

RIPPLE EFFECTS: POPULATION AND COASTAL REGIONS

by Liz Creel

Coastal regions, areas that are home to a large and growing proportion of the world's population, are undergoing environmental decline. The problem is particularly acute in developing countries. The reasons for environmental decline are complex, but population factors play a significant role. Today, approximately 3 billion people—about half of the world's population—live within 200 kilometers of a coastline. By 2025, that figure is likely to double. The high concentration of people in coastal regions has produced many economic benefits, including improved transportation links, industrial and urban development, revenue from tourism, and food production. But the combined effects of booming population growth and economic and technological development are threatening the ecosystems that provide these economic benefits. Unless governments and users of coastal resources take action, population pressures and the associated levels of economic activity will further degrade many coastal habitats.

The challenge for policymakers and coastal resource managers is to figure out how to reap the economic benefits of coastal resources while preserving them for future generations. Addressing population issues is key to achieving such balance. This policy brief looks at how population growth, urbanization, and other factors affect coastal resources; how environmental degradation influences people's lives; and how policymakers can integrate population and resource management issues.

Coastal Regions: Benefits and Challenges

Because there is no common definition of what constitutes a coastal region, estimates of coastal populations vary. Most are based on an area within 60 to 200 kilometers of the shoreline and may include coastal floodplains, coastal forests called mangroves, marshes, and tidflats (coastal areas affected by the rise and fall of the tide), as well as beaches, dunes, and coral reefs.¹ The term "coastal regions" also covers marine fisheries

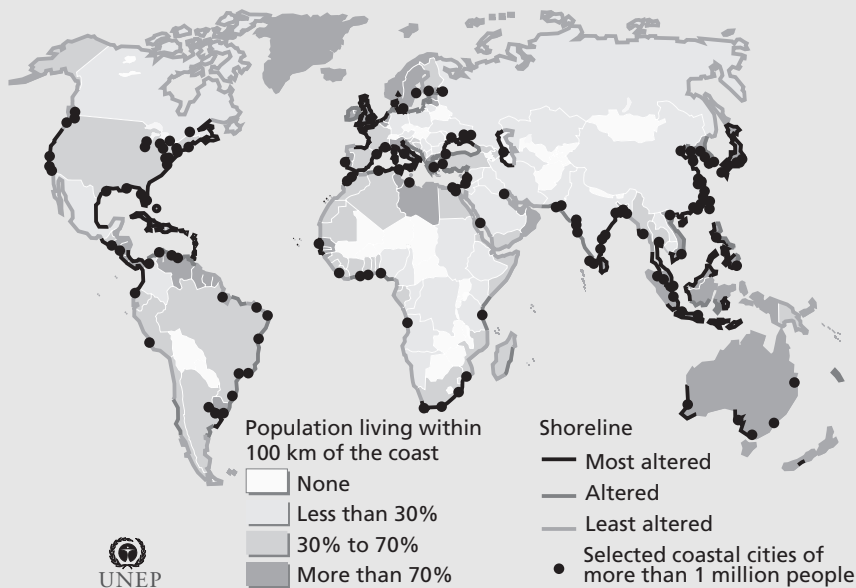
Photo has been removed for copyright reasons.

As human pressure on coastal areas increases, identifying ways to balance people's needs with sustaining coastal resources is becoming more important.

because the bulk of the world's marine fish harvest is caught or reared in coastal waters.² Coastal areas help prevent erosion; filter pollutants; and provide food, shelter, breeding areas, and nursery grounds for a wide variety of organisms. Coastal regions also provide critical inputs for industry, including water and space for shipping and ports; opportunities for recreational activities such as fishing and diving; and other raw materials, including salt and sand.

In many countries, populations in coastal areas are growing faster than those in noncoastal areas. This is a concern because population growth and the activities associated with it can degrade coastal and marine ecosystems.³ A number of worrying trends are already visible. In some areas, heavy use of fisheries has reduced endemic coastal fish stocks to 10 percent to 30 percent of the supply that existed 30 years ago.⁴ Half of the world's wetlands disappeared in the 20th century, as did 50 percent of all mangroves, and nearly 60 percent of the world's coral reefs are seriously degraded—in some cases beyond recovery—or threatened by development and other human activities.⁵ Pollution from industry, agriculture, and urban areas is degrading the quality of much

Figure 1

Coastal Populations and Shoreline Degradation

SOURCES: Laretta Burke et al., *Pilot Analysis of Global Ecosystems: Coastal Ecosystems* (2001); and Paul Harrison and Fred Pearce, *AAAS Atlas of Population and Environment 2001*(2001).

of the world's fresh water. These challenges are particularly acute for island countries, where coasts often comprise the entire territory.⁶ Such countries may also be threatened by rising sea levels, a possible consequence of climate change.

Population Factors' Effects on Coastal Regions

Changes in the size, composition, and distribution of human populations affect coastal regions by changing land use and land cover. Fishing or harvesting, the destruction of mangroves, and pollution and sedimentation from human activities all can affect the coastal environment.

Population Density

The average population density in coastal areas is about 80 persons per square kilometer, twice the world's average population density.⁷ Up to 50 percent of the population in northern Africa and Bangladesh lives in coastal areas (see Figure 1); along the Nile Delta, the population density reaches 500 to 1,000 people per square kilometer.⁸

The additional demands that high population density places on the coasts have meant that higher density is associated with increased risks to marine ecosystems. But higher population densities may have beneficial effects as well: As population grows, some governments make greater investments in infrastructure such as sewer lines and sewage treatment plants that ultimately reduce levels of environmental contamination.

Migration

Migration is a key factor affecting coastal zones. The figures in China and Southeast Asia are staggering: 1,000 people arrive in China's large coastal cities each day, and similar numbers move to the coasts in Vietnam and the Philippines. The population of Ecuador's Galapagos Islands has grown rapidly since the early 1980s, largely due to the arrival of coastal fishermen. These fishermen sometimes unknowingly exacerbate a problem created by tankers and ocean liners. By discharging ballast water near the islands, large vessels and smaller fishing boats have introduced nonindigenous plant and animal species to the islands' coasts.⁹ The situation in the Galapagos Islands also highlights how migration can contribute to the depletion of natural resources. The arrival of new fishermen, together with the introduction of new fishing techniques and increased access to credit and markets, has contributed to the overexploitation of sea cucumbers in the region.¹⁰

Urbanization

Many of the world's coasts are becoming increasingly urban. In fact, 14 of the world's 17 largest cities are located along coasts. Eleven of these cities, including Bangkok, Jakarta, and Shanghai, are in Asia. In addition, two-fifths of cities with populations of 1 million to 10 million people are located near coastlines.¹¹ The urbanization of coasts brings with it coastal development (including demands for fresh water and sewage treatment) and damage to coastal ecosystems.

Urbanization has a deleterious effect on mangroves. Mangroves, forests of salt-tolerant trees and shrubs that grow in the shallow tidal waters of estuaries and coastal areas in tropical regions, line about 8 percent of the world's coastlines and 25 percent of the world's tropical coastlines, where they absorb the impact of storms and offer nutri-

ents for most of the world's marine life.¹² A study by the U.S.-based World Resources Institute found that mangrove loss was strongly correlated with the growth of cities and ports.¹³ Mangrove forests are also cleared for timber and to make room for fish and shrimp ponds, human settlements, and agricultural and industrial development. Kenya, Liberia, the Philippines, and Puerto Rico, have lost over 70 percent of their mangroves.¹⁴

Population's Interaction With Other Factors

Nondemographic factors, including the economy, national and local policies, technology, and culture, interact with population changes to affect the natural environment. Tourism, fishing, and aquaculture are industries with major economic influences on coastal ecosystems.

Tourism

Coastal areas worldwide are major destinations for tourism, which represents the fastest growing sector of the global economy.¹⁵ Tourism dominates the economy of some regions and small island states; for example, tourism constitutes 95 percent of the economy of the Maldives and is the country's only source of hard currency.¹⁶ Tourism can offer some environmental benefits, such as greater appreciation of the value of natural resources. In the Caribbean, for instance, diving tourism has helped raise awareness about the need for reef conservation. But tourism can also have harmful effects (see Box 1). It can lead to unsustainable coastal development as infrastructure is built on the shoreline to accommodate tourists. In the Caribbean, official estimates say that 70,000 tons of waste are generated annually from tourism activities.¹⁷ Yachts, charter boats, and cruise ships are major sources; they bring visitors to ports that often have inadequate collection systems for dealing with the solid waste discharged by the ships. Moreover, the ships provide few long-term economic benefits for the local population, since they do not employ many local citizens.

Fishing and Aquaculture

Marine fisheries and aquaculture (the controlled cultivation and harvesting of freshwater and marine organisms) produce close to 100 million

tons of fish, shellfish, and edible plants every year, providing a livelihood for about 35 million people, most of whom live in developing countries.¹⁸ Overharvesting to meet global consumers' growing demand for seafood can deplete many species and alter the biological structure of coastal ecosystems. Many species are overharvested because the world fishing fleet is larger than it

Box 1

Buccoo Reef, Tobago: Balancing Tourism, Health, and Livelihood

Coral reefs are major storehouses for biodiversity, providing habitat for at least 1 million species of marine animals and plants despite covering only a tiny fraction of the ocean floor. They also provide food, building materials, shoreline protection, and many indirect benefits for people living near them. More than 100 countries—many of them small islands—rely on the resources that coral reefs provide.¹ But coral reefs are increasingly threatened by human activity, particularly in developing countries. Coral reefs worldwide are deteriorating at an alarming rate: As of late 2000, 27 percent were severely damaged, compared with 10 percent in 1992.² More reefs are degraded and threatened by dynamite fishing, coral mining, and other human activities, as well as by bleaching caused by rising ocean temperatures.

Buccoo Reef, a marine park in Tobago, is the Caribbean island's largest, shallowest, and most accessible reef; as such, it is of immense value to the tourism industry. Tourism, Tobago's largest employer, relies on a healthy marine environment and especially on the health of Buccoo Reef. Recent estimates indicate that over 34,000 people take glass-bottomed boats to visit the reef every year.³ Most reef boats stop to allow visitors to walk on the reef to observe fish, even though reef walks are illegal. The reef is also threatened by inadequate treatment of sewage in the surrounding area. The high nutrient content of wastewater discharged into Buccoo Bay and other waters adjacent to the reef has spurred rapid growth of algae, which damages the reef.⁴ High levels of fecal coliform bacteria, which pose a threat to human health, have been measured on certain beaches in the park, indicating that the water has been contaminated with human or animal feces.⁵

References

1. Reef Relief, "Map of World's Coral Reefs," accessed online at www.reefrelief.org/Coral%20Forest/map.html, on Aug. 19, 2003; and R. Costanza et al., "The Value of the World's Ecosystem Services and Natural Capital," *Nature* 387 (May 15, 1997): 256-60.
2. C. Wilkinson, *Status of Coral Reefs of the World: 2000* (Townsville, Australia: Global Coral Reef Monitoring Network, 2000).
3. Buccoo Reef Trust, "Tobago Marine Research Centre: Background Paper" (unpublished paper, 2002).
4. B. Lapointe, *Impacts of Land-Based Nutrient Pollution on Coral Reefs of Tobago* (report prepared for Buccoo Reef Trust, 2003).
5. Institute of Marine Affairs, "The Formulation of a Management Plan for Buccoo Reef Marine Park" (prepared for the Tobago House of Assembly, 1995).

needs to be. Other problems include destructive harvesting methods such as trawling (dragging weighted nets across the sea floor to catch shrimp and bottom-dwelling fish), and bycatch (unintended catch of nontarget species).¹⁹ Modern trawling equipment scoops through sediment and rock and often kills the worms, sponges, and other species that live on the seafloor. Aquaculture, the world's fastest growing food production activity, with an annual growth rate of about 10 percent in the 1990s, can lead to the destruction of mangroves and may lead to irreversible damage to both estuarine and offshore fisheries by introducing biological, chemical, and organic pollutants (such as antibiotics and pesticides) and by modifying habitats.²⁰

Human Health, Food Security, and Gender Issues

People who live in coastal regions may suffer the cumulative burden of environmental stress from the activities on and overcrowding of the coast and from upstream and inland development. If not properly managed, development can result in pollution, deforestation, and inadequate management of soil, water, pesticides, and fertilizers. Damming rivers can also have negative environmental effects, such as soil erosion and destruction of ecosystems that support various fish and marine mammals. When concentrated in small, confined, and overcrowded areas such as coastal zones, pollution and other problems pose greater threats to human health.

Worldwide, sewage is the largest source of environmental contamination, and discharges have increased dramatically in the past three decades. Eighty percent of marine pollution comes from land-based sources; the remaining 20 percent comes from atmospheric sources, including acid rain and marine-based sources such as oil spills.²¹ As coastal communities grow, sewage can become a threat to local waterways: Demand often exceeds available sewage treatment, and much of the sewage is dumped without being treated. Bathing in or ingesting sewage-contaminated water can cause infections and transmit diseases such as cholera, particularly among children under 5.²² In developing countries, more than 90 percent of wastewater and 70 percent of industrial wastes are discharged in coastal waters without

being treated. The United Nations Environment Programme estimates that South Asian waters are at the highest risk of pollution: 825 million people in the region do not have basic sanitation services.²³ In Mumbai, India, for instance, almost half of the city's 12 million residents are either slum dwellers or homeless with little access to sewage and sanitation facilities. The Municipal Corporation of Brihan Mumbai, with support from the World Bank, has started the \$300 million Bombay Sewage Disposal Project to collect and dispose of 80 percent of the sewage currently flowing untreated into the sea.²⁴

Chemicals and heavy metals found in pesticide runoff and industrial effluents also damage human and marine health. The most serious concerns worldwide involve persistent organic pollutants (POPs), which can be transported in the atmosphere and have become common in the oceans. POPs tend to linger in living tissue and become more concentrated as they move up the food chain, so they are sometimes found even in people who live in remote, undeveloped regions. Evidence links long-term, low-level exposure to certain POPs with reproductive, immunological, neurological, and other problems in marine organisms and humans.²⁵ In Mozambique, for example, more than 100 factories in and around the capital city of Maputo do not have waste treatment plants; toxic wastes, poisons, non-degradable substances, and organic matter are drained into coastal waters.²⁶ These toxins can kill or contaminate marine life; people who eat seafood from polluted areas or who swim in contaminated waters are vulnerable to gastric and other infections.

Contaminants and activities that destroy coastal habitats and ecosystems also contribute to the loss of the marine fauna on which many people rely for food and income. Maintaining a healthy coastal habitat is critical because most of the world's fish produce their young inshore and feed on organisms in coastal waters. Breaking the marine food chain reduces vital supplies of protein for about 1 billion people, most of whom live in developing countries.²⁷

Yet restricting fishing rights and access to coastal waters in order to protect marine fauna may harm vulnerable groups of people. Poor women depend especially heavily on fish and fishing. They

tend to fish close to the shore and use the catch to feed their families, whereas men typically engage in large-scale commercial fishing offshore or in major inland water bodies.²⁸ Operating on a smaller scale, women who fish earn only 40 percent of what men earn for fishing in El Salvador. The situation is similar in rural Honduras, where women earn about half of what men do.²⁹

Being less visible in their work, women are also less likely to have access to decisionmakers or to be consulted about the management of natural resources. In the early 1990s, community leaders in El Salvador informally banned fishing in estuaries due to concerns about the overfishing of shrimp and other sea life in the estuary. Women were not consulted in this process and lost a vital source of household protein and income.³⁰ Women usually have different access to and control over land and water in coastal zones: Fewer than 5 percent of beneficiaries of land reform in El Salvador and Honduras were women.³¹

Integrated Coastal Management

Managing population pressures in coastal zones is difficult because those regions encompass many physical, social, and regulatory divisions. In addition, multiple competing economic sectors, including tourism, fishing, agriculture, aquaculture, forestry, manufacturing, oil and gas extraction, waste disposal, marine transportation, and real estate development have interests in coastal zones. Governments usually manage each sector separately, if at all. Consequently, many coastal nations have experienced rapid uncontrolled development along their coastlines.

In a growing number of countries, coastal zone managers are adopting integrated, multidisciplinary approaches to resource management that incorporate the perspectives of all stakeholders, including governments, the private sector, nongovernmental organizations (NGOs), and individuals. Integrated coastal management (ICM), an internationally accepted approach to managing resources that is based on the United States' 1972 Coastal Zone Management Act, allows policymakers and planners to take population issues into account when looking at the pressures, threats, and opportunities facing coastal areas. ICM has been endorsed repeatedly in international conferences, including the 1992 UN

Conference on Environment and Development in Rio de Janeiro, Brazil, and the 2002 World Summit on Sustainable Development in Johannesburg, South Africa.

ICM attempts to forge a balance between users of water and natural resources while ensuring that long-term environmental health and productivity are not compromised.³² Countries may use ICM to address the depletion of coastal and ocean resources; deal with pollution that endangers public health; distribute the economic benefits of using the coast and ocean; or develop and manage coastal and marine areas that are not yet being exploited.

At least 107 of the world's 134 coastal developing nations are involved in some type of ICM effort at the national or subnational level.³³ In general, the most successful ICM efforts share several characteristics:

- Multiple stakeholders, including representatives from all levels of government, NGOs, indigenous groups, communities, and the private sector;
- A strong scientific foundation to inform the management process;
- A formalized mandate and funding mechanisms;
- Formal decisionmaking that incorporates social, environmental, and economic data;
- Public participation starting at the initial stages of policy formulation and program development;
- Community-based management initiatives to develop community experience, build support, and provide information about regional or national programs;
- Capacity building of local experts through training, education, and applied research;
- Strong outreach services that provide information and education to all levels of management; and
- Regular collection of reliable data to measure the success of management initiatives.³⁴

Future Steps in Addressing Population Issues in Coastal Regions

Managing coastal areas requires concerted multi-sectoral efforts by government institutions at all levels, the private sector, and community groups, as well as sustained political support. Achieving a

Box 2

Integrating Population, Health, and Environment Interventions in the Philippines: The People and Environment Coexistence Development Project

Since 2000, Save the Children has been implementing the People and Environment Coexistence Development Project (PESCO-DEV), working with 12 coastal fishing communities in the Philippines to find ways to balance activities linked to population growth and environmental concerns through participatory research, community mobilization, and pilot projects.

The project used a three-stage approach to identify and address population changes that affect fishing in the area. First, the project conducted an environmental site assessment to obtain data on coastal environmental conditions, resource management practices, population dynamics, and community attitudes toward both population and environmental issues. Second, staff used geographic information system maps to compare data on population and land use for the past 50 years. Finally, people from local communities worked with PESCO-DEV to construct three-dimensional maps of their areas to highlight current land-use patterns and environmental resources.

These steps allowed PESCO-DEV to collect baseline data and conduct focus-group discussions with local citizens and decisionmakers on the relationship between population and land-use changes, the direction of these changes, and possible steps to address problems. Once they understood that population pressures were increasing sedimentation along the coast and threatening corals and fish, community members began reforestation projects on the coasts and inland and began to encourage the use of family planning services. As a result, the use of modern family planning methods among couples of reproductive age increased by 7 percent in less than two years, and communities decided to increase the size of protected marine areas from 12 to 203 hectares. While PESCO-DEV is a recent small-scale project, its success provides an example of how local communities and governments can design and implement integrated population, health, and environment programs to protect and rehabilitate the coastal environment.¹

Reference

1. R. Layng, "Strengthening Formative Environmental Research Through the Inclusion of Population Variables," *Population-Environment Fellows Newsletter* (Winter 2002/2003).

balance between top-down legislative authorities and bottom-up community involvement requires understanding issues and maintaining strong links with stakeholders in the area.

Efforts to balance local interests with national legislation need to consider the socioeconomic context of coastal populations and what role demographic patterns play in the region. Policymakers and program managers can take several steps to address and integrate population concerns into their coastal management efforts.

Include Population Data in Baseline Studies on Coastal and Marine Resources

Baseline studies assessing the threats to coastal areas should include data on population and the environment, indigenous peoples' concerns, applicable legislation and the agencies involved, gender concerns, and socioeconomic characteristics of the areas. These studies can be conducted using either exhaustive research or rapid assessment techniques. Data can then be applied with simple participatory tools to quickly assess coastal and marine resources and identify critical threats, such as the extent of fishing and any destructive fishing practices (see Box 2).

Incorporate Population and Gender Dynamics Into Planning

Coastal resource managers and policymakers need to integrate health, population, gender, and nutrition considerations into ICM by determining the characteristics of beneficiaries and stakeholders, NGO capacity, and opportunities in specific areas. For example, women in coastal areas may have unmet need for family planning—that is, they may want to limit or space their future births but may not be using contraceptives.³⁵ Helping women reach their family planning goals can protect the environment by limiting population growth, but addressing family planning needs must be coordinated with several sectors, particularly the health sector.

Several strategies can be used to incorporate population and gender dynamics in planning project activities:

- **Staggered introduction.** A program is established in one sector, and another program in a different sector is later incorporated into the first activity.
- **Simultaneous introduction.** A number of programs are introduced at the same time, and stakeholders consider multiple issues at each stage.
- **Bridge approach.** Single-sector activities support one another but are conducted by different staff.
- **Symbiotic method.** Program activities are dependent on one another and are conducted by the same staff.³⁶

In the Philippines, for example, projects have used a combination of these models to build links

across sectors. ICM projects developed out of separate single-sector programs, such as those introducing ecologically sound fishing practices and improving the quality and availability of couples counseling on family planning, and later evolved into integrated programs in which project staff worked with local communities and external experts to coordinate integrated population, health, and environment programs (see Box 2).

Monitor and Assess Human Impacts on the Marine Environment

Integrated management of the marine environment and its natural resources requires greater emphasis on acquiring, analyzing, and using environmental data from a variety of disciplines. It also involves improving the exchange of data between the science and management communities and focusing more on demographic and socioeconomic factors that contribute to marine pollution and coastal degradation.

Population estimates for coastal watersheds could provide useful information for coastal managers, especially if the data describe population dynamics on a larger scale. In the United States, the National Oceanographic and Atmospheric Administration has developed the Coastal Assessment Framework, which uses census data and mapping programs to provide managers and analysts with a watershed-based system for collecting and organizing resource-use data and developing coastal management strategies.³⁷ Many problems with water quality and ecosystems are best solved at the watershed level, which encompasses the full area that drains into a particular body of water.

The Caribbean Coastal Marine Productivity Programme (CARICOMP), a regional network of marine laboratories, parks, and reserves that studies land-sea interactions, strives to identify which changes in coastal systems are caused by human disturbances and which are simply long-term natural variations. The program focuses on understanding the structure and function of mangroves, seagrasses, and coral reefs, the primary coastal ecosystems in the Caribbean. CARICOMP is one example of a functioning international program for monitoring the coastal marine environment and can be used as a model for other countries or regions.³⁸

Conclusion

Demographic factors, especially migration, are major considerations in how people use coastal regions. Understanding how population issues can be integrated into coastal management will help policymakers, program managers, and communities design more viable and sustainable strategies for using and safeguarding the world's coasts and the resources they provide.

References

- ¹ Brian Voigt, "Glossary of Coastal Terminology" (March 1998), accessed online at www.csc.noaa.gov/text/glossary.html, on Aug. 15, 2003; Organization for Economic Cooperation and Development (OECD), *Coastal Zone Management: Integrated Policies* (Paris: OECD, 1993); and Integrated Coastal Management, "What Is the 'Coast'?" accessed online at http://icm.noaa.gov/story/icm_coast.html, on Aug. 12, 2003.
- ² United Nations Development Programme (UNDP) et al., *World Resources 2000-2001—People and Ecosystems: The Fraying Web of Life* (Washington, DC: World Resources Institute [WRI], 2001): 44.
- ³ Joel E. Cohen et al., *How Many People Can the Earth Support?* (New York: W.W. Norton & Co., 1997).
- ⁴ Veravat Hongskul, *Into the Next Millennium: Fishery Perspective* (November 1999), accessed online at www.fao.org/DOCREP/003/x6947E/X6947E00.htm, on Aug. 12, 2003.
- ⁵ United Nations Food and Agriculture Organization (FAO), *World Fisheries and Aquaculture Atlas CD-ROM* (Rome: FAO, 2001); Lauretta Burke et al., eds., *Pilot Analysis of Global Ecosystems: Coastal Ecosystems* (Washington, DC: WRI, 2001): 19; and Barbara Best and Alan Bornbusch, eds., *Global Trade and Consumer Choices: Coral Reefs in Crisis* (Feb. 19, 2001), accessed online at www.aas.org/international/Africa/coralreefs/Coral_Reefs.pdf, on Aug. 12, 2003.
- ⁶ Sara Curran et al., "Interactions Between Coastal and Marine Ecosystems and Human Population Systems: Perspectives on How Consumption Mediates This Interaction," *Ambio: A Journal of the Human Environment* 31, no. 4 (2002): 264-68.
- ⁷ United Nations System-Wide Earthwatch, "Oceans and Coastal Areas," accessed online at <http://earthwatch.unep.net/oceans/coastalthreats.php>, on June 20, 2003.
- ⁸ Katrina Brown et al., *Making Waves: Integrating Coastal Conservation and Development* (London: United Nations Environment Programme [UNEP], 2002): 2; and UNEP, *Global Environment Outlook 3* (London: UNEP, 2003): 188.
- ⁹ Joint Group of Experts on the Scientific Aspects of Marine Protection (GESAMP), *Protecting the Oceans From Land-Based Activities: Land-Based Sources and Activities Affecting the Quality and Uses of the Marine, Coastal, and Associated Freshwater Environment* (Jan. 1, 2001), accessed online at <http://gesamp.imo.org/no71/index.htm>, on Aug. 15, 2003.
- ¹⁰ Jason Bremner and Jaime Perez, "A Case Study of Human Migration and the Sea Cucumber Crisis in the Galapagos Islands," *Ambio: A Journal of the Human Environment* 31, no. 4 (2002): 306-10.
- ¹¹ John Tibbetts, "Coastal Cities: Living on the Edge," *Environmental Health Perspectives* 110, no. 11 (2002): 674-81.

PRB's **Population, Health, and Environment Program** disseminates the latest analysis and scientific information on the causes and consequences of critical population, health, and environment linkages, and on the ways that these linkages can be addressed. This information is targeted to those who influence policy, such as policymakers and their advisers, the media, and nongovernmental organizations. For more information on the PHE Program, please write to PHE@prb.org.

Founded in 1929, the Population Reference Bureau is the leader in providing timely and objective information on U.S. and international population trends and their implications. For more information on PRB and its programs, please visit PRB's website at www.prb.org.

¹² American Association for the Advancement of Science (AAAS), "Mangroves and Estuaries" (2000), accessed online at <http://atlas.aaas.org/index.php?part=2&sec=eco&sub=mangroves>, on Aug. 15, 2003.

¹³ WRI, *World Resources 2000-2001—People and Ecosystems: The Fraying Web of Life* (Washington, DC: WRI, 2001): 69-79.

¹⁴ WRI, *World Resources 2000-2001*: 74.

¹⁵ Brown et al., *Making Waves*.

¹⁶ Brown et al., *Making Waves*.

¹⁷ UNEP, "Tourism's Three Main Impact Areas" (Oct. 9, 2001), accessed online at www.unep.org/pc/tourism/sust-tourism/env-3main.htm, on Aug. 14, 2003.

¹⁸ FAO, *World Fisheries and Aquaculture Atlas*: 13; and FAO, *The State of World Fisheries and Aquaculture*, 2002 (Rome: FAO, 2003): 5.

¹⁹ WRI, *World Resources 2000-2001*: 76.

²⁰ WRI, *World Resources 2000-2001*: 76.

²¹ Biliana Cicin-Sain et al., *A Guide to Oceans, Coasts and Islands at the World Summit on Sustainable Development* (August 2002), accessed online at www.gpa.unep.org/documents/WSSD/Oceans-Coasts-and-Islands-at-the-WSSD.pdf, on Aug. 25, 2003.

²² Philomene A. Verlaan, "The Importance of Coastal Management to Human Health," in *International Perspectives on Environment, Development and Health*, ed. Gurinder S. Shahi et al. (New York: Springer Publishing Company, Inc., 1997).

²³ Mansi Jasuja, *Water Supply and Sanitation Coverage in UNEP Regional Seas* (Nairobi, Kenya: 2002).

²⁴ World Bank Group, "Sewage Disposal Project Transforming Urban Environment and Improving Quality of Life in Mumbai, India" (1999), accessed online at [http://lnweb18.worldbank.org/sar/sa.nsf/Attachments/MbaiSewg/\\$File/MbaiSewg.pdf](http://lnweb18.worldbank.org/sar/sa.nsf/Attachments/MbaiSewg/$File/MbaiSewg.pdf), on Aug. 28, 2003.

²⁵ Burke et al., eds., *Pilot Analysis of Global Ecosystems*.

²⁶ UNEP, *Global Environment Outlook 3*: 190.

²⁷ WRI, *World Resources 2000-2001*: 70.

²⁸ FAO, "Coastal Zone Management and Equality Between Women and Men" (1998), accessed online at www.fao.org/epdirect/epre0048.htm, on June 20, 2003.

²⁹ Manuel Benítez et al., "A Platform for Action for the Sustainable Management of Mangroves in the Gulf of Fonseca" (November 2000), accessed online at www.unesco.org/csi/wise/fonseca1.htm, on Aug. 14, 2003.

³⁰ Benítez et al., "A Platform for Action for the Sustainable Management of Mangroves in the Gulf of Fonseca."

³¹ Carmen Diana Deere and Magdalena León, *Derechos de propiedad y acceso de la mujer a la tierra en El Salvador* (1999), accessed online at www.prisma.org.sv/pubs/prisma32.pdf, on Aug. 28, 2003.

³² United States National Oceanographic and Atmospheric Administration (NOAA), "What Is Integrated Coastal Management?" accessed online at www.icm.noaa.gov/story/icm_def.html, on Aug. 15, 2003.

³³ Jens Sorensen, *Baseline 2000: Background Report*, accessed online at www.uhi.umb.edu/b2k/baseline2000.pdf, on Aug. 18, 2003.

³⁴ Biliana Cicin-Sain and Robert Knecht, *Integrated Coastal and Ocean Management: Concepts and Practices* (Washington, DC: Island Press, 1998); and communication with Pam Rubinoff, July 16, 2003.

³⁵ Joan Castro et al., "Integrating Population and Coastal Resource Management for Food Security—The Philippines' Model" (2000), accessed online at www.path.org/philippines/phils_model.htm, on June 20, 2003.

³⁶ Rainera L. Luero and Robert Layng, "Understanding Reproductive Health/Natural Resource Management Integration in the Philippines," *World Neighbors* 28, no. 2 (2002).

³⁷ NOAA Office of Ocean Resources Conservation and Assessment (ORCA), "ORCA's Coastal Assessment Framework," accessed online at <http://spo.nos.noaa.gov/projects/caf/caf.html>, on June 30, 2003.

³⁸ Bjorn Kjerfve et al., "CARICOMP: A Caribbean Network of Marine Laboratories, Parks, and Reserves for Coastal Monitoring and Scientific Collaboration" (May 1998), accessed online at www.unesco.org/csi/pub/papers/kjerfve.htm, on June 20, 2003.

Acknowledgments

Liz Creel prepared this policy brief with assistance from PRB staff and other colleagues. Thanks are due to Lori Ashford, Patricia Biermayr-Jenzano, Roger-Mark De Souza, John Williams, and Nancy Yinger, PRB; Pam Rubinoff and Elin Torell, the Coastal Resources Center of the University of Rhode Island's School of Oceanography; Don Hinrichsen, author and UN consultant; Marea Hatziolos, the World Bank; Alfred Nakatsuma and Tom Gardiner-Outlaw, U.S. Agency for International Development; Richard Langton, Buccoo Reef Trust; Naida Pasion, Save the Children/Philippines; and Salif Diop, Patrick M'mayi, and Philippe Rekecwicz of the United Nations Environment Programme.

This work has been funded by the U.S. Agency for International Development (USAID) under the MEASURE *Communication* project (HRN-A-00-98-000001-00). PRB's work with Save the Children in the Philippines, highlighted in this brief, has been supported by the David and Lucile Packard Foundation.

© September 2003, Population Reference Bureau



POPULATION REFERENCE BUREAU MEASURE *Communication*

1875 Connecticut Ave., NW, Suite 520, Washington, DC 20009 USA
Tel.: 202-483-1100 ■ Fax: 202-328-3937 ■ E-mail: measure@prb.org or popref@prb.org
Website: www.measurecommunication.org or www.prb.org

