

Migration and environment in the context of globalization

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Human migration and population growth, in concert with globalization trends, greatly affect the environment and conservation efforts. In the Americas, the movement of people, capital, goods, and services has caused different types of ecosystem change, including deforestation. Urbanization, a dominant trend in the Americas, is a two-edged sword for conservation, moving human populations away from rural and protected areas, but also increasing per capita demand for energy, goods, and services. Migration to the forest frontier and the abandonment of marginal rural land present opposite but equally difficult ecological challenges. Projected climate change will also complicate both conservation and migration flows, particularly in developing countries with limited economic and technical capacity. However, better integration of ecological, demographic, and sociological data and theory can lead to the development of predictive models, which will help us to understand and project human migration patterns and their dynamic relationship with ecological change. This interdisciplinary work could lead to the successful development of long-range conservation policy and interventions.

La migración humana y el crecimiento de la población, aunado a las tendencias de la globalización, afectan substancialmente al medioambiente y los esfuerzos de conservación. En el continente americano, el movimiento de personas, capital, bienes y servicios ha causado diferentes tipos de cambios en los ecosistemas, incluyendo deforestación. La urbanización, tendencia dominante en el continente americano, es un arma de dos filos para la conservación, ya que, por un lado, desplaza a las poblaciones humanas fuera de las áreas rurales y protegidas, pero por otro lado, incrementa la demanda de energía, bienes y servicios. La migración hacia zonas boscosas y el abandono de tierras rurales marginadas exponen retos ecológicos opuestos, pero igualmente difíciles. Además, el cambio climático previsto complicará los flujos migratorios y la conservación de los ecosistemas, particularmente en los países en desarrollo cuya capacidad económica y tecnológica es limitada. Sin embargo, una mejor integración de los datos y de las teorías ecológicas, demográficas y sociales, encaminarán a desarrollar modelos predictivos que ayudarán a entender y proyectar los patrones de migración humana y su relación dinámica con el cambio ecológico. Este trabajo interdisciplinario puede encaminarnos hacia el desarrollo de políticas e intervenciones de conservación exitosas.

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International, regional, and local human migration and population growth are strong forces that substantially affect the global and local environment and conservation

efforts. In the Americas, historically rapid growth and the relatively easy movement of people, capital, goods, and services across national boundaries have led to major ecosystem change. Maintaining the capacity of natural systems to provide environmental goods and services in the context of shifting demographic patterns is a challenge that affects not only human well-being but also the conservation of ecosystems and biodiversity (MA 2005).

The world is now characterized by interrelated and dynamic sociodemographic and ecological change across multiple scales. Globalization is an irreversible trend, with powerful and uneven consequences. The relationship between migration and the environment is particularly affected by: (1) the constant growth of the global economy and increasingly unequal distribution of wealth among and within countries (Rubio 2001; Sen 2002); (2) the inability of many farmers to cope economically with the consequences of climate change, adopt sustainable patterns of production, and remain competitive (Babbitt 2006); and (3) the social and economic devaluation of

In a nutshell:

- Human migration, driven by globalization and interrelated economic, environmental, and social factors, will play a major role in the future of ecosystems, biodiversity, land use, and conservation policy
- Challenges related to migration and the environment include rapid urbanization and sprawl, local and global deforestation, abandonment of rural areas, unsustainable agricultural and production systems, difficulties in building effective governance systems, and the effects of migrants on source and destination human communities and ecosystems
- Migration and other demographic processes and cycles, in conjunction with ecological trends and data, present opportunities for modeling, projections, and the development of long-range conservation strategies and policy interventions

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rural life, lands, and resources, which often leads to migration (Berkes 2002; Zamora and Foladori 2006). These conditions, along with the increased rate of information transmission, have intensified and accelerated traditional “push” and “pull” migration factors.

Globalization and migration have increased the pressures on natural systems and have created new complications through the expansion of international markets for labor and products. These sociodemographic processes have also facilitated the dispersal of invasive species. These trends present both risks and opportunities for academics and policy makers searching for sustainability – the use of natural systems and resources in a way that allows for the maintenance of ecosystem capacity to provide natural goods and services (MA 2005).

■ **Demographic and migration trends and their ecological effects**

Since 1950, the human population of the Americas has increased from 340 million to 890 million, and it is projected to rise to 1.2 billion (medium projection) by 2050 ((UN Population Division 2004; Figure 1). While most of the recent historical and projected population growth in the Western hemisphere is due to above-replacement fertility rates and increased life expectancy, migration also plays a role. Fertility rates are projected to continue to decline in most parts of the Americas (the US is a notable exception), lowering net annual population growth from nearly 10 million per year to less than 3 million per year by 2050 ((UN Population Division 2004).

In Latin America and the Caribbean, average population density has more than tripled in the past half century, with negative consequences for both conservation and development. In densely populated countries such as El Salvador (860 persons per square mile), less than 5% of the original forest cover remains. Globalization and other forces continue to attract people to the Americas – net migration to the Western hemisphere exceeds half a million people per year (UN Population Division 2006), flowing primarily to the US and Canada. However, Latin America has now become a net source of migrants to the rest of the world (beyond the Western hemisphere). Migration among countries within the Americas is an even greater force, amounting to several million people annually.

As with other species, humans migrate toward resources and opportunities and, to a lesser extent, away from environmental, economic, and political perils. As a general rule, migration occurs from less developed to more developed nations, both in the Americas and globally. Net annual migration (documented and undocumented) to the US has increased from about 250 000 in the 1960s to about 1.5 million in the 1990s and early 2000s (US Census Bureau 2006; Figure 2).

About 800 000 people (net) emigrate annually

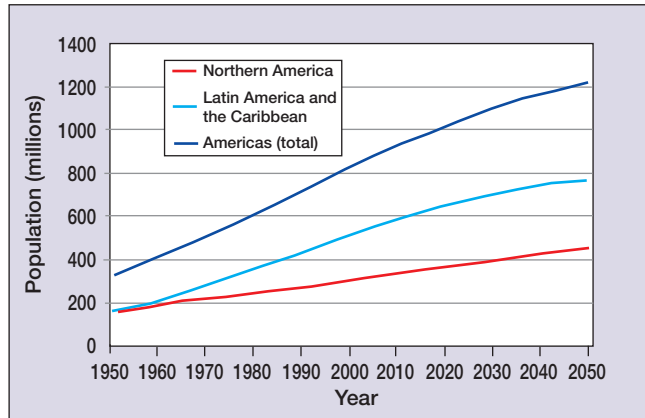


Figure 1. Historical and projected population growth in the Americas, 1950–2050. Data and projections source: US Census Bureau, International Database.

from Latin American countries to the US, Canada, and other parts of the world; about half of those migrants are from Mexico (Figure 3). Such movement is particularly high in Central America, especially Guatemala, Mexico, Nicaragua (which produces net emigration), and Costa Rica (which attracts substantial net immigration relative to its size; UN Population Division 2005). Peru, Colombia, and Ecuador also have significant net emigration. In addition, many countries, including Mexico, Brazil, and Argentina, are major sources, destinations, and transit points for migrants. Changes in economic trends, global demand, and product tastes can rapidly alter agricultural and other labor demand and related migration (Aide and Grau 2004).

The current official policy of most countries in the Americas is to maintain their existing immigration and emigration levels. However, practices such as the relaxation of passport and visa requirements among South American countries and the periodic tightening and loosening of border controls greatly affect movement. Moreover, while government policies have some effect, migration is often primarily a function of global, regional, and national economic and political conditions. During the 20th century, rural–rural migration was promoted as

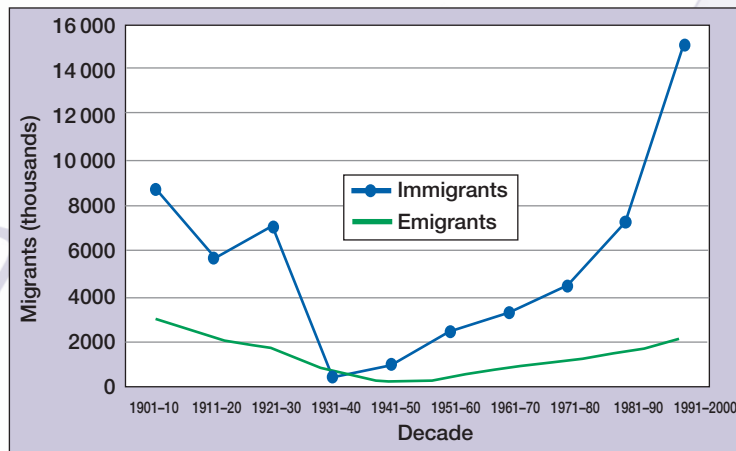


Figure 2. Immigration and emigration in the US by decade, 1901–2000. Data source: US Immigration and Naturalization Service.

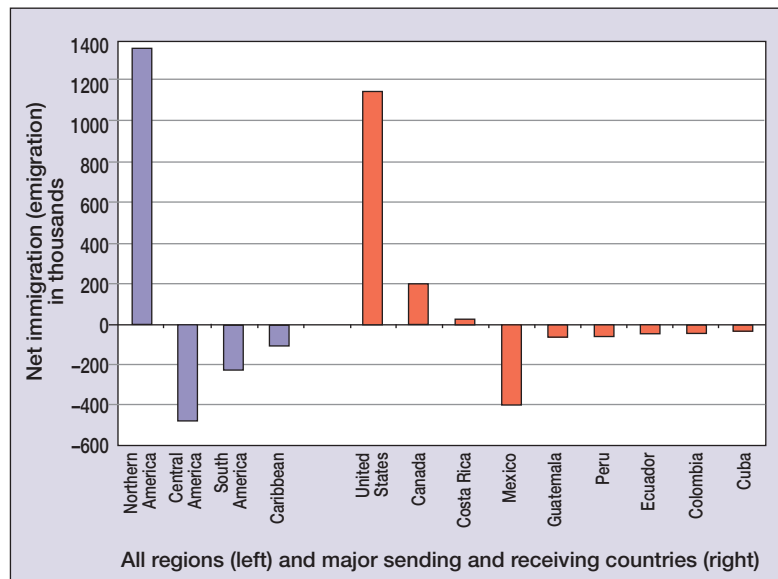


Figure 3. Annual net migration in the Americas, 2000–2005. Data source: UN Population Division, *International Migration 2006*.

part of the national policy for colonization of tropical regions, resulting in substantial deforestation and biodiversity loss (Jones 1989; Bedoya 1995; Meyerson 2006), though those demographic policies and the resulting patterns of migration have decreased in intensity over time.

High rates of rural–urban migration have occurred in the Americas for more than five decades. This pattern is projected to continue, as both national and international rural–urban movements are projected to increase. North American cities, in particular, have become destinations or transit points for large numbers of international migrants. A new migratory pattern, particularly strong in the Americas, is the tendency toward definitive (permanent) migration, which leads to the decline and loss of social ties between migrants and their original communities and countries of birth. This trend is related to the tightening of migration policy by the US (Durand 2006) and other countries, which has restricted movement across national boundaries (Figure 4).

Within individual countries of the Americas, migration patterns and causes are complex. Where there is a forest or agricultural frontier, migration may occur toward areas with new cultivation and exploitation opportunities, even if the quality of land available for agriculture is marginal. This frontier migration can be critical for local conservation efforts and protected areas, because a relatively low population density can still result in substantial deforestation, as well as habitat and biodiversity loss (Meyerson 2003). Even in areas with relatively stable or slowly declining rural populations, such as the Misiones Province in Argentina, monoculture forestry, pastureland, and other biological resource use often continue to expand, with adverse effects for conservation (Izquierdo *et al.* 2006).

However, at a larger scale, the dominant trend in the Americas is urbanization – the continued migration of people from rural areas to cities. In practice, this has

meant that the total rural population of the Americas has remained more or less constant at about 190 million since 1970, while, over the same period, total urban population has more than doubled, to over 700 million. Since 1950, the percentage of the overall population residing in urban areas has increased to almost 80%, making the Americas one of the most urbanized regions in the world (UN 2005; Figure 4). These trends are expected to continue, with net rural population either remaining stable or declining slightly, while urban areas are projected to absorb essentially all additional net population growth.

Urbanization is a double-edged sword for conservation. While it moves human population growth away from rural and protected areas, it can also increase per capita demand for energy, material goods, and services, since migrants to cities often become more affluent and consume more resources. Demand for food

is projected to require a doubling of production by 2050 (Kirschenmann 2006). To meet both growing per capita demand and the needs of the 300 million projected new inhabitants of urban areas in the Americas by 2050, pressure on natural resources, the agricultural and forest frontier, and conservation areas will increase. High rates of population growth in Latin American cities during the last four decades have already profoundly altered social, economic, and environmental conditions (Durand 2006).

Several ecological trends interact with migration. Global warming is altering temperature and precipitation patterns, which in turn affect agriculture, grazing, forestry, and fishing. Long-term droughts in parts of the Americas are likely to lead to rural migration to more promising agricultural regions and urban areas. The erosion of biological diversity will also have serious impacts on productive systems and human health (Daily 2005; Guegan and Renaud 2005). Finally, population growth is driving the expansion of food production systems that are highly dependent on external inputs of water, energy, fertilizer, and other subsidies. In many cases, these agricultural systems prove to be environmentally or economically unsustainable, leading to abandonment and subsequent human migration (Babbitt and Sarukhán 2005; Kirschenmann 2006).

Border fences, roads, clearings, and other barriers interfere with the dispersal not only of humans, but also of animal and plant species (see Figure 5). For instance, US legislation passed in 2006 would replace several hundred miles of barbed wire fence in wilderness areas of the southwest, along the Mexican border, with a continuous double barrier of impermeable fencing separated by a brightly lit access road for patrol vehicles. This could prevent the cross-border movement of large species like ocelot and jaguar, as well as smaller mammals and reptiles such as snakes and turtles. Wildlife corridors that cross national boundaries are relevant not only for seasonal migration, but also for the larger

habitat and ecosystem shifts caused by climate variability and change.

■ Consequences for conservation

Migration trends pose at least seven major challenges for the attainment of environmental conservation and sustainability goals. These are discussed below.

Environmental impacts of urbanization

Rapid urbanization in the Americas has created large cities with unhealthy water, soil, and air pollution levels, as well as expanding urban demand for natural resources and environmental services (Avila 2006; Izazola 2006; Walker and Hoski 2006). As cities grow by an additional 300 million people over the next four decades, these problems will worsen.

In urban areas, natural deterioration frequently accompanies social deterioration. Many poor urban residents lack the ability to fulfill basic human needs for education, recognition, identity, employment, and property (Anand and Sen 1997). Exclusion and marginalization of major social groups, due in part to large migration flows, have led to conditions of insecurity and lawlessness in many urban areas of the developing world and some cities in industrialized countries (Melé *et al.* 2000; Schteinger and Salazar 2000). Rapid urban demographic growth in the Americas and elsewhere has often outstripped the capacity of governments to provide both environmental and social services.

Suburban sprawl, facilitated by increasing personal vehicle ownership, now creates much larger ecological footprints for cities than in the past, raising per capita energy, materials, and land use. Once primarily associated with developed countries, sprawl now affects most urban areas in Latin America, as less affluent migrants have occupied marginal suburban areas and personal transportation options and home and lot size tastes have changed among the more affluent. Intra-urban migration to newly developed suburbs has allowed cities such as Washington, DC, Sao Paulo, and Mexico City to expand dramatically, often into neighboring states or districts. Urban population concentrations also cause serious environmental impacts, far beyond the limits of the cities where they originate. For instance, the transport of urban air and water pollutants can affect ecosystems and human health hundreds or thousands of miles away.

Forest frontier migration and population growth

Globally, several million hectares of forest cover are lost each year, largely due to the expansion of agriculture (MA 2005). Large-scale tropical forest cover loss continues in the Western hemisphere, particularly in the Amazon and

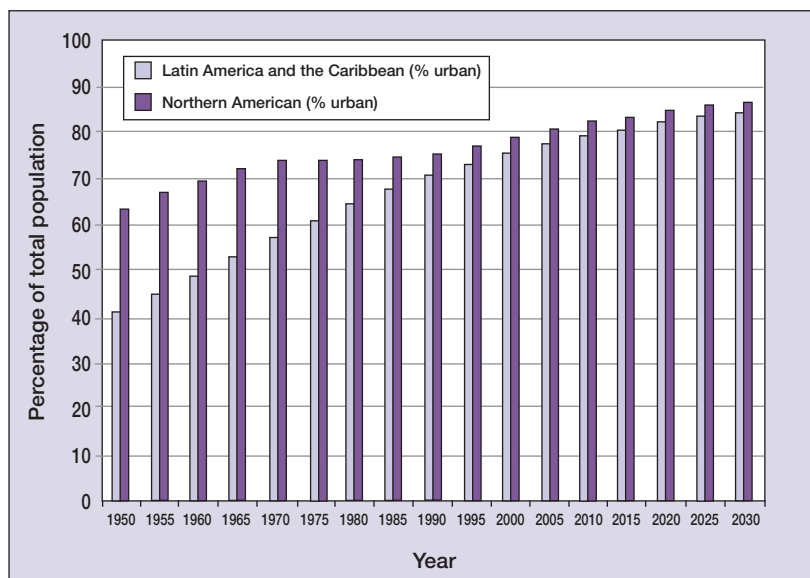


Figure 4. Urban–rural population distribution in the Americas, 1950–2030. Data and projections source: UN Population Division, *World Population Prospects, 2004 Revision*.

in parts of Central America, although estimates of both total forest cover and rates of change vary, depending on the classification method used. To some extent, primary forest loss is being mitigated by the regrowth of secondary forests on abandoned lands and by forest plantations (see below), but this is often associated with loss or degradation of the original ecosystems and species.

In many forest frontier regions, rapid population growth continues as a function of both high fertility rates and migration (Figure 6). In Central America, there is a strong correlation between human population density and loss of forest cover at multiple scales (Meyerson 2006), though demographic changes always occur in combination with other economic and political factors (Geist and Lambin 2001; Carr 2004). In the Petén region of northern Guatemala, for instance, more than 70% of the original forest cover has been removed in the past 50 years; during this period, human population growth averaged 8–9% annually, approximately half of which was the result of migration (Sader *et al.* 1997; Meyerson 2003). High fertility rates at the forest frontier are the result of many factors and processes, including a lack of empowerment and opportunities for women and limited access to reproductive healthcare and basic medical services. The causes of frontier migration are equally complex, but include factors such as rapid population growth, unequal land distribution, development policies, and armed conflicts in adjacent regions (Barbieri and Carr 2005).

Maintaining the integrity of protected areas in the face of human migration is a challenge across Latin America. In Peru, *colonos* (migrants) from impoverished and conflict-ridden parts of the country put pressure on mountain forests, both in terms of their numbers and because of their lack of knowledge about the harmful effects of slash-and-burn agriculture on these sensitive ecosystems (Fuentealba



Figure 5. Photos of US–Mexico border fences taken in July 2006. (a) Border fence located east of San Diego, CA. (b) Recently built “permeable” border barrier located south of San Diego will allow migration of smaller species, but proposed double-barrier impermeable fencing may not.

Durand and Bravo Ávila 2006). Reliance on labor-intensive slash-and-burn practices, which favor larger families, is often the result of poverty, marginalization, and the lack of more productive and sustainable options.

In some countries, such as the US and Canada, the demographic transition to lower fertility rates occurred decades ago, but population pressure remains a major environmental factor for forest areas, partly due to internal and international migration. In other countries, such as Brazil, demographic transition has occurred comparatively recently, and population growth is rapidly decelerating, but rural–rural migration and development policies continue to put severe pressure on forest habitats and biodiversity.

The abandonment and “aging” of the countryside

The depopulation of agricultural and rural areas, along with a demographic shift toward an increased average age of remaining residents (“aging”), is a potentially irreversible process that could represent serious threats to natural systems and resources locally (Guzmán 2006; Zamora and Foladori 2006). The causes of rural depopulation are complicated, and their importance, relative to each other, is not well understood. However, they include ecological and resource degradation, economic and social unsustainability, local population growth, and the relative attractiveness of cities. In parts of the Americas, rural depopula-

tion trends are already creating a problem by reducing the social capital and labor needed for sustainable local development (Merino 2004). As the countryside loses social value, natural resources also tend to become devalued by local communities, which then invest less in management and environmental protection.

On the other hand, depopulation of some rural areas and abandonment of traditional agricultural zones has led to a forest transition. Regrowth of forest vegetation occurred in large areas of the US and Canada in the 19th and 20th centuries, as well as in some parts of Latin America more recently, not only as a result of agricultural abandonment of marginal land, but also because of the rise of commercial forestry (Aide and Grau 2006; Hecht *et al.* 2006). While forest recovery holds great promise for conservation, it is also often accompanied by exotic species invasions, which can prevent or restrict the recovery of native biodiversity and ecosystems (Gutierrez Angonese *et al.* 2006). In the case of commercial forestry, complex, biodiverse ecosystems may be replaced with monocultures, composed of non-native tree species.

Unsustainable industrialized farm, forest, and fishing systems

Agricultural, grazing, forestry, and aquaculture production systems cover nearly one-third of the global land surface.

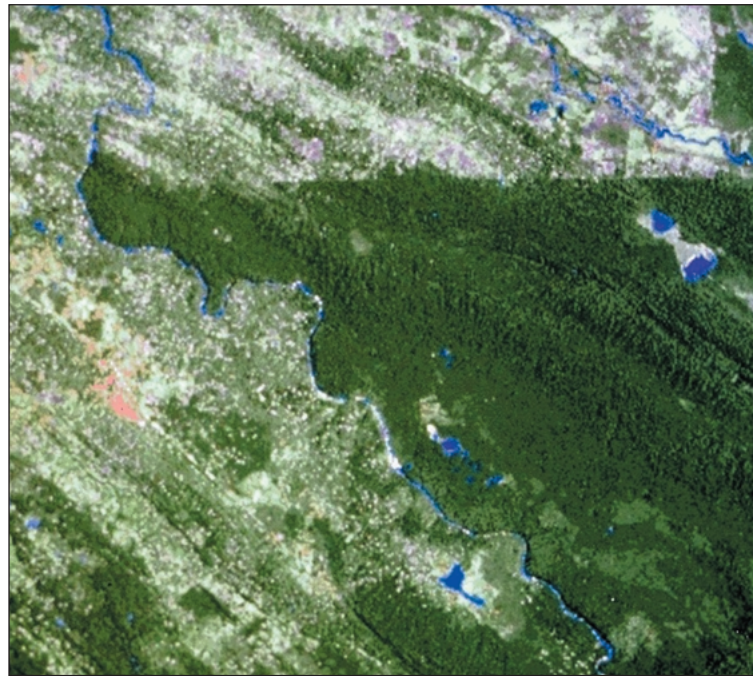
The major indirect drivers of land and soil degradation are local population growth and migration, which affect land-cover change and resource exploitation at many scales (MA 2005). Many existing agroproduction systems are unsustainable in terms of groundwater, energy, and fertilizer use (Camin *et al.* 2006), their impacts on biodiversity, soil, aquatic ecosystems, and climate, and their introduction or facilitation of invasive species (Kalin 2006; Ruiz *et al.* 2006). In addition, agroproduction systems are often economically unsustainable, particularly where they are based on large economic and natural subsidies. Socially unsustainable impacts include the loss of viability of small-scale and traditional producers and the massive migration of rural workers (Rubio 2001; Bartra 2003).

The emergence of global demand for a particular crop or product, such as soybeans, may rapidly and dramatically alter patterns of human migration, agricultural land use, and deforestation (Fearnside 2001). Globalization and its ability to move people, economic resources, and information can quickly transform the landscape and biodiversity of regions, sometimes with short-term economic benefits but long-term negative environmental effects (eg soil depletion, introduction of invasive species; Babbitt 2006; Kirschenmann 2006; Majluf 2006).

Global warming effects on natural systems, agro-ecological systems, and urban areas

Global climate change, including the alteration of temperature and precipitation patterns, could ultimately lead to human migration and associated environmental problems. For instance, warming may enhance the desertification trends already seen in many areas of the world and is theorized by many scientists to increase the intensity of hurricanes (Santer *et al.* 2006) and the frequency and intensity of forest fires (Kasischke *et al.* 1995). Warming is also affecting biodiversity through the disruption and destruction of species' habitats. This is of particular concern for species with limited mobility or small ecological niches, which may therefore face local or global extinction.

Projected sea level rise due to warming will have major impacts on coastal areas, where most of the main cities of the world and the densest populations are located. While most people will be able to move in response to climate-related threats such as sea-level rise and increased storm intensity, these large-scale migrations will create serious obstacles to conservation in both sending and receiving areas (Meyerson 2003). Existing protected areas may be inadequate or inappropriate for their original purposes because of climate-induced shifts in ecosystems and biodiversity and the



Courtesy of T Sever/Marshall Space Flight Center, NASA

Figure 6. Deforestation in the Petén region of northern Guatemala and adjacent Mexican border areas. Population growth in the Petén averaged 8–9% annually during the second half of the 20th century, approximately half of which was the result of migration (Meyerson 2003). The Petén had ~95% forest cover in the mid-20th century; less than one-third of this original forest cover remains.

direct effects of sea-level rise, and may face new pressures due to human migration.

Sustainable human systems in developing countries

The governments of many developing countries lack the scientific and technical expertise to conduct effective ecological assessments and develop conservation policies. Accountability and enforcement systems may also be weak. Governance strategies are often not well coordinated across agencies, so that programs to promote migration and development may be in direct conflict with environmental policies (UN Millennium Project 2005). These incongruities and contradictions exist not only at local and national levels, but also with respect to the programs of international development and environmental agencies.

Structural and bureaucratic limitations hinder the development of ecologically sustainable human systems, and the situation is further complicated by migration. Poverty and exclusion can create difficult, repeating cycles of local unsustainability and regional migration. For the poor, the loss of basic natural assets and substandard living conditions in turn weaken the possibilities for sustainable development (UN Millennium Project 2005).

Weakening ties between migrants and their original communities

As a direct result of international and rural–urban migration, some communities in the Americas are losing fun-

damental human resources, including heads of households and community leaders (Zamora and Foladori 2006). This loss of human capital can adversely affect the capacity to achieve social and environmental sustainability as well as attitudes toward it. Flows of financial remittances from migrants to developing countries and from urban areas to “source” rural and protected areas can have both negative and positive effects for conservation and the protection of biodiversity (McSweeney 2005). Strengthening the relationships among local and migrant communities could help to develop new perspectives and possibilities for local sustainability, prosperity, and democracy. However, recent tightening of migration policy puts these potential opportunities in jeopardy (Durand 2006).

■ Future research

The relationship between migration and environment can be explored in several ways. One perspective involves research on the effects of environmental conditions on migration (Douglas and Axinn 2006). Results of such studies show that migration is a complex process and that the decision to migrate is multifactorial. In general, people are more likely to migrate toward opportunities than away from problems. Environmental deterioration may count among the factors, but it is not the main reason for migration, except in cases of environmental disasters.

Another way of studying the relationship between environment and migration is to analyze the effects of migration on the environment of the recipient region (Barbieri and Carr 2005; Fuentealba Durand and Bravo Ávila 2006; Izazola 2006). A third research framework involves examining the environmental consequences of migration for source regions – for instance, those (often rural) areas that are losing population (Patiño-Pascual 2003) or receiving remittances from emigrants. Some integrative studies include two or more of these approaches.

Predictive approaches and models

Human demographic cycles and trends, including migration, can present opportunities for conservation strategies and interventions. Can we better predict future human migration patterns and create projections useful for conservation policy? Several tools are available for this purpose, including:

- (1) Current and historical migration, fertility, age distribution, household size, consumption patterns, and other demographic datasets and projections
- (2) Estimates of the geographical distribution of unexploited biotic and abiotic resources likely to attract future migration and development
- (3) Trends and projections of global and regional market demand for those resources
- (4) Projections of climate change and variability, includ-

ing regional and local temperature and precipitation, in relation to agricultural production, ecosystems, and human carrying capacity

To accomplish the successful merging and interrelation of these datasets and projections, better communication and collaboration are necessary among communities of ecologists, demographers, sociologists, and economists. To date, there has been only limited exchange of information among these communities. Although thousands of scientists attend professional meetings in each of these areas, only a few attend the conferences of more than one discipline. Causes for this inadequate cross-fertilization include the discipline-centric structure and reward system in academia and science, and the difficulty and time requirements of mastering and remaining current in more than one field.

Human demography is a field in which long-range projections are routine and for which datasets are often extensive. While predictive accuracy varies, near- and mid-term human demographic projections are often more reliable than ecological and economic forecasts. A major challenge will be the development of predictive models that integrate data and projections from other fields with different terminology and statistical methods (Curran and de Sherbinin 2004). A successful outcome would allow for the projection of population distribution, migratory, land-use, and ecological trends in a way that supports conservation and protected areas management.

New migration-related research questions

We would like to suggest several future research and policy questions, including:

- (1) Research on the patterns of human settlement required for sustainable farming, forestry, and fishery systems, and the development of conservation models based on sustainable use (eg the “gardening of the earth”; Babbitt and Sarukhán 2005)
- (2) Development of viable models for local conservation, based on local stewardship and governance for areas affected by rural abandonment (Merino 2004; Molnar *et al.* 2004; Jenkins *et al.* 2005)
- (3) Research on potential governance models (stewardship, rights, incentives, and management) for areas with valuable ecosystems and biodiversity that are experiencing population growth and migration pressures (Ostrom 1990; Gibson 1999; Meyerson 2006)
- (4) Development of new methods by which the dynamics of land-use change and conditions of natural systems can be monitored in the context of migration and demographic trends (Evans and Moran 2002)

More broadly, ecological and social research needs to be fundamentally reoriented toward an interdisciplinary understanding of these complex processes, so that it is

more immediately relevant and can have a greater impact on future development and conservation policies. It should also become strategically oriented, that is, designed and developed within a framework of problem solving. Finally, knowledge must be considered and managed as a public good, with free access to information for different stakeholders and social groups (Hess 2004).

■ Conclusions

Migration will continue to be a powerful force, shaping human development, ecosystem change, and conservation. In fact, if fertility rates continue to decline, and global population stabilizes or peaks above nine billion after 2050 as projected, migration will become the dominant human demographic force, both in the Americas and globally. In a world made susceptible to rapid transformation by the forces of globalization and climate change, understanding the socioeconomic and environmental drivers behind migration will be critical. Projecting the likely future distribution and movement of people on our increasingly populated planet, and responding to the conservation threats and opportunities associated with that migration, will require new skills and greater collaboration and integration among disciplines and organizations.

Science – ecological and social – is a powerful tool in this pursuit. However, the situation calls for a substantial reorientation of the way academic work is performed, transmitted, and valued. As academics, we urgently need to promote fruitful collaboration among the environmental and social sciences, including the development of common terminology, statistical methods, indicators, and databases. Scientists who are real leaders and want to drive conservation policy must overcome the tendency to remain within the comfort of their particular disciplines and native countries. The environmental and scientific rewards are much greater than the professional risks.

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