	**–**	**–**	**8,619**	**792,266**	**5.9**	**977**	**211,406**
AFRICA												
Algeria	24.96	114	3.01	610	44 / 4	H	1.991	19	12,719	5.3	1	2
Angola	9.19	82	2.63	197	45 / 3	H	–	5	2,641	2.1	2	62
Benin	4.62	459	2.82	105	46 / 3	S	389	2	844	7.5	0	0
Botswana	1.24	24	3.40	33	45 / 3	H	2,666	9	10,025	17.6	–	–
Burkina Faso	8.99	357	2.50	185	48 / 4	H	290	12	2,662	9.7	–	–
Burundi	5.49	2,337	2.80	124	46 / 3	H	218	3	89	3.2	–	–
Cameroon	11.52	270	2.83	263	46 / 3	H	858	14	2,050	4.3	1	160
Central African Rep	3.01	52	2.58	64	42 / 3	H	407	13	6,106	9.8	–	–
Chad	5.55	48	2.28	108	43 / 4	S	212	7	2,980	2.3	–	–
Comoros*	0.55	2,466	3.45	17	48 / 3	H	460	0	0	0.0	0	0
Congo	2.23	71	2.82	51	45 / 3	L	1,060	10	1,177	3.4	1	300
Côte d'Ivoire	11.98	421	3.86	348	48 / 3	S	677	12	1,993	6.2	1	30
Djibouti	0.44	208	4.46	15	45 / 3	S	–	1	10	0.4	0	0
Egypt	52.43	563	2.58	1,127	41 / 4	H	611	13	800	0.8	3	62
Equatorial Guinea	0.35	135	7.22	19	43 / 4	L	345	0	0	0.0	0	0
Ethiopia	49.83	496	2.12	867	46 / 3	H	123	11	2,534	2.1	1	200
Gabon	1.16	50	4.01	36	33 / 6	L	3,879	6	1,045	3.9	2	1,058
Gambia	0.86	932	3.01	21	44 / 3	H	367	3	18	1.6	0	0
Ghana	15.02	723	3.58	421	45 / 3	H	420	8	1,075	4.5	0	0
Guinea	5.76	256	2.23	105	44 / 3	H	498	3	164	0.7	0	0
Guinea-Bissau	0.96	366	1.87	16	41 / 4	H	187	0	0	0.0	0	0
Kenya	23.59	458	3.56	648	49 / 2	H	350	36	3,470	6.0	3	7
Lesotho	1.75	620	2.78	40	43 / 4	H	582	1	7	0.2	–	–
Liberia	2.58	294	3.17	65	46 / 4	H	–	1	129	1.3	0	0
Libya	4.55	29	4.37	149	50 / 2	S	–	3	155	0.1	0	0
Madagascar	12.01	228	3.06	290	47 / 3	H	207	36	1,115	1.9	1	2
Malawi	9.58	1,137	3.42	230	48 / 3	H	200	9	1,059	8.9	–	–
Mali	9.21	83	2.85	210	47 / 4	H	251	11	4,012	3.2	–	–
Mauritania	2.02	22	2.60	43	44 / 3	S	500	4	1,746	1.7	0	0
Mauritius	1.08	5,463	1.09	11	30 / 5	S	2,380	0	0	0.0	1	4
Morocco	25.06	604	2.56	529	41 / 4	H	1,033	10	362	0.8	2	13
Mozambique	14.20	195	2.27	290	44 / 3	S	84	1	2	0.0	0	0
Namibia	1.44	19	2.94	34	46 / 3	–	1,584	11	10,371	12.6	–	–
Niger	7.73	67	3.36	204	49 / 3	H	303	6	9,697	7.7	–	–
Nigeria	108.54	1,310	3.20	2,717	45 / 2	H	305	20	3,062	3.3	0	0
Rwanda	7.03	3,157	2.87	159	48 / 3	H	282	2	327	12.4	–	–
Senegal	7.33	413	2.81	167	46 / 3	H	736	9	2,180	11.1	4	81
Sierra Leone	4.15	627	2.32	80	44 / 3	H	202	2	82	1.1	0	0

AFRICA (continued)	{A} Population, 1990 (millions)	{B} Population Density, 1993 (per 1,000 ha)	{C} Average Annual Population Change, 1985-90 (%)	{D} Average Annual Population Increment, 1985-90 (1,000s)	{E} Percentage of Population <15 / ≥65, 1992	{F} Gov't View of Fertility, 1992 (H too high S satisf'c'y L too low)	{G} Per Capita GNP, 1991 (US$)	{H} Number of Terrestrial Protected Areas, 1993	{I} Extent of Terrestrial Protected Areas, 1993 (1,000 ha)	{J} Percentage of Land Protected, 1993	{K} Number of Marine & Coastal Protected Areas, 1993	{L} Extent of Marine & Coastal Protected Areas, 1993 (1,000 ha)
Somalia	8.68	152	3.20	232	46 / 3	S	–	16	9,383	3.7	0	0
South Africa	37.96	334	2.58	814	40 / 4	H	2,543	235	7,413	6.1	13	152
Sudan	25.20	115	3.11	628	46 / 2	S	–	16	9,383	3.7	0	0
Swaziland	0.75	473	3.07	19	46 / 3	H	1,210	4	46	2.6	–	–
Tanzania	25.99	325	3.28	663	48 / 3	H	95	28	13,000	13.8	0	0
Togo	3.53	714	2.93	83	49 / 2	H	427	11	647	11.4	0	0
Tunisia	8.06	552	2.57	175	38 / 5	H	1,504	6	44	0.3	1	4
Uganda	17.56	964	2.72	383	49 / 2	H	163	32	1,871	7.9	0	0
Zaire	37.39	182	3.18	932	43 / 4	H	–	8	9,917	4.2	0	0
Zambia	8.14	120	3.58	225	49 / 2	H	418	20	6,361	8.5	–	–
Zimbabwe	9.95	282	3.22	249	45 / 3	H	641	25	3,068	7.9	–	–
ASIA												
Afghanistan	16.56	315	(2.02)	(309)	46 / 4	H	–	5	183	0.3	–	–
Armenia	3.33	1,256	–	–	30 / 5	–	1,928	4	222	7.4	–	–
Azerbaijan	7.13	852	–	–	33 / 5	–	1,232	11	178	2.1	–	–
Bahrain	0.52	7,588	3.67	17	35 / 2	S	6,360	0	0	0.0	0	0
Bangladesh	113.68	9,388	2.68	2,528	44 / 3	H	205	8	97	0.7	3	32
Bhutan	1.54	351	2.10	27	39 / 4	S	174	5	906	19.3	–	–
Brunei Darussalam*	0.30	570	–	–	36 / 3	S	15,390	4	122	23.1	–	–
Cambodia	8.34	510	2.40	166	36 / 3	L	202	0	0	0.0	0	0
China	1,153.47	1,292	1.44	14,888	28 / 6	H	364	434	30,767	3.2	20	1,184
Cyprus*	0.70	759	1.04	7	26 / 10	L	7,050	0	0	0.0	0	0
Georgia	5.46	785	–	–	25 / 9	–	1,788	15	187	2.7	–	–
India	846.19	3,016	2.14	15,559	36 / 4	H	330	331	13,160	4.0	14	474
Indonesia	184.28	1,074	2.06	3,275	37 / 4	H	592	186	19,339	10.2	68	8,941
Iran	58.27	386	4.40	1,932	46 / 3	H	2,274	62	7,979	4.8	3	725
Iraq	18.08	455	3.27	462	45 / 3	L	–	0	0	0.0	0	0
Israel	4.66	2,662	1.75	71	31 / 9	L	12,293	21	207	10.0	1	31
Japan	123.54	3,319	0.68	806	18 / 13	L	26,824	685	4,666	12.3	30	637
Jordan	4.01	499	3.07	97	48 / 3	H	935	8	100	1.1	0	0
Kazakhstan	16.74	64	–	–	32 / 6	–	2,026	8	835	0.3	–	–
Kyrgyzstan	4.39	239	–	–	37 / 5	–	1,163	5	197	1.0	–	–
Korea, North	21.77	1,915	1.71	326	29 / 4	S	–	2	58	0.5	0	0
Korea, South	43.38	4,508	1.36	536	26 / 5	S	6,277	26	757	7.6	3	285
Kuwait	2.14	1,024	4.48	69	45 / 1	S	–	1	25	1.4	0	0
Laos	4.20	200	2.29	78	44 / 4	S	218	0	0	0.0	–	–
Lebanon	2.74	2,836	(0.01)	(0)	40 / 5	S	–	1	4	0.3	0	0
Malaysia	17.89	586	2.60	383	37 / 4	S	2,497	48	1,487	4.5	9	52
Mongolia	2.19	15	2.76	49	44 / 4	H	–	15	6,168	3.9	–	–
Myanmar	41.83	678	2.09	745	37 / 4	S	–	2	173	0.3	0	0
Nepal	19.57	1,541	2.85	456	42 / 3	H	170	12	1,109	7.9	–	–
Oman	1.52	80	4.91	55	47 / 3	S	6,148	2	54	0.3	1	1

ASIA (continued)	{A} Population, 1990 (millions)	{B} Population Density, 1993 (per 1,000 ha)	{C} Average Annual Population Change, 1985-90 (%)	{D} Average Annual Population Increment, 1985-90 (1,000s)	{E} Percentage of Population <15 / ≥65, 1992	{F} Gov't View of Fertility, 1992 (H too high S satisf'c'y L too low)	{G} Per Capita GNP, 1991 (US$)	{H} Number of Terrestrial Protected Areas, 1993	{I} Extent of Terrestrial Protected Areas, 1993 (1,000 ha)	{J} Percentage of Land Protected, 1993	{K} Number of Marine & Coastal Protected Areas, 1993	{L} Extent of Marine & Coastal Protected Areas, 1993 (1,000 ha)
Pakistan	118.12	1,661	3.31	3,075	44 / 4	H	383	53	3,655	4.6	1	16
Philippines	62.44	2,232	2.58	1,342	39 / 4	H	728	27	573	1.9	5	31
Qatar*	0.37	335	4.16	14	28 / 1	S	9,920	0	0	0.0	0	0
Saudi Arabia	14.87	77	5.57	601	45 / 3	S	7,893	9	21,197	9.9	2	475
Singapore	2.71	45,869	1.16	29	23 / 6	L	14,263	1	2	2.6	0	0
Sri Lanka	17.22	2,769	1.67	258	35 / 4	H	495	43	784	11.9	6	303
Syria	12.36	748	3.46	329	49 / 4	S	1,141	0	0	0.0	0	0
Tajikistan	5.30	401	–	–	43 / 4	–	697	3	86	0.6	–	–
Thailand	54.68	1,113	1.83	894	34 / 4	H	1,697	106	6,475	12.6	10	625
Turkey	55.99	774	2.50	1,181	35 / 4	H	1,793	18	269	0.3	3	114
Turkmenistan	3.67	81	–	–	41 / 4	–	1,439	8	1,111	2.3	–	–
United Arab Emirates	1.59	204	5.69	67	35 / 1	S	22,170	0	0	0.0	0	0
Uzbekistan	20.51	515	–	–	41 / 4	–	978	10	245	0.5	–	–
Vietnam	66.69	2,178	2.18	1,237	39 / 5	H	–	59	897	2.7	2	34
Yemen	11.68	246	3.43	308	49 / 3	H	557	0	0	0.0	0	0
AUSTRALIA & OCEANIA												
Australia	17.09	23	1.40	213	22 / 11	S	17.068	733	81,403	10.6	184	13,035
Belau (Palau)*	0.01	203	–	–	–	–	–	1	1	2.0	–	–
Cook Islands*	0.01	416	–	–	–	–	–	1	0.2	0.1	–	–
Fd St of Micronesia*	0.09	1,282	–	–	–	–	–	0	0	0.0	0	0
Fiji	0.73	409	1.97	13	38 / 3	H	1,945	4	6	0.3	1	4
French Polynesia*	0.19	579	–	–	37 / 3	–	-	7	11	3.4	–	–
Kiribati*	0.07	968	–	–	–	–	600	10	27	39.1	–	–
Marshall Islands*	0.04	2,517	–	–	51 / 3	–	-	0	0	0.0	0	0
Nauru*	0.01	3,803	–	–	–	–	9,091	0	0	0.0	0	0
New Caledonia*	0.16	88	–	–	33 / 5	–	-	30	60	0.3	–	–
New Zealand	3.39	130	0.84	27	23 / 11	S	12,301	124	2,901	10.7	32	1,386
Niue*	0.01	385	–	–	–	–	–	0	0	0.0	0	0
Papua New Guinea	3.88	92	2.29	75	40 / 3	H	932	6	29	0.1	0	0
Solomon Islands	0.32	126	3.50	9	47 / 3	H	684	0	0	0.0	0	0
Tonga*	0.10	1,339	–	–	–	–	–	6	0.4	0.1	–	–
Tuvalu*	0.01	3,846	–	–	–	–	–	0	0	0.0	0	0
Vanuatu*	0.14	303	–	–	45 / 3	S	860	0	0	0.0	0	0
Wallis & Futuna*	0.01	476	–	–	–	–	–	1	0.003	0.0	0	0
Western Samoa*	0.16	1,438	–	–	40 / 4	H	720	2	0.002	0.0	–	–

	{A} Population, 1990 (millions)	{B} Population Density, 1993 (per 1,000 ha)	{C} Average Annual Population Change, 1985-90 (%)	{D} Average Annual Population Increment, 1985-90 (1,000s)	{E} Percentage of Population <15 / ≥65, 1992	{F} Gov't View of Fertility, 1992 (H too high S satisf'c'y L too low)	{G} Per Capita GNP, 1991 (US$)	{H} Number of Terrestrial Protected Areas, 1993	{I} Extent of Terrestrial Protected Areas, 1993 (1,000 ha)	{J} Percentage of Land Protected, 1993	{K} Number of Marine & Coastal Protected Areas, 1993	{L} Extent of Marine & Coastal Protected Areas, 1993 (1,000 ha)
SOUTH AMERICA												
Argentina	32.32	122	1.43	419	30 / 9	S	3,966	100	9,336	3.4	7	1,499
Bolivia	7.17	71	2.55	152	41 / 4	H	654	26	9,250	8.4	–	–
Brazil	149.04	185	2.23	2,856	35 / 5	S	2,920	214	27,742	3.3	20	2,032
Chile	13.17	184	1.68	195	31 / 6	S	2,359	65	13,715	18.1	32	10,050
Colombia	32.30	327	2.11	591	36 / 4	S	1,254	79	9,391	8.2	9	615
Ecuador	10.55	409	2.72	237	41 / 4	H	1,010	15	11,136	39.3	5	8,975
French Guiana*	0.11	13	–	–	–	–	6,700	0	0	0.0	0	0
Guyana	0.80	41	0.80	6	33 / 4	S	302	1	59	0.3	0	0
Paraguay	4.28	117	3.20	109	40 / 4	S	1,266	19	1,483	3.6	–	–
Peru	21.55	179	2.31	424	39 / 4	H	1,055	22	4,176	3.2	4	710
Suriname	0.42	29	1.66	6	34 / 4	S	3,874	13	736	4.5	5	128
Uruguay	3.09	180	0.64	19	26 / 12	L	2,883	8	32	0.2	1	3
Venezuela	19.32	234	2.66	428	38 / 4	S	2,728	104	27,534	30.2	11	704
CARIBBEAN, CENT. AMERICA & NORTH AMERICA												
Barbados*	0.26	5,930	0.16	0	25 / 11	S	6,370	0	0	0.0	0	0
Belize	0.19	89	2.63	4	45 / 6	S	2,176	10	291	12.7	NA	NA
Canada	26.64	30	0.90	222	21 / 11	S	20,740	411	49,448	5.0	48	7,106
Costa Rica	3.02	640	2.91	72	36 / 5	H	1,841	25	621	12.1	7	194
Cuba	10.61	993	0.81	80	23 / 9	S	–	57	894	8.1	6	227
Domincan Rep	7.17	1,575	2.38	144	39 / 3	H	922	18	1,048	21.5	7	270
El Salvador	5.17	2,663	0.92	43	44 / 4	H	1,087	5	19	0.9	0	0
Guatemala	9.20	925	2.82	209	45 / 3	H	944	17	833	7.6	3	13
Haiti	6.49	2,501	1.83	102	45 / 4	H	375	3	10	0.3	0	0
Honduras	5.14	503	3.59	144	46 / 3	H	587	38	543	4.8	1	350
Jamaica	2.42	2,304	1.60	36	34 / 8	H	1,446	1	2	0.1	0	0
Mexico	84.49	472	2.40	1,710	38 / 4	H	2,971	60	9,897	5.1	11	1,119
Nicaragua	3.68	346	2.83	85	47 / 4	H	283	21	952	7.3	1	4
Panamá	2.66	337	2.17	45	35 / 5	S	2,133	15	1,328	17.2	6	898
Trinidad & Tobago	1.31	2,493	1.40	16	34 / 5	H	3,793	9	18	3.4	2	3
USA	249.98	281	0.92	2,142	22 / 13	S	22,356	937	98,456	10.5	107	54,317
EUROPE												
Albania	3.25	1,218	2.07	58	33 / 5	S	–	13	45	1.5	5	28
Austria	7.71	943	0.02	2	17 / 15	S	20,410	187	2,118	25.3	–	–
Belarus	10.26	496	–	–	23 /10	S	3,288	4	237	1.1	–	–
Belgium	9.97	3,311	0.01	1	18 / 15	S	19,043	3	77	2.5	0	0
Bosnia-Hercegovina*	4.35	852	–	–	28 / 6	–	–	–	–	–	–	–
Bulgaria	8.99	807	0.22	20	20 / 13	L	1,818	50	261	2.4	0	0
Croatia*	4.69	829	–	–	21 / 12	–	–	–	–	–	–	–

EUROPE (continued)	{A} Population, 1990 (millions)	{B} Population Density, 1993 (per 1,000 ha)	{C} Average Annual Population Change, 1985-90 (%)	{D} Average Annual Population Increment, 1985-90 (1,000s)	{E} Percentage of Population <15 / ≥65, 1992	{F} Gov't View of Fertility, 1992 (H too high S satisf'c'y L too low)	{G} Per Capita GNP, 1991 (US$)	{H} Number of Terrestrial Protected Areas, 1993	{I} Extent of Terrestrial Protected Areas, 1993 (1,000 ha)	{J} Percentage of Land Protected, 1993	{K} Number of Marine & Coastal Protected Areas, 1993	{L} Extent of Marine & Coastal Protected Areas, 1993 (1,000 ha)
Czechoslovakia†	15.66	1,258	0.24	38	23 / 12	S	2,473	65	2,059	16.1	–	–
Denmark	5.14	1,219	0.00	0	17 / 16	S	23,793	65	409	9.5	3	12
Estonia	1.58	365	0.75	56	22 / 11	–	3,914	37	360	8.0	–	–
Finland	4.98	165	0.51	24	19 / 13	S	24,089	38	850	2.5	0	0
France	56.72	1,043	0.47	258	20 / 14	L	20,486	88	5,300	9.6	27	849
Germany	79.48	2,308	(0.16)	(127)	16 / 15	L	19,204	472	8,781	24.6	14	733
Greece	10.12	792	0.60	58	19 / 14	L	6,530	18	103	0.8	13	84
Hungary	10.55	1,136	(0.12)	(12)	20 / 14	L	2,700	54	577	6.2	–	–
Iceland	0.26	26	1.13	3	26 / 11	S	23,324	20	916	8.9	5	509
Ireland	3.50	505	0.87	30	27 / 11	S	11,245	6	39	0.6	0	0
Italy	57.66	1,966	0.25	141	17 / 14	L	18,588	143	2,008	6.7	18	211
Latvia	2.69	430	0.61	16	21 / 12	–	3,850	21	175	2.7	–	–
Lithuania	3.73	826	0.88	31	23 / 11	–	2,415	0	0	0.0	–	–
Luxembourg*	0.37	1,448	0.32	1	17 / 13	L	24,860	0	0	0.0	–	–
Macedonia*	2.30	894	–	–	29 / 7	–	–	–	–	–	–	–
Malta*	0.35	11,031	0.49	2	23 / 11	S	5,820	0	0	0.0	–	–
Moldova	4.36	1,293	–	–	28 / 8	–	1,700	0	0	0.0	–	–
Netherlands	14.94	4,502	0.48	68	18 / 13	S	18,858	67	353	9.4	10	54
Norway	4.25	140	0.32	13	19 / 16	S	24,065	81	1,609	5.0	12	3,508
Poland	38.18	1,265	0.90	326	25 / 10	S	1,787	80	2,242	7.2	4	73
Portugal	9.87	1,073	0.28	28	21 / 13	S	5,944	23	560	6.1	8	132
Russia	149.28	88	–	–	23 / 10	–	3,469	75	20,033	1.2	–	–
Romania	23.27	1,015	0.47	105	23 / 11	L	1,380	40	1,089	4.6	0	0
Serbia-Montenegro*	10.39	1,016	–	–	24 / 9	–	–	–	–	–	–	–
Slovenia*	1.95	963	–	–	23 / 11	–	7,150	–	–	–	–	–
Spain	38.96	784	0.49	186	20 / 13	S	12,482	161	3,504	6.9	9	75
Sweden	8.57	211	0.10	8	18 / 18	S	25,254	193	2,960	6.6	5	12
Switzerland	6.71	1,725	0.47	30	16 / 15	L	33,850	112	753	18.2	–	–
Ukraine	51.84	865	–	–	22 / 12	S	2,191	17	465	0.8	–	–
United Kingdom	57.41	2,393	0.10	58	19 / 16	S	16,606	131	4,635	18.9	35	1,194

– = not applicable or not available; * = see sources note below; † = before partitioning into Czech Republic and Slovakia.

Except for countries marked with an asterisk, the data come from the following sources: Population, population change, population increment: WRI 1994:268-269 (Table 16.1). Per capita GNP: WRI 1994:256-257 (Table 15.1). Population density: WRI 1994:284-285 (Table 17.1). Protected area columns: WRI 1994:316-317 (Table 20.1). Population <15 / ≥65, government view of fertility: PRB 1992. For an in-depth discussion of the quality of the data, the method by which they were derived, and qualifications thereto, see the technical notes appended to the tables in WRI 1994. For countries marked with an asterisk, the data come from the following sources: Population, population density: Hunter 1993 or WRI 1992. Population change, population increment: WRI 1992. Per capita GNP: WRI 1992 or Hunter 1993 (some of these data refer to years other than 1991). Protected areas columns: WRI 1992 or IUCN 1992a, 1992b, 1992c, 1992d (these data refer to the year 1990). Population <15 / ≥65, government view of fertility: PRB 1992.

0.10%. Only since about 1950 have annual rates reached the levels seen in Column C.

- **Column D** expresses average annual growth as the number of people added to the national population each year. This is a more concrete way to visualize growth. For example, one can quickly see that the world added another 81.5 million to its population every year during 1985-90.
- **Column E** gives the percentage of the population below age 15 and that aged 65 or older. It is a basic indicator of the age structure of the population.
- **Column F** is the government's official view of the fertility situation. Needless to say, the official view may differ from that of even the majority of individuals within the populace, or of segments therein.
- **Column G,** the 1989 per capita gross national product, gives a very general indication of the material wealth of the populace. It is not a reliable measure of natural resource consumption, but does indicate the economic disparities between developed and developing countries.
- **Columns H, I,** and **J** gives the number, extent, and national coverage of terrestrial protected areas in IUCN Categories I-V (see IUCN 1990:10-14). Designations such as strict nature reserve, national park, natural monument, wildlife sanctuary, and protected landscape are included. Excluded are multiple-use areas such as production forests.
- **Columns K** and **L** give the number and extent of marine and coastal protected areas. Included are all protected areas with littoral, coral, island, marine, or estuarine components.

Let us look briefly at some of the demographic issues raised in Table 1.

Sheer population growth. The most striking aspect of the table is the figures in Columns C and D, which show how pervasive population growth is around the world. It is often said that the demographics of the industrialized and developing countries are radically different. This is certainly true in terms of age structure, current and projected growth rates, and innumerable socioeconomic factors. But the underlying, bedrock commonality is that virtually no country has yet stabilized, let alone begun to reduce, its population. There are a handful of exceptions (all in Europe) whose population in 2025 is projected to be lower than it was in 1990: Belgium, Bulgaria, Denmark, Greece, Hungary, and Italy (WRI 1994:269). Outside of these and a few other of the most sparsely populated, slowest-growing countries, tens of thousands of people will continue to be added to national populations each year for decades to come—if current trends continue. The rate of growth is far slower than it was in 1950s and 1960s, but it is growth nonetheless.

The world's population doubled between 1950 and 1990, and is projected to reach about 8.5 billion in 2025 (WRI 1994:268). This fact is the heart of the numbers issue, but one cannot speak of "overpopulation" without linking it to "overconsumption." Out of the mountain of recent scholarly inquiry into environmental questions, the most telling single result to have emerged is this: about 40% of the net primary productivity of plants has been appropriated by humans for our use (Vitousek et al. 1986:372). One species out of thousands is using 40% of the energy upon which all forms of higher life depend. This one fact speaks volumes about overpopulation and overconsumption. *Homo sapiens* has arrogated to itself a grossly disproportionate share of the planet's life-giving photosynthesis. The inevitable result is the destruction of

other species through the extreme simplification of ecosystems. In short, the world is being domesticated, and a token 5% or 10% under protected status may ultimately not be of much account. This is not to say that there will be nothing of nature left in a world of 8 billion people; only that, in comparison with the biological richness which existed within living memory, those vestiges will be like tatters from a tapestry.

Population growth rates. Looking at Column C, we find the highest growth rates (3% and above) in Africa, the Gulf States and some other Asian Islamic countries, and scattered countries elsewhere (e.g., Honduras, Paraguay, Solomon Islands). Rates of 1-3% are common everywhere else outside of Europe. These rather abstract numbers are perhaps better expressed in Column D, the number of people added each year to the population. As we noted above, nearly every country in the world is now adding, and will continue to add for many years to come, tens of thousands of people annually. In many cases the increment will be hundreds of thousands or even millions.

By comparing Columns C and G one gets an idea of the relationship between economic development and population growth. Rates of growth in the wealthiest countries (those with a per capita GNP over $10,000) are usually far lower than those in the poorest countries (per capita GNP less than $580, the World Bank benchmark; see WRI 1992:29). Almost all of the wealthiest countries are growing at an annual rate of less than 1%, while the great majority of the poorest countries—China and Sri Lanka being notable exceptions—are growing at rates of 2% or more. In fact, there is only one example of a poor country with growth rate lower than 1%: Guyana (0.80%). Despite this pattern, as we shall see below the old cliché "development is the best contraceptive" is turning out to be an oversimplification.

Density and distribution. Where people live can be as important a factor as how many people there are. Column B gives nationwide population densities. This is a rough indicator of the "crowdedness" of a country, but it says nothing about how the population is distributed within its borders. A nation might have a high overall population density because most of its people are clustered in urban areas, with the countryside settled much less thickly. In such a country, direct population pressures on protected areas (i.e., demands for resources imposed by nearby residents) could be lower than they might seem from a glance at the national density figure. On the other hand, even a protected area in a remote, sparsely populated region can be subject to major indirect impacts attributable to population-related demands. Here are three examples.

- Resource extraction or production activities adjacent to a park could be driven up by demands in faraway populous areas. Cities, for example, are often built on prime agricultural land; the Food and Agriculture Organization of the United Nations estimates that 1.4 billion ha of arable land will be lost to city growth from 1980 to 2000. Consequently, agricultural productivity per worker has to rise to compensate for an increasingly urbanized population. This could lead to a situation where arable land near protected areas is more intensively farmed than previously, with new chemical inputs that end up in agricultural run-off, increased competition for local water supplies, more soil erosion caused by mechanized equipment, and so on (Ypsilantis 1992:52, 55).
- Air- or waterborne pollution from distant cities or industrial

facilities can have adverse effects. In the USA, smog from greater Los Angeles has damaged Grand Canyon National Park, which lies more than 800 km to the east.

- There may be desires for adjacent vacation developments from people living hundreds of kilometers away. This is a common situation within English national parks (which are actually protected landscapes): holiday and second homes account for a high percentage of dwellings in some parishes (Harmon 1991:36).

The lesson from this is that subnational analyses of density and distribution are needed to determine the full range of population-related impacts on a country's protected areas.

Age structure. Here is where the demographics of the developing and developed countries split. The world's population growth over the coming century will ride on a swelling tide of young people in developing countries. In these countries, mortality rates have dropped sharply in recent decades. Fertility rates—high though they are—actually are now falling quickly too, but not yet as fast. The ensuing gap leaves a situation where over 40% of the population in most of the developing countries is under the age of 15.

Column E tells the story. The left-hand number is the percentage of the country's population under the age of 15; the right-hand number, the percentage 65 or older. The greater the difference between the two, the more skewed the population is toward youthfulness. Most African and Arabic countries have differences of 40 percentage points or more; industrialized countries generally have differences of only 10-15 points.

As the cohort of people under age 15 grow up and reach their child-bearing years, a built-in "demographic momentum" takes hold. As van den Oever and Suprapto (1992) point out, Africa provides the prime example of demographic momentum. In 1990, some 292 million people, 45% of the total population, were under 15. Even if mortality among this group were to be high, by 2005 there would still be something on the order of 250 million Africans—125 million potential couples—aged 15 to 29, the peak age group for reproduction.

> Even if fertility in Africa were to change today and drop to "replacement level," where a couple produce just enough children to replace themselves in the next generation, the population would still increase enormously, due to the sheer number of couples in the reproductive ages. This pattern will be echoed in the future ("baby booms" and "baby busts"). If fertility remains at replacement level, the effect will be less pronounced with each subsequent generation, until the effects of past high population growth rates are entirely cancelled out and a zero population growth rate is achieved (van den Oever and Suprapto 1992:41).

In developed countries, the questions revolve around the implications of an aging population. The debate is moving beyond the old argument over whether restrictive protected areas, such as backcountry or designated wilderness, discriminate against old people who are less physically able to use them. (There does not seem to be any disproportionate lack of support for wilderness or backcountry among older age groups.) The darkling questions waiting down the road are those of "intergenerational equity" within individual countries—a euphemism for the fear that divisive rifts will form between young working people and an increasingly large group of retirees. One of the hallmarks of a

developed country is a public welfare system, often including some form of universal pension for the elderly. How can a shrinking base of young workers, scrambling in an ever-more-competitive global jobs market, generate enough revenue to pay for the welfare? Will expenditures for programs seen as "non-essentials"—which in all likelihood would include protected areas—be cut to compensate? Protected areas tend to have a broad appeal in the wealthy developed countries, but this might not save them if the economic vise tightens enough.

There are two other demographic issues particularly important to the future of protected areas that are not covered in Table 1: urbanization and migration.

Urbanization. Urbanization is a special facet of population density and distribution. The growth of urban areas, and the concentration of increasing percentages of people in them (both globally and within countries), is the demographic hallmark of our age. It is well-known that the future growth of the global population will be concentrated in cities in developing nations. In 1950, 13 of the 25 most populous cities were in lesser-developed countries; by 2000, 20 out of 25 will be (Ypsilantis 1992:52).

We have seen how cities can exert indirect influences on faraway protected areas. Obviously, parks near expanding cities face immediate challenges. Everglades National Park in the USA is a vast freshwater wetland whose ecological integrity is threatened by the greatly increased demand for water for human activities in the southern quarter of the state of Florida. South Florida's population, centered on metropolitan Miami, has increased more than tenfold since 1950. Miami's environs, once dozens of kilometers from the park boundary, now sprawl to its very edges. This, in tandem with intensive agriculture north of the park, has disrupted the delicate water-flow regime that is the lifeblood of the Everglades ecosystem (Webb 1993).

In terms of human psychology, there are profound consequences implicit in switching from a world in which most people grew up in rural areas—close to the land, so to speak—to one in which most grow up in cities. Profound, but unpredictable. It has been suggested that succeeding generations of city-dwellers will eventually become so detached from nature that their support for parks and reserves will fade (cf. Lusigi 1988:44). More to the point, it may be that conditions in burgeoning cities will preclude more and more people from even thinking about nature except sporadically, and then only as an abstract adjunct to the production of food or other necessities. On the other hand, it has also been theorized that humans have an ingrained, almost genetic need for nature (Wilson 1984). If there is such an ineradicable need, then perhaps high concentrations of people in cities will actually fuel increased desire for nature protection as "absence makes the heart grow fonder."

Migration. Rural-to-urban migration, a main force behind the explosive growth of cities around the world, is driven by economic considerations: people move to cities in search of a job or a better standard of living. Those that arrive from depressed rural areas have been termed "economic refugees." There are also economic refugees moving from one rural area to another in search of land. This form of migration is prevalent in countries where land is not distributed equitably. A closely related form of rural-to-rural migration occurs when land-use practices once sustainable become untenable as population increases. People abandoning worked-out land are called "environmental refugees," as are those escaping from natural

or human-caused environmental disasters.

Of course, the classic refugee is one fleeing war or political persecution. Areas adjacent to war zones in Africa, the Balkans, and Central America are among those that have recently received large numbers of refugees. Sometimes they pour into what had been sparsely settled districts near protected areas. For example, the population in the region around Taï National Park in Côte d'Ivoire, one of the last extensive tracts of rainforest in the Guinean zone of West Africa, has increased fivefold in less than a decade. Of the population of 57,000, some 48% are refugees from the war in Liberia who have arrived since 1989 (Castleton and Bonnehin 1992).

Some Examples of Population–Protected Area Interactions

It must be said that Table 1 does not shed much light on the relationship between population growth and protected areas within a given country. The raw numbers of Columns H-L say nothing about how completely the protected areas represent the country's ecosystems, how effective the management of the areas is, what specific population-related problems are at hand, and so on. For this we need to turn to country-by-country evaluations, such as have been gathered by IUCN (1992a; 1992b; 1992c; 1992d).

It is not difficult to imagine the sort of pressures protected areas face in countries that are both heavily and densely populated, such as Bangladesh, China, India, Indonesia, Japan, Nigeria, and Pakistan. What we would like to do here is take a glimpse at population-related issues in a few other countries where the problems may not be so well-known or obvious. We have tried to illustrate a range of existing or potential problems, both direct and indirect.

Kenya, Tanzania. These two East African countries epitomize the popular image of the continent, each boasting populations of spectacular wildlife species. Tourism is the largest foreign exchange earner in Kenya, and Tanzania earns some US$70 million in foreign exchange each year from wildlife tourism and hunting. This is largely due to the reputation of the region's wildlife and natural areas, represented in protected area systems which include such world-renowned national parks as Amboseli, Kilimanjaro, Serengeti, and Tsavo. Kenya's annual growth rate, 3.56%, and Tanzania's, 3.28%, put them among the highest in Africa. In Tanzania, according to Mwalyosi (1986), "there are conflicts between the needs of parks and of local people as populations increase; the loss of wildlife continues as a result of human encroachment into protected areas and of poaching pressure, particularly on elephant and rhino; there is also some concern about the ecological viability of some of the parks as land use changes around their perimeters." In Kenya, despite great advances in family planning (Robey, Rutstein, and Morris 1993:63-64), "population increase, coupled with agricultural encroachment, shifting cultivation, cattle grazing, unlicensed timber extraction for building poles and charcoal, intensive logging, illegal settlement, the conversion of indigenous forest to plantations, subsistence hunting, legal degazetting of forest land for conversion to other types of land use, and rapid industrialisation are threats to the forest resource, both within and around various forest reserves" (IUCN 1992c:127). Kenya's marine parks are threatened by sedimentation, expanding settlements, and pollution.

Congo, Gabon, Zaïre. These countries in Central Africa have large areas of relatively unexploited tropical rainforest, which endows them with an international environmental importance. All have annual growth rates over 2.8%—

Gabon's a staggering 4.01%—and all are expected to maintain rates of over 2.6% through at least 2005. Despite this, Congo's government views fertility as being too low, as does Gabon's, presumably because of the countries' currently low population and density. In Congo, significant areas of natural rainforest remain, but much is already disturbed (IUCN 1992c:60). Gabon has fared better. Its major ecosystems intact, it has been called "one of the few countries in the world that still offers exceptional potential for conservation" (IUCN 1992c:93). The protected areas of both are now under little direct population pressure, but the prospect of long-term high annual growth is disquieting.

Zaïre, the largest nation in Central Africa, is considered a "megadiversity country" in terms of species richness. Forced relocations from some of Zaïre's national parks and sport hunting zones have displaced numerous rural people from their ancestral land without any compensatory benefits. The track record of alienation would seem to make Zaïre's protected areas even more vulnerable to population pressures than they might otherwise be. Even under the best of circumstances, an annual increment of over 1 million people to the population does not bode well for the continued integrity of Zaïre's equatorial forest zone, which has heretofore escaped overexploitation because of low population densities. Even in the remote eastern part of the country, the more accessible transitional forest areas have been largely cleared for agriculture (IUCN 1992c:336-337). One might expect that, as transportation improves, the burgeoning population will start having a direct effect on the rainforests. Perhaps further into the future the same will hold for Congo and Gabon.

Côte d'Ivoire. Such consequences, still speculative in Central Africa, have already come all-too-true in West African countries such as Côte d'Ivoire. Although a small country, Côte d'Ivoire has a significant system of protected areas, covering over 2 million ha. The country's growth rate is 3.86% per year, adding 348,000 people annually to a population of 12 million. Not surprisingly, there is pressure to convert protected areas, often considered to be "unproductive." According to IUCN (1992c:67, summarizing Djédjé Bagno 1990 & Roth and Hoppe-Dominik 1990), "illegal hunting pressure has built up to such an enormous extent, due to greater accessibility of remote areas, increasing human populations and the insufficiency of protein sources for human nutrition," that, despite a twenty-year-old ban on hunting throughout the country, "poaching remains the most serious problem facing protected areas." The sheer number of people produces demand to open up remaining remote areas, with the result that previously unexploited wildlife comes under tremendous pressure. Côte d'Ivoire's situation is an example of protected areas being literally the last bastion of nature, since timber cutting, forest clearance, and livestock grazing have modified or eliminated almost all the natural vegetation outside of them (Roth and Hoppe-Dominik 1990).

Malaysia. Malaysia is considered to be an example of a "rapidly industrializing country"—one whose economy is on the cusp of transforming from an agricultural base to one with vigorous industrial sectors, such as energy production, manufacturing, and transportation. In many ways it is a remarkable social success story, with marked reductions over the past generation in poverty, illiteracy, infant mortality, and the birth rate (WRI 1992:44). Yet the average annual growth rate for 1985-90 remained a high 2.64%, producing an additional 443,000 people each year. In recent years the government has actively pro-

moted population growth, including giving tax incentives for larger families (EIU 1990:8). The increasing population has put direct pressure on Malaysia's forested protected areas, both on the mainland peninsula and in Sabah and Sarawak, the two states on the island of Borneo. Peninsular Malaysia was historically dominated by lowland rainforests rich in biologically important Dipterocarp tree species. Forest cover on the peninsula fell from 90% a century ago to 68% in 1966 and, precipitously, to 47% in 1985. In Sarawak, the forest cover has been reduced to at least 67%; in Sabah, to at least 45%. During this same period there were many advances in the expansion and management of the country's protected areas, but few are under complete legal protection, and authorities are concerned that they will be subject to disturbance as pressure for land and timber increase. Lands have already been excised from several protected areas in response to shifting cultivation (IUCN 1992a:75-76).

Philippines. The Philippines is an example of a country whose protected areas exist on paper only. Some 59 national parks have been established since 1900, but a 1986 assessment found that none met IUCN's international standards for protected areas (Haribon Foundation 1986). This ineffectiveness is caused by direct population pressure in the form of demand for productive land compounded by government corruption and inattention. Deforestation has fragmented the original cover everywhere in the country except for the island of Palawan, where the population density is low. At least 5.7 million people have encroached on lands that are supposed to be protected public domain (Cruz et al. 1992), with some 54,000 ha under cultivation. Plans are now underway to virtually start over and remake the protected areas system (IUCN 1992a:115-116). However, an annual population increment exceeding 1.4 million people, coupled with a per capita GNP of $700, cast grave doubts on the ability of anyone to formulate an effective protected areas system for the Philippines.

Guatemala. Guatemala provides several examples of how migration affects protected areas. In a study of in-migration's effects on protected areas in Guatemala's fast-growing Petén Province, Ypsilantis (1992:57-60) identified five main sources of migrants: former refugees from military and political repression returning from Mexico, Mexican nationals leaving their country because of land-distribution problems and resource depletion, slash-and-burn agriculturalists coming from deforested areas in Guatemala's eastern provinces, landless farmers from the country's southern provinces, and Indians from the Altiplano who are driven out by population increases that have steadily reduced the size of inherited farm allotments to the point where they can no longer sustain young families. In addition, the government has encouraged colonization in Petén under its Instituto Nacional de Transformación Agraria. Sixty thousand people have been relocated, with another 100,000 proposed (Colchester 1991). The agricultural frontier has now moved deep into the Petén forests to the edge of the 1.6-million-ha Maya Biosphere Reserve, which encompasses four national parks (including Tikal, a World Heritage Site) and three "protected biotopes." Immigration into Petén is considered the greatest threat to the biosphere reserve (Santiso 1993).

USA. While examples of most kinds of protected area–population interactions can be found in the United States, the situation at Shenandoah National Park in the state of Virginia exemplifies certain problems endemic to wealthy countries. All of northeastern Virginia is undergoing rapid population growth caused by urban sprawl from the

capital city of Washington. Located within 50 km of Washington, the area around Shenandoah has been transformed from a rural to a near-suburban landscape. The effects of regional population growth on the park have been wide-ranging. Highways have been improved and businesses relocated closer to Shenandoah, which has allowed people with a wide range of occupations to move near the park and still keep their high-wage jobs. Real estate values in the area have risen 400%, with parcels abutting the park even more desired. Farms and woodlots have been subdivided and strip developments are springing up. Wildlife management may change as sport hunting declines among the newcomers on the periphery of the park. Changes in ownership have cut off long-standing points of access to park trails along the boundary. Day-use of the park is now higher than before. Visibility from Shenandoah's famous Skyline Drive has decreased by 50% over the past two decades because of higher industrial pollution, which has also led to airborne pollution of park streams. What people see from Skyline Drive is no longer a pleasing pattern of farms, woodlots, forests, and small towns, but a jumble of industrial facilities, small "farmettes," and housing subdivisions. In response to these population-related issues, Shenandoah's managers have begun cooperative planning to protect park values on nearby lands as well as those inside the boundary (Haskell 1991).

Mediterranean Europe. The Mediterranean Sea is a microcosm of pressures facing coastal areas everywhere (see Hinrichsen 1994). Mediterranean coastal regions now receive 100 million international and domestic tourists each year. According to projections by the Mediterranean Blue Plan commission, under even poor economic conditions that number will rise to 170 million by 2025, and could go as high as 340 million (Batisse 1994). The U.N. Environment Program has projected that the number in 2025 could be as high as 760 million (FNPPE 1993:43). With continuing population growth along the southern and eastern coasts, the pressures on the sea are intensifying. The effects are beginning to show on coastal and near-shore protected areas. For example, long stretches of the Spanish Mediterranean coast have been developed for tourism. The area around Coto Doñana National Park—which is an internationally important confluence of migratory bird routes between Africa and Europe—is no exception. Visitor pressure and excessive water extraction are among the reasons natural water sources within Coto Doñana have been drastically reduced (IUCN 1992b:308). The Portuguese Algarve, France's Côte d'Azur, and the coastal areas of Italy and Greece have seen similar problems.

Societal Transformation

So what are the prospects for protected areas as we head into a century which could well see the world population reach 10 billion people or more? Our analysis proceeds from four propositions:

- The current protected area estate does not satisfactorily protect the natural systems and cultural facets it is meant to safeguard, for two reasons: it is far too small and there are too many other pressing demands to enable governments to devote the funds necessary to manage it properly.
- Widespread public support is a prerequisite for expanding and strengthening the management of the protected area estate.
- Such public support will be impossible to get and keep unless it is built up within a larger context of societal transformation—a transformation which leads first to economic and political secu-

rity, and eventually the stabilization, followed by a gradual reduction, of the world's population.

- Conservationists working in and on behalf of protected areas must contribute to this transformation by (1) continuing to innovate ways of integrating the needs of people with the protection aims of parks and reserves, and (2) concerning themselves with issues of social justice and human development that hitherto have been seen as separate from natural and cultural resource protection.

The first two propositions seem evident. No scientific authority has ever claimed that the existing extent of protected areas is adequate to the tasks set them. The same is true for their funding. Indeed, the consensus is quite to the contrary. The 1982 World Parks Congress proposed a doubling of the protected area estate, to 10% of the global land surface, within ten years (McNeely and Miller 1984). At 5.9%, we are obviously far short of this goal—a goal which itself has more to do with present political realities than with the objective requirements of ecosystem protection. Evidence from conservation biology suggests that far more than 5-10% will have to come under systematic management if biodiversity and the functioning of natural processes are to be protected. This will undoubtedly require funding far higher than is now allotted to protected area conservation.

If we accept the first proposition, then the next follows readily. The move toward second-wave, nonexclusionary designations has been driven by the recognition that public support is essential for making protected areas work under *current* conditions. To expand protected areas further entails even more contentious competition with other, more directly productive forms of land use. There is no reason to think that future protected area expansion can be effected against the wishes of the populace at large and local people in particular.

The societal transformation referred to in the third proposition is by no means speculative or utopian: there are initial signs of it already around the world, manifested in the fact that fertility is now declining across a broad range of developing countries *in the absence of economic growth.*

> Contrary to the expectations of many observers, developing nations are not experiencing the classical demographic transition [from high to low birth and death rates] that took place in many industrialized countries over the past century. In the U.S. and the U.K., for instance, declining birth rates came only after economic growth had brought improvements in health care and education. The transition took many decades. In contrast, recent evidence suggests that birth rates in the developing world have fallen even in the absence of improved living conditions. The decrease has also proceeded with remarkable speed (Robey, Rutstein, and Morris 1993:60).

The authors of this study highlight three reasons for the broad-based fertility decline in developing countries: better education of women, the diffusion through the mass media of contemporary cultural attitudes favoring smaller families, and, most importantly, access to modern methods of contraception. They also make it clear, however, that the mix of factors differs among regions and even between countries (Robey, Rutstein, and Morris 1993:62-67).

A crucial inference to be drawn from these findings is that the kind of wasteful and destructive economic development characteristic of the rise of industrialized countries is

not a prerequisite for reducing fertility. To put it another way, lowered fertility in the developing countries can be attributed to a combination of changes that also happen to be elements of a sustainable society. Better education, access to contraception and family planning, improved health care, heightened status of women—all are among the elements of a transformation to a more equitable, humane, sustainable social structure. (There are, of course, many others; for one view, see Viederman 1993.)

Family planning organizations try to provide their services within the context of the development of the community, the family, and individuals. This should signal to conservationists that controlling fertility is not merely an end in itself or a means of protecting the environment: it is a valuable tool to open up new possibilities for human development, both collectively and individually. *Family planning opens new horizons for people and increases their chances for leading productive and fulfilling lives.* Conservationist approaches to population issues have largely missed this point.

What does all this mean for protected areas? This brings us to our fourth proposition: there must be a mutually reinforcing relationship between human development aims and the environmental and cultural protection aims of parks and reserves. People who are concerned with protected areas must be concerned with population issues. And to be concerned with population issues means being concerned with social and economic justice, the status of women, access to family planning, and a host of other socioeconomic changes needed if we are to establish a sustainable human presence on Earth.

Many family planning agencies have now adopted a community-centered development model that stresses achieving sustainability at the local level. This too is relevant to the future of protected areas. An individual park or reserve can do relatively little to influence sustainability on a national or international scale, but it can contribute a great deal to local sustainable development. This is the driving force behind the movement toward second-wave, nonexclusionary designations. There are numerous examples of integrated conservation-development projects involving protected areas; West and Brechin (1991) treat the subject in detail.

In short, making the economy sustainable is a protected area issue. Family planning is a protected area issue. Getting better education for girls and women is a protected area issue. Human development is a protected area issue.

Stabilization, Reduction, Restoration

Progress toward economic and political security and enhanced human development is the start of the societal transformation; stabilizing and subsequently reducing the world's population is the next step. Reducing the global population is not some arbitrary or ideological goal. Rather, it is a *means* of providing social and economic opportunities that would be impossible to offer in a more populous world. Just as importantly, population reduction allows enhanced appreciation of and support for biological and ecological stability.

It is a telling fact that only a few on the fringe of the population debate are talking about actually reducing the world's population. This is certainly understandable given that there is absolutely no prospect of this happening anytime soon, barring some pandemic catastrophe. Nonetheless, there is no iron law which says that the world's population could not contract—in a humane, non-coercive way—from whatever level it ultimately reaches. If there were consensus from the grassroots up, and enlightened gov-

ernment and other institutional leadership from the top down, every country could turn the tide of growth into a moderated contraction within a few decades. The current dramatic declines in developing-world fertility show that reproduction can be directed downward without destabilizing society.

Admittedly, a consciously moderated population contraction would be unprecedented in recorded history. But if it seems totally far-fetched on a global scale, it certainly is not on a national basis. As we noted above, six European countries are expected to do just that by 2025. Indeed, it is incumbent upon the industrialized countries to lead the way in reducing their national populations because they still consume the lion's share of resources. Fewer North Americans and Europeans means fewer people living wasteful lifestyles (at least in the short run; it would remain to be seen if consumption increases in the South would fill the void). It is the developed countries that have fueled their economic prosperity through large-scale, unsustainable resource depletion and environmental degradation.

In summary, our ideal would be for all developed countries to reduce their fertility to replacement levels or slightly lower, thus embarking on a moderated contraction of their populations, with all of them achieving so-called negative growth rates during the next century. For countries locked in the grip of demographic momentum, the ideal would be to institute as soon as possible the entire range of reforms required for the societal transformation discussed above, with the result that their growth is arrested toward the end of the next century. Then, perhaps early in the 22nd century, the population of the developing countries would begin a moderated contraction too.

But let us imagine now that the year is 2094, and that our ideal has been achieved. The world's population has peaked and is now embarked, through an international consensus, upon the beginnings of a sustained, planned decline. The most intense human pressures on the remaining intact protected areas have been relieved. World leaders have realized that increasing the number, extent, and effectiveness of protected areas is needed to help revive the global environment. The problem is, in many countries practically all land outside protected areas has been heavily modified for human use. What can be done?

Under such circumstances, restoring disturbed ecosystems will be the only way to make additions or repairs to protected area systems (cf. Jordan, Peters, and Allen 1988). Virtually new protected areas could conceivably be made out of degraded or disturbed land. In fact, the first experiments have already begun. Guanacaste National Park in Costa Rica is being knitted together out of private holdings, part of a previously existing national park, and other public holdings with diminished productivity. One of the park's objectives is to use leftover remnants of the once-extensive dry forest as the basis for restoring about 700 square kilometers to a condition able to support all the flora and fauna found in Costa Rica when the conquistadors arrived (WRI and IIED 1988:220). If Guanacaste is successful, it will point the way for remedial protected area expansion in the coming century and beyond.

Conclusion

If there is to be any hope for achieving a world which is both ecologically sustainable and humane, one which has a complement of protected areas safeguarding a meaningful portion of land and water, there will have to be a widespread consensus that redirecting population change is both necessary and desirable. As we have

seen, there is already "bottom-up" momentum for reducing fertility in many countries; this needs to be linked with more "top-down" support from governments and political leaders (cf. Brechin and West 1990). We need to reach a point where most people and their governments support a stabilization-reduction-restoration scenario. The barrier is getting over the idea that reproduction is exclusively a personal matter and that there is no legitimacy in trying to overtly influence individual reproductive decisions. Unless one takes the cynical view that all systems of social improvement are based on coercion rather than consent, it will be seen that a government enunciation of a stabilization-to-reduction population policy is no different *in kind* that any other public policy, whether it be one of economics, national defense, or public welfare.

The next hundred years will decide the fate of the protected area conservation movement. Protected areas might end up devalued and relegated to a sideline role as artifacts, museum-pieces with little practical relevance to what's left of the natural environment. But if we can link environmental protection, human development, and population policy, protected areas might emerge from the crucible as one of the institutions leading the world to sustainability.

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