VANISHING BORDERS

Protecting the Planet in the Age of Globalization

HILARY FRENCH

W•W• NORTON & COMPANY
New York London

Other Norton/Worldwatch Books

Lester R. Brown et al.

State of the World 1984 through *2000* (an annual report on progress toward a sustainable society)

Vital Signs 1992 through *1999* (an annual report on the environmental trends that are shaping our future)

Lester R. Brown
Christopher Flavin
Sandra Postel
Saving the Planet

Alan Thein Durning
How Much Is Enough?

Sandra Postel
Last Oasis

Lester R. Brown
Hal Kane
Full House

Christopher Flavin
Nicholas Lenssen
Power Surge

Lester R. Brown
Who Will Feed China?

Lester R. Brown
Tough Choices

Michael Renner
Fighting for Survival

David Malin Roodman
The Natural Wealth of Nations

Chris Bright
Life Out of Bounds

Lester R. Brown
Gary Gardner
Brian Halweil
Beyond Malthus

Sandra Postel
Pillar of Sand

Worldwatch Database Disk

The data from all graphs and tables contained in this book, as well as from those in all other Worldwatch publications of the past two years, are available on 3 ½-inch disks for use with PC or Macintosh computers. This includes data from the *State of the World* and *Vital Signs* series of books, other Norton/Worldwatch books, Worldwatch Papers, and *World Watch* magazine. The data (in spreadsheet format) are provided as Microsoft Excel 5.0/95 workbook (*.xls) files. Users must have spreadsheet software installed on their computer that can read Excel workbooks for Windows. To order, send check or money order for $89 plus $4 shipping and handling, or credit card number and expiration date (Mastercard, Visa, or American Express), to Worldwatch Institute, 1776 Massachusetts Ave., NW, Washington DC 20036. Or you may call (800) 555-2028, fax us at (202) 296-7365, or reach us by e-mail at wwpub@worldwatch.org.

Visit our Web site at www.worldwatch.org

Printed in the United States of America

First Edition

The WORLDWATCH INSTITUTE trademark is registered in the U.S. Patent and Trademark Office.

The text of this book is composed in ITC Berkeley Oldstyle, with the display set in Helvetica Neue and Bank Gothic. Book design by Elizabeth Doherty. Composition by Worldwatch Institute; manufacturing by the Haddon Craftsmen, Inc.

ISBN 0-393-32004-9

W.W. Norton & Company, Inc., 500 Fifth Avenue, New York, N.Y. 10110
www.wwnorton.com

W.W. Norton & Company Ltd., 10 Coptic Street, London WC1A 1PU

1 2 3 4 5 6 7 8 9 0

♻ This book is printed on recycled paper.

CONTENTS

Acknowledgments *ix*

1. One World? *3*

I. The Ecology of Globalization *13*

2. Nature Under Siege *15*

3. The Biotic Mixing Bowl *34*

4. Global Grocers *48*

5. The Export of Hazard *71*

6. Sharing the Air *87*

II. Reforming Global Governance *109*

7. Trade Wars *111*

8. Greening the Financial Architecture *127*

9. Strengthening Global Environmental Governance *144*

10. Partnerships for the Planet *163*

Notes *177*

Index *245*

About the Author *258*

ACKNOWLEDGMENTS

In 1972, Lester Brown published a book that was ahead of its time: *World Without Borders*. Nearly 30 years later, the message of that volume still rings true. I am indebted to Lester for his vision of a humane and environmentally sustainable world—a vision that he expressed in that early book and has continued to put forth as Founder and President of Worldwatch Institute. More specifically, I am grateful to Lester for his enthusiasm for this project and, over the years, for the broader program of research from which it sprung.

Undertaking a book of the breadth of *Vanishing Borders* is a daunting task. It could not have been accomplished without extraordinary support from my colleagues at the Worldwatch Institute. This book cuts across the research programs of the Institute, and I have been fortunate to be able to draw on this rich storehouse of knowledge.

I would particularly like to thank Staff Researcher Lisa Mastny for providing key assistance with all aspects of this book. Lisa helped collect, organize, and analyze an often

overwhelming amount of information. Her research talents, and her good cheer under fire, were much appreciated. I am also deeply grateful to freelance editor Linda Starke, both for her skillful editing and for her patience and flexibility in working with an author with a penchant for pushing deadlines to their limits. My thanks to Art Director Elizabeth Doherty for producing a beautiful design for the book and for helping make our tight schedule work; to Molly O'Meara and Payal Sampat for pitching in with critical last-minute proofreading assistance; to Librarian Lori Brown for help tracking down obscure documents; and to Suzanne Clift for offering both administrative and moral support.

Most of my colleagues on the Worldwatch staff read various pieces of this book in different forms at different times, including as a draft *State of the World* chapter. I am grateful to all of them. For their comments, I thank Janet Abramovitz, Dick Bell, Chris Bright, Lester Brown, Seth Dunn, Christopher Flavin, Gary Gardner, Brian Halweil, Ashley Mattoon, Anne Platt McGinn, Michael Renner, David Malin Roodman, and Curtis Runyan. Outside the Institute, I am indebted to reviewers Ricardo Bayon, Michelle Chan-Fishel, David Downes, and Frances Seymour for offering useful input on short notice. This book is much the better for the collective contributions of this group.

Now that *Vanishing Borders* is nearing completion, I am finally able to contemplate the outreach process. I look forward to working with a talented Worldwatch team—Dick Bell, Mary Caron, Christine Stearn, and Liz Hopper—in helping this book find its audience, and with Reah Janise Kauffman in offering it to publishers outside the United States. And at W.W. Norton & Company, our U.S. publisher, I appreciate the dependable talents of Amy Cherry, Andrew Marasia, and Nomi Victor.

As always, all of us at Worldwatch are grateful to the various foundations that support the Institute's work: the

Geraldine R. Dodge, Ford, William and Flora Hewlett, W. Alton Jones, the John D. and Catherine T. MacArthur, Charles Stewart Mott, Curtis and Edith Munson, David and Lucile Packard, Summit, Turner, Wallace Genetic, Weeden, Wege, and Winslow Foundations; Rockefeller Financial Services; the U.N. Population Fund; and the Wallace Global Fund. We are also indebted to the Institute's Council of Sponsors—Tom and Cathy Crain, Vicki and Roger Sant, Robert Wallace, and Eckart Wintzen—who contribute generously each year to the Institute.

Finally, I am especially grateful to three individuals. My parents, Alan and Mary French, helped inspire this book in innumerable ways, including childhood hiking trips, visits to the United Nations, and stimulating dinner table conversations. And Christopher Flavin not only provided key substantive input but also, and even more important, offered unwavering encouragement and support. My heartfelt thanks to all.

Hilary French

Worldwatch Institute
1776 Massachusetts Ave., N.W.
Washington, D.C. 20036

December 1999

Chapter 1

One World?

In late November 1999, trade ministers from 135 countries assembled in Seattle to launch a new round of global trade talks. But things did not go according to plan. Instead, delegates to the World Trade Organization (WTO) meeting were greeted by tens of thousands of demonstrators from around the world who delayed the start of the talks through a massive street protest that kept delegates from the convention hall. Sadly, the event turned violent when a handful of renegades used the occasion to launch a spree of random violence, and police sprayed tear gas and fired rubber bullets at the protesters. By the end of the week, hundreds of demonstrators were in jail, mainly for the relatively innocuous offense of blocking public streets. But the official meeting was also in tatters, with delegates scurrying for airplanes without having agreed even to a pro forma official declaration.[1]

The "battle of Seattle," as it was quickly dubbed, may have marked a critical turning point. "If there is any clear message coming through the clouds of tear gas and broken glass in Seattle this week, it is that the terms of the debate

about free trade have changed," reported the *Washington Post*. "It is no longer a debate about trade at all, but rather a debate about globalization, a process that many now understand affects not only traditional economic factors such as jobs and incomes but also the food people eat, the air they breathe…and the social and cultural milieu in which they live." Concern about the environmental implications of the WTO and broader globalization trends were high on the list of the concerns of the protesters.[2]

As the controversy swirling around the Seattle meeting made clear, "globalization" has become a contentious process. Part of the conflict stems from the fact that the term means vastly different things to different people. To some, globalization is synonymous with the growth of global corporations whose far-flung operations transcend national borders and allegiances. To others, it signals a broader cultural and social integration, spurred by mass communications and the Internet. The term can also refer to the growing permeability of international borders to pollution, microbes, refugees, and other forces.[3]

Globalization is used here to refer to a broad process of societal transformation that encompasses all of the above, including growth in trade, investment, travel, computer networking, and transboundary pollution. (See Table 1–1.) This book explores the collective impact of these phenomena on the health of the planet's natural systems.[4]

Today's integrated world is the result of a process that can be traced back 1 million years, when early humans first migrated out of Africa throughout Eurasia. It was not until the 1500s, however, that people living several continents apart came into contact as a result of the European Age of Exploration. The late nineteenth century brought the development of steam-powered ships and railroads, which dramatically expanded international commerce and exchange. Two World Wars and the Great Depression slowed globalization dramatically in the first half of the twentieth century. But the second half brought globalization back with abandon, as trade rebounded and widespread international air travel and the use of personal computers revolutionized links between countries and cultures.[5]

Growth in trade has consistently outpaced the expansion of the global economy since World War II. The world economy has grown sixfold since 1950, rising from $6.7 trillion to $41.6 trillion in 1998. But exports increased 17-fold over this period, reaching $5.4 trillion in 1998. (See Figure 1–1.) While exports of goods accounted for only 5 percent of the gross world product in 1950, by 1998 this figure had climbed to 13 percent.[6]

In recent decades, international investment by multinational corporations has also exploded. Over the 1980s, foreign direct investment flows grew twice as fast as trade—increasing 15-fold between 1970 and 1998, from $44 billion to $644 billion. The number of transnational corporations (TNCs) has also soared in recent decades, increasing from only 7,000 in 1970 to more than 53,000 in 1998. And not only companies are now investing abroad. Some 44 million U.S. households have at least some money in mutual funds, up from only 4.6 million in 1980. Their dollars are increasingly invested overseas: the assets of U.S.-based international and global mutual funds climbed from just $16 billion in 1986 to $321 billion at the end of 1996.[7]

The globalization of commerce in recent decades has internationalized environmental issues. Trade in natural resources such as timber and fish is soaring. Common trappings of daily life—a teak coffee table, for instance, or a salmon dinner—can affect the well-being of people and ecosystems on the other side of the world. And international investments are giving millions of people an influence, albeit often unwitting, on environmental developments in distant corners of the planet.[8]

TABLE 1–1

Globalization at a Glance

Indicator	Trend
World Trade	Between 1950 and 1998, world exports of goods increased 17-fold—from $311 billion to $5.4 trillion—while the global economy expanded only sixfold. Exports of services have also surged in recent decades—from $467 billion in 1980 to $1.3 trillion in 1997—and now represent nearly one fifth of total world trade.
Private Investment/ Capital Flows	Between 1970 and 1998, global foreign direct investment increased from $44 billion to $644 billion. Capital flows to developing countries alone grew 11-fold between 1970 and 1998, from $21 billion to $227 billion. The share of capital entering the developing world from private sources doubled between 1990 and 1997, reaching 88 percent.
Transnational Corporations (TNCs)	Between 1970 and 1998, the number of TNCs worldwide grew from 7,000 to an estimated 53,600, with some 449,000 foreign subsidiaries. The sales of TNCs outside their home countries are growing 20–30 percent faster than their exports, and sales of goods and services by foreign subsidiaries—valued at $9.5 trillion in 1997—surpass total world exports by nearly 50 percent.
Shipping	Between 1955 and 1998, the tonnage of goods carried by ship rose more than sixfold, to 5.1 billion. Meanwhile, the unit cost of carrying freight by ship dropped 70 percent between 1920 and 1990 (in 1990 dollars).
Air Transport	Between 1950 and 1998, the number of passenger-kilometers flown internationally grew nearly 100-fold, from 28 billion to 2.6 trillion. Air freight also soared over this period, from 730 million to 99 billion ton-kilometers carried. Meanwhile, the average revenue per mile for air transport fell from 68¢ to 11¢ between 1930 and 1990 (in 1990 dollars).
Tourism	Between 1950 and 1998, international tourist arrivals increased 25-fold, from 25 million to 635 million. Some 2 million people now cross an international border each day, compared with only 69,000 in 1950.
Refugees	Between 1961 and 1998, the number of international refugees qualifying for and receiving U.N. assistance grew 16-fold, from 1.4 million to 22.4 million. Today, the total number of refugees worldwide—including internally displaced persons, asylum seekers, and people living in refugee-like situations—tops 56 million.
Telephones	Between 1960 and 1998, the number of lines linking non-cellular telephones directly to the global phone network grew eightfold, from 89 million to 838 million. In developing countries, the number of phone connections per 100 people jumped from only 1 in 1975 and 2 in 1985 to 6 in 1998. Meanwhile, the average cost of a three-minute phone call from New York to London fell from $244.65 in 1930 to $3.32 in 1990 (in 1990 dollars).
Internet/ Computing	Since 1995, the Internet has grown by roughly 50 percent each year, following 15 years of more than doubling in size annually. In 1998, some 43 million host computers wired an estimated 147 million people to the Internet. Today, 1 in every 40 people has access. Meanwhile, the unit cost of computing power fell 99 percent between 1960 and 1990 (in 1990 dollars).
Nongovernmental Organizations (NGOs)	Between 1956 and 1998, the number of international NGOs (groups operating in at least three countries) grew 23-fold, from only 985 to an estimated 23,000. A study of 22 nations worldwide found that the nonprofit sector accounted for 5.7 percent of the national economy on average and employed 5 percent of the total workforce.

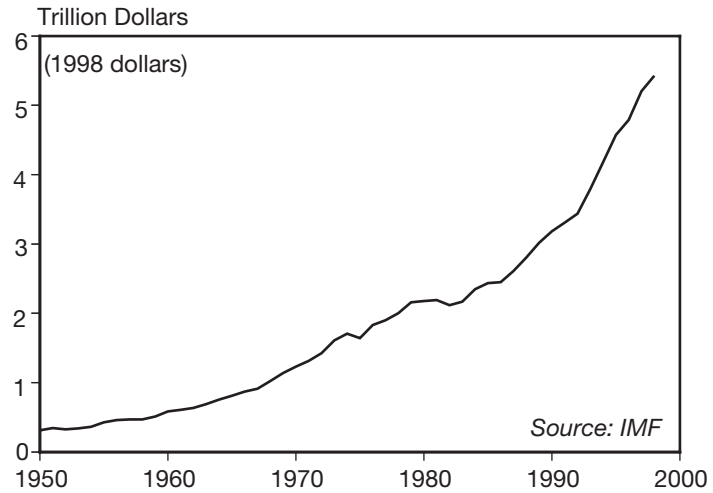
SOURCE: See endnote 4.

A biotic intermingling of unprecedented proportions is also taking place as species and microbes that were once neatly contained within geographic boundaries are now let loose by trade and travel. And wind and ocean currents, rainfall, rivers, and streams carry contaminants hundreds or even thousands of miles from their sources. DDT and PCBs, for instance, have been found throughout the Inuit food chain in the Arctic, from the snow and edible berries to fish and polar bears. On an even larger scale, ozone depletion, climate change, and oceanic pollution threaten all nations.[9]

The unparalleled economic expansion after World War II

FIGURE 1–1

World Export of Goods, 1950–98

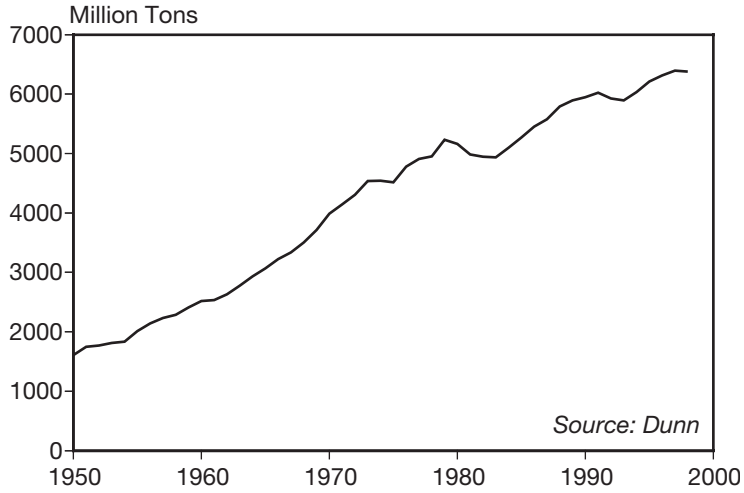


brought with it a burst in the consumption of material goods. Global wood consumption has more than doubled since 1950, paper use has increased sixfold, fish consumption has grown fivefold, water and grain consumption have tripled, and steel use and fossil fuel burning have climbed fourfold. The world has also seen an explosion in human numbers. The number of people inhabiting the planet has more than doubled—from 2.5 billion in 1950 to 6.0 billion in 1999.[10]

The combination of these trends has caused the world economy to begin to push up against the planet's ecological limits. In 1998, the carbon emissions that are one of the main causes of global warming were near their peak (see Figure 1–2), and carbon dioxide concentration in the atmosphere again reached record levels. Biologists warn that we have entered a period of mass extinction of species—the largest die-off in 65 million years. According to surveys by

FIGURE 1–2

World Carbon Emissions From Fossil Fuel Burning, 1950–98



the World Conservation Union–IUCN, an estimated one quarter of the world's mammal species are threatened with extinction, as are nearly 13 percent of plant species. The world's major fisheries are on the verge of collapse, and water scarcity and land degradation threaten our ability to feed the more than 6 billion people that now inhabit the planet.[11]

The global nature of both the economy and of ecological systems causes the exchange of "environmental space" among nations. A team of researchers led by Mathis Wackernagel of the Center for Sustainability Studies in Xalapa, Mexico, has calculated what they call the "ecological footprint" of 52 nations: the amount of biologically productive land area appropriated by these countries and their inhabitants. When all 52 are tallied up, it becomes clear that the world is already living beyond its ecological means. But some countries are doing so far more than others as a result

of either scarce natural capital, profligate consumption patterns, or some combination of the two. (See Table 1–2.) Countries in ecological deficit import natural capital from those in surplus, an element of globalization that few people are conscious of.[12]

As environmental concerns become more pressing, they are climbing higher on the international political agenda. The Seattle meeting demonstrated that global economic negotiations that ignore ecological issues do so at their peril. But global eco-politics is becoming increasingly strained. Industrial countries often disagree among themselves, with the European Union and the United States now at odds on issues ranging from global climate change to genetically modified organisms. Environmental issues have also become acrimonious in North-South relations, with rich and poor countries divided over how to address these issues in the context of the global economy, and over how to apportion responsibility for reversing the planet's ecological decline.

Globalization in its many guises poses enormous challenges to traditional governance structures. National governments are ill suited for managing environmental problems that transcend borders, whether via air and water currents or through global commerce. Yet international environmental governance is still in its infancy, with the treaties and institutions that governments turn to for global management mostly too weak to put a meaningful dent in the problems. Nations are granting significant and growing powers to economic institutions such as the WTO and the International Monetary Fund, but environmental issues remain mostly an afterthought in these bodies, despite the best efforts of demonstrators and public policy groups.

While nation-states are losing ground in the face of globalization, other actors are moving to the fore, particularly international corporations and nongovernmental organizations. New information and communications technologies

TABLE 1–2

Ecological Footprint Per Person in Selected Nations, 1995

Country	Available Ecological Capacity	Ecological Footprint	Ecological Deficit or Surplus (Capacity minus Footprint)
	(hectares per capita)		
Netherlands	1.2	5.9	– 4.7
United States	6.7	10.9	– 4.2
Japan	0.8	4.7	– 3.9
Israel	0.3	3.7	– 3.5
South Korea	0.4	3.8	– 3.4
United Kingdom	1.8	4.9	– 3.1
Greece	1.8	4.8	– 3.0
Germany	1.9	4.8	– 2.9
South Africa	1.3	3.1	– 1.8
France	4.0	5.4	– 1.4
Mexico	1.4	2.6	– 1.2
China	0.6	1.5	– 0.8
India	0.5	1.0	– 0.5
Russia	4.3	4.7	– 0.5
Indonesia	2.7	1.4	1.3
Canada	12.6	7.4	5.2
Brazil	9.1	3.8	5.3
Australia	16.3	10.0	6.3
Iceland	21.8	6.6	15.2
New Zealand	26.8	8.2	18.6
World	2.0	2.4	– 0.4

SOURCE: Mathis Wackernagel and Alejandro Callejas, "The Ecological Footprints of 52 Nations (1995 data)," Redefining Progress, available at <www.rprogress.org>.

are facilitating international networking, and activist groups, businesses, and international institutions are forging innovative partnerships.

But though the economy and the environment are both increasingly global, politics continues to be mostly national and local. As Professor Dani Rodrik of Harvard University puts it: "Markets are sustainable only insofar as they are embedded in social and political institutions.…It is trite but true to say that none of these institutions exists at the global level."[13]

The world economy and the natural world that it relies on are both in precarious states as we enter the new millennium, provoking fears that an era of global instability looms on the horizon. Over the course of the twentieth century, the global economy stretched the planet to its limits. The time is now ripe to build the international governance structures needed to ensure that the world economy of the twenty-first century meets peoples' aspirations for a better future without destroying the natural fabric that underpins life itself.

I

THE ECOLOGY OF GLOBALIZATION

Chapter 2

NATURE UNDER SIEGE

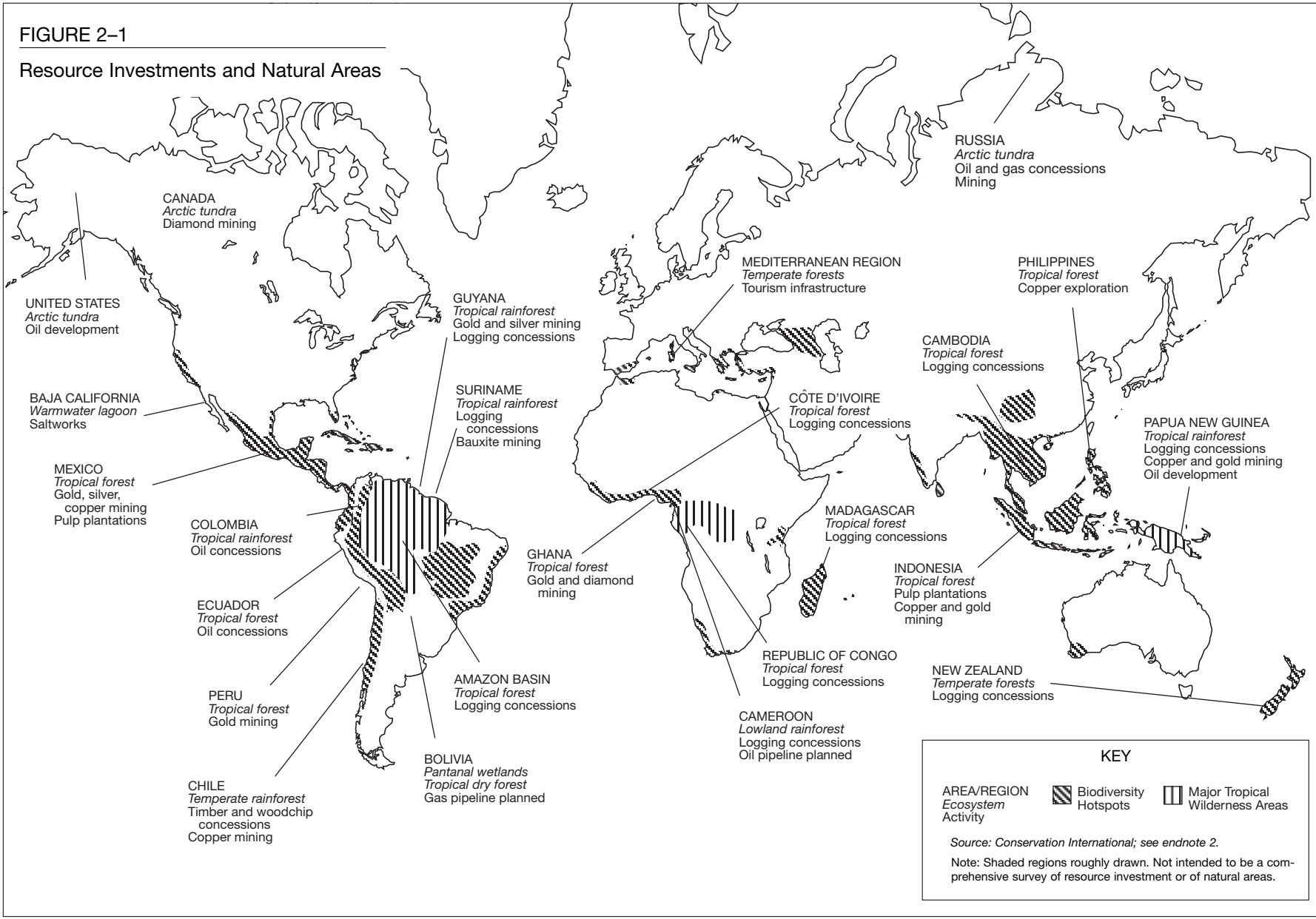
While economists tout record-breaking increases in global commerce in recent decades, more sobering statistics are being put forth by the world's leading biologists: the loss of living species in recent decades, they report, represents the largest mass extinction since the dinosaurs were wiped out 65 million years ago.[1]

Globalization is a powerful driving force behind today's unprecedented biological implosion. Trade in timber, minerals, and other natural commodities is climbing, and many of the world's hotspots of biological diversity are now threatened by a surge of international investment in resource extraction. (See Figure 2–1.) Yet the new rules of the global economy pay little heed to the importance of reversing the biological impoverishment of the planet. This mismatch between ecological imperatives and prevailing economic practice will need to be bridged if the world is to avoid an unraveling of critical environmental services in the early part of this new century.[2]

Human beings remain fundamentally dependent on the

FIGURE 2–1

Resource Investments and Natural Areas



Source: Conservation International; see endnote 2.

Note: Shaded regions roughly drawn. Not intended to be a comprehensive survey of resource investment or of natural areas.

natural world. One shortcoming of conventional economics is its failure to account for the critical services provided by natural ecosystems such as forests, wetlands, coral reefs, rivers, and seas. In 1997, a team of 13 ecologists, economists, and geographers published a path-breaking article that put a price tag on the value of a range of functions provided by these ecosystems. The study covered a broad array of services, including genetic resources, flood control, pollination, water supply, and erosion control. The authors arrived at the stunning conclusion that the economic value of "nature's services" adds up to some $33 trillion each year—almost as much as the entire annual gross world product.[3]

Despite their value to humankind, ecosystems are being degraded at an unparalleled rate as a result of human activity. One benchmark of the losses is the rapid rate at which species are being extinguished. Biologists warn that as many as one fifth of all plant and animal species could disappear within the next 30 years. Another measure of ecological health is the extent to which humans have transformed ecosystems from their natural state into cropland, pasture, plantations, human settlements, and other uses. Many countries have seen already seen more than half of their land area undergo this conversion, including Argentina, Australia, India, Mexico, South Africa, and Spain.[4]

Nations ostensibly set about the task of staunching biological losses at the U.N. Conference on Environment and Development in Rio in 1992, when they finalized a U.N. Convention on Biological Diversity. The accord has now been ratified by more than 175 countries (although the United States is not one of them). Among its many provisions, the treaty requires countries to adopt national biodiversity strategies and action plans, establish protected areas, conserve threatened species, restore degraded habitats, and fairly and equitably share the benefits of genetic resources. But unlike the rules of the World Trade Organization (WTO),

the biological diversity convention contains few concrete commitments and no effective enforcement mechanisms. Not surprisingly, it has so far failed to put a measurable dent in the burgeoning global extinction crisis. Reversing ecological decline will require going beyond exhortation to weave biological integrity into the fabric of the global economy.[5]

THE TIMBER TRADE

The world's forests are a particularly important reservoir of biological wealth. They harbor more than half of all species on Earth and provide a range of other important natural services, including flood control and climate regulation. But the planet's forest cover is steadily shrinking as human numbers and the global economy continue to expand. Nearly half of the forests that once covered Earth have already been lost, and almost 14 million hectares of tropical forest—an area nearly three times the size of Costa Rica—is being destroyed each year.[6]

The role of international trade in global deforestation has been a subject of controversy over the years. Global timber trade is far from the only culprit in forest loss: the clearing of land for agriculture and grazing is also a major cause, as are fuelwood gathering and the felling of trees for domestic use. Yet the draw of international markets can be an inducement for countries to cut down trees far faster than would be required to meet domestic demand alone. Several countries export more wood than they consume domestically, including Cameroon, Canada, Gabon, and Papua New Guinea. Indonesia and Malaysia have both pushed plywood exports with gusto in recent years, contributing in no small measure to rapid deforestation in both countries. Plywood exports from the two countries combined exploded from just 233,000 cubic meters in 1975 to 12 million cubic meters in 1998. These two countries now account for nearly 60 percent of world plywood exports, up from just 4 percent in 1975.[7]

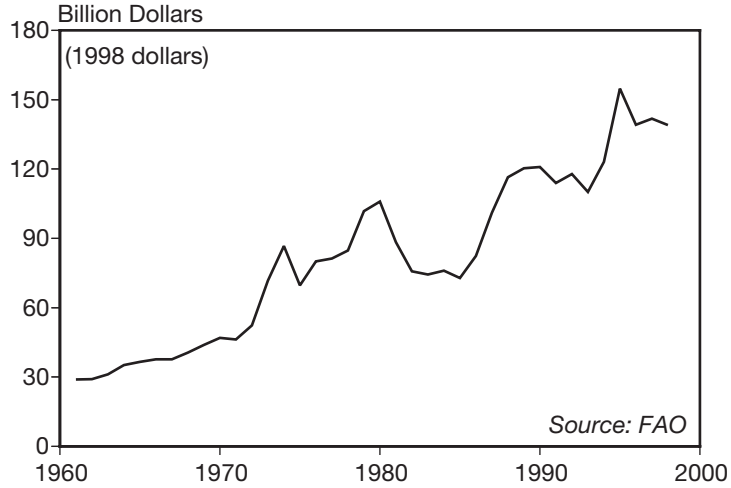
Recent studies have concluded that commercial logging is the preeminent threat to the world's most biologically rich forests. High on this list are the "frontier forests" of Alaska, Canada, Russia, the Amazon Basin, and the Guyana Shield—the world's last remaining tracts of relatively undisturbed natural forests. A 1997 World Resources Institute report concluded that nearly 40 percent of the world's frontier forests are threatened by ongoing or planned human activities, with logging implicated in more than 70 percent of the cases. Commercial logging often sets in motion the destruction of a far larger area, as road construction opens the way to mining, farming, hunting, and other disruptive activities. Timber operations also contribute to forest destruction by displacing local peoples, concentrating them on smaller forest fragments that are less able to supply fuelwood and fodder at sustainable rates.[8]

The value of global trade in forest products has risen steadily over the last few decades, climbing from $29 billion in 1961 to $139 billion in 1998. (See Figure 2–2.) Recent years have seen particularly rapid growth in trade in more finished types of forest products such as plywood, pulp, and paper. Between 1970 and 1998, exports of wood-based panels increased fivefold in volume, plywood and paperboard exports quadrupled, and exports of sawnwood (a more processed type of wood used in construction) and wood pulp both doubled, according to U.N. Food and Agriculture Organization estimates. Exports of industrial roundwood (raw logs), in contrast, have remained relatively constant. For all products other than logs, exports as a share of total world production increased significantly over this period—an important indication of the growing globalization of the industry. (See Table 2–1.) This growth trend is expected to continue, in response to growing competition, market segmentation, and trade liberalization, among other forces.[9]

Industrial countries are the dominant players in forest

FIGURE 2–2

World Trade in Forest Products, 1961–98



products trade, accounting for roughly 80 percent of the value of both exports and imports. (See Table 2–2.) But developing countries have steadily increased their share of plywood, pulp and paperboard, and other forest products exports over the last few decades. Because most net deforestation today is taking place in a handful of biologically rich tropical countries, forest products exports from these nations have particular significance for global biodiversity loss. Brazil, Indonesia, and Malaysia have all now joined the ranks of the top 10 forest products exporters. But their forests have paid a heavy price for this export success—these three countries alone accounted for some 40 percent of global forest loss during the 1980s and 36 percent of the loss in the first half of the 1990s.[10]

Officially reported trade represents just the tip of the iceberg, as much of the international timber trade is illegal, conducted in the shadows. Bolivia, Brazil, Cambodia,

TABLE 2–1

Trade in Selected Wood and Wood Products, 1970 and 1998

Product	1970 Exports[1] (million)	1970 Exports as Share of Production (percent)	1998 Exports[1] (million)	1998 Exports as Share of Production (percent)
Wood Pulp	17	17	34	21
Paper and Paperboard	23	18	90	31
Industrial Roundwood	94	7	85	6
Plywood	5	15	21	40
Sawnwood	57	14	114	27
Wood-Based Panels	10	14	53	34

[1]All units in cubic meters except wood pulp and paper and paperboard, which are in tons.

SOURCE: Worldwatch Institute, based on data in U.N. Food and Agriculture Organization, *FAOSTAT Statistical Database*, electronic database, <apps.fao.org>, viewed 22 October 1999.

Cameroon, Ecuador, Georgia, Ghana, Indonesia, Kenya, Laos, Mexico, Paraguay, the Russian Federation, Thailand, and Viet Nam are among the countries where illegal trade in timber plays an important role in the decimation of forests.[11]

For many years now, companies from countries with depleted forests have been turning their chain saws loose overseas. European firms, for instance, have long been active in Africa: in the early 1980s, some 90 percent of logging operations in Gabon were foreign-owned, as were some 77 percent of those in Congo, nearly 90 percent of those in Cameroon, and virtually all of those in Liberia. At least 17 European companies were operating in Côte d'Ivoire alone

TABLE 2–2

Top 10 Exporters and Importers of Forest Products by Value, 1998

Country	Exports (billion dollars)	Share of World Total (percent)
Canada	25	18
United States	18	13
Finland	11	8
Germany	10	7
Sweden	10	7
Indonesia	5	4
Austria	4	3
Malaysia	4	3
Russian Federation	3	2
Brazil	3	2
World	139	100

Country	Imports (billion dollars)	Share of World Total (percent)
United States	24	16
Japan	17	12
Germany	11	8
United Kingdom	10	7
Italy	9	6
China	9	6
France	7	5
Canada	5	3
Netherlands	5	3
South Korea	4	3
Hong Kong	4	3
World	148	100

SOURCE: Worldwatch Institute, based on data in FAO, *FAOSTAT Statistical Database*, electronic database, <apps.fao.org>, viewed 22 October 1999.

in 1990, and they have shown no sign of letting up in recent years. Japanese firms, for their part, joined forces with local companies in the 1970s and 1980s to decimate the forests of Southeast Asian countries such as Indonesia and Malaysia.[12]

With their own forests greatly reduced, logging companies from Indonesia, Malaysia, and elsewhere in Asia have themselves begun investing abroad. Asian companies have in recent years purchased vast timber concessions in Africa, Asia, and North and South America that threaten some of the world's last remaining untouched forests. Brazil, Cameroon, the Democratic Republic of Congo, Guyana, Papua New Guinea, and Suriname are among the countries that have sold foreign investors the rights to log large tracts of primary forests—often at prices that do not reflect the marketplace value let alone the ecological worth of these areas. Some of the companies involved have a long record of catastrophic environmental destruction as well as corruption—a fact that does not bode well for the countries that extended the welcome mat.[13]

International companies are also stepping up their investments in related wood-products industries such as sawmills and pulp and paper operations that feed off of steady streams of locally supplied wood. Some 15 U.S. wood-products companies have set up shop in Mexico since the North American Free Trade Agreement was ratified in 1994. And in Argentina, Brazil, Chile, China, and Indonesia, multinational companies have joined forces with local investors to produce wood chips and pulp and paper at mills supplied by vast monoculture tree plantations that are being planted at a rapid rate. Japanese companies are major players in this business, with pulp and paper operations located in Australia, Canada, Chile, China, and Papua New Guinea, among other places.[14]

A controversial proposed World Trade Organization agreement on liberalizing trade in forest products could add to the pressures that global commerce is placing on the

world's forests. Under the agreement now being considered, most industrial countries would eliminate tariffs on pulp and paper by 2000, and on wood and other forest products such as furniture by 2002. Developing countries would be given an additional two years to meet these terms. The precise effects of these steps are difficult to predict, but studies suggest that the higher prices paid to producers as a result of tariff reductions will boost production in some countries. A recent U.S. government report concluded that the agreement would likely increase production by nearly 3 percent in Malaysia and over 4 percent in Indonesia, although the report also forecasts production declines in some countries, including Mexico and Russia. With so little of today's timber industry based on sustainable practices, production increases often translate into increased forest destruction.[15]

Although the proposed accord would initially take aim only at tariffs, its scope might well be expanded later to include so-called nontariff barriers to trade. Over the longer term, these provisions might pose an even greater threat to the health of the world's forests, and to the diversity of species that inhabit them. For instance, forest certification initiatives aimed at creating a market for sustainably harvested timber could run head-on into WTO rules in the years ahead. A recent report by Asia-Pacific Economic Cooperation, a regional trade grouping, flagged a number of important forest protection policies as potential nontariff trade barriers, including a ban on logging in China's upper Yangtze basin that was instituted in response to recent catastrophic flooding in the region.[16]

MINING THE EARTH

Mining and petroleum development also threaten the health of the world's forests, mountains, waters, and other sensitive ecosystems. Mining exacts enormous environmental costs,

ranging from the destruction of huge tracts of land to the generation of prodigious quantities of pollution and waste. For every kilogram of gold produced in the United States, for example, some 3 million kilograms of waste rock are left behind. Prime extraction sites are often located in previously undisturbed forests or wilderness areas. According to the World Resources Institute, mining, energy development, and associated activities represent the second biggest threat to frontier forests after logging, affecting nearly 40 percent of threatened forests.[17]

Besides disturbing valuable ecosystems, mining also can be devastating for local people: by one estimate, 50 percent of the gold produced in the next 20 years will come from indigenous peoples' lands. Toxic byproducts of mining poison the rivers that local people drink from, and the mining operations themselves destroy the forests and fields that provide sustenance.[18]

Industrial countries are the main consumers of minerals, accounting for nearly 100 percent of nickel imports, more than 90 percent of bauxite imports, over 80 percent of zinc imports, and roughly 70 percent of copper, iron, lead, and manganese imports. But it is developing countries that are the main exporters of mineral resources, and that are most at risk from the associated environmental damage. Collectively, developing countries account for 76 percent of all exports of bauxite and nickel ore, 67 percent of copper, 54 percent of tin, and 45 percent of iron ore.[19]

In recent years, minerals exploration has slowed in traditional mining countries while picking up in many parts of the developing world. From 1991 to 1999, spending on exploration for nonferrous metals more than tripled in Latin America and grew slightly in Africa and in the Pacific region, while declining steeply in North America. Nearly 30 percent of spending on mineral exploration currently takes place in Latin America, now the leading region, up from just 11 percent in 1991. (See Table 2–3.)

The U.S. mining industry blames environmentalists for the migration, arguing that tighter environmental regulations have made domestic mining a difficult and expensive proposition. More significant is the fact that host countries are inviting international investors in with open arms; some 70 countries have rewritten their national mining codes in recent years with the aim of encouraging investment. Yet few are devoting similar energy to strengthening environmental laws and enforcement.[20]

Like mining companies, multinational oil and gas firms continually scour the planet for new development opportunities, as the most accessible fields in industrial countries have already been tapped. More than 90 percent of known

TABLE 2–3

Worldwide Metals Exploration Spending, by Location, 1991 and 1999[1]

Region	1991		1999	
	Amount (million dollars)	Share (percent)	Amount (million dollars)	Share (percent)
Latin America	200	11	630	29
North America	771	41	450	21
Australia	353	19	404	19
Africa	315	17	323	15
Pacific Region	125	7	175	8
Rest of World[2]	82	4	182	8
Total[3]	1,846	100	2,170	100

[1]Includes precious, base, and other non-ferrous hard-rock metals; based on the budgets of major mining companies that represent 81 percent of worldwide metals exploration spending. [2]Includes Europe, former Soviet Union, Middle East, and Asia (excluding Pacific nations). [3]Share columns may not add up to 100 percent due to rounding.

SOURCE: Metals Economic Group (MEG), *Strategic Report* (Halifax, NS, Canada: November/December 1991); MEG, "A 23% Decrease in 1999 Exploration Budgets," press release (Halifax, NS, Canada: 20 October 1999).

oil reserves and nearly 60 percent of natural gas reserves are located in the developing world. The Middle East is still the dominant region for oil and gas, but the major companies are also increasingly striking deals—and oil—in the Central Asian republics, deep in the South American rainforest, and off Asian and West African shores. As with mineral extraction, the environmental and social costs are high when previously remote and pristine areas are opened up to development.[21]

HARNESSING NATURAL WEALTH

There can be little doubt that globalization has accelerated the unprecedented loss of biological riches in recent decades. But this tragic connection is not immutable. A variety of alternative policies and practices now being tried around the world could be scaled up to create a global economy that nurtures rather than decimates natural wealth.

One promising approach is to harness consumer power on behalf of environmental change. The last few years have seen a flurry of activity aimed at encouraging more sustainable timber harvesting through certification and eco-labeling programs. The pioneer in these efforts is the Forest Stewardship Council (FSC), an independent body established in 1993 to set standards for sustainable forest production through a cooperative process involving timber traders and retailers as well as environmental organizations and forest dwellers. Although certified timber currently accounts for only a small share of all timber production, demand for this product is growing fast, as is the number of certified forestlands. As of late 1999, FSC-accredited bodies had certified some 17 million hectares of forest, up from only 1 million hectares in late 1995. More than 70 percent of all certified forests are located in just three countries—Sweden, Poland, and the United States. But certified forests can be found in

30 countries overall, including Brazil, Canada, Malaysia, and the Solomon Islands. In 1998, the World Bank entered into a partnership with the World Wildlife Fund aimed at boosting the number of hectares of independently certified forests to 200 million worldwide (100 million each in the tropical and temperate regions) by 2005.[22]

Another strategy for preserving forests while providing a livelihood to those who live in them is to promote trade in nontimber forest products such as nuts, rattan (palm stems used for wicker furniture and baskets), rubber, and spices. International trade in these products is already substantial—some $11 billion annually, according to the U.N. Food and Agriculture Organization. Although there is no guarantee that alternative forest products will be harvested sustainably, they are more likely to be than timber. This approach was first pursued by Brazil's rubber tappers, who have worked to attain rights to "extractive reserves" where these nontimber forest products can be produced on a sustainable basis and sold to companies like Ben and Jerry's and The Body Shop, which derive environmental cachet for their products by their association with this cause.[23]

Carefully controlled tourism is another possible means for channeling funds into the preservation of threatened ecosystems, although without care it can also be a quick route toward their destruction. International tourism has climbed rapidly in recent decades, as air travel has become steadily cheaper, disposable income and leisure time have grown, and tourist destinations have generally become more accessible. In 1950 there were 25 million international tourist arrivals worldwide. By 1998 this number had grown 25-fold, to 635 million. The World Tourism Organization projects that international arrivals will reach 1.6 billion by 2020, an increase of 250 percent over 1998. "Nature tourism" is one of the fastest-growing segments of the industry—accounting for some 40–60 percent of the total,

depending on how it is defined. The tourism group projects that the trendiest vacation destinations in the new millennium will be "the tops of the highest mountains, the depths of the oceans, and the ends of the Earth."[24]

The growing reach of international tourism threatens to put great strains on sensitive environments, and to contribute to the erosion of threatened cultures. The number of countries offering whale watching excursions, for example, has grown from 10 to 65 in the past two decades, and more than 5 million tourists participate in the activity each year. But these excursions, which often advertise whale "petting" as well as viewing, have contributed to the disturbance and harassment of whale populations in their traditional breeding sites, including the warm waters off Baja California, Argentina, and the Canary Islands. Similarly, ecotourism activity in remote regions of Venezuela has led to conflicts between tour operators and indigenous communities, who claim that tourist camps are pushing them from their customary lands. And all too often the economic benefits accrue to international investors and national treasuries rather than to local people.[25]

Yet a number of countries have succeeded in harnessing revenues from tourism in a way that allows wildlife and wild places to pay their own way, bringing in much needed income for impoverished people. Costa Rica is a case in point. The country's moist cloud forests, sandy beaches, and dry deciduous forests have made tourism the top foreign exchange earner, surpassing traditional export mainstays such as bananas and coffee. The Costa Rican government is working to ensure that this tourism is carried out in an environmentally friendly and culturally sustainable manner through its Certification for Sustainable Tourism program, which categorizes and rates hotels and tourism providers according to how responsibly they operate. And several African nations, including Zimbabwe and Rwanda, have

successfully funneled wildlife tourism income to local people, thereby giving them a stake in wildlife preservation.[26]

"Bioprospecting" is another possible strategy for making the preservation of biological diversity pay. Drug and seed companies have long used the genetic diversity of the developing world to create new products. Yet even when a traditional crop variety proves essential for breeding a new line of seeds, or when a wild plant yields a valuable new drug, corporations have rarely paid anything for access to the resource. The Convention on Biological Diversity signed at the Earth Summit in 1992 gives nations the right to charge for access to genetic resources, and it allows them to pass national legislation setting the terms of any bioprospecting agreements. One of the goals of these provisions was to make it more profitable for biologically rich countries to preserve their natural wealth than to destroy it. Looming in the background were rapid advances in biotechnology, which relies on a rich natural storehouse of genetic material and could thus boost bioprospecting returns substantially.[27]

A year before the Earth Summit, Merck and Company, one of the world's largest pharmaceuticals firms, and Costa Rica's Instituto Nacional de Biodiversidad (INBio) reached a precedent-setting bioprospecting agreement roughly along the lines of the arrangement subsequently envisioned in the biodiversity treaty. Merck agreed to pay INBio $1.135 million in support of conservation programs in exchange for access to the country's plants, microbes, and insects, as well as royalty payments when any discovery makes its way into a product. Though widely hailed as an important step forward, the agreement has also generated substantial controversy. Its critics question whether or not the royalty rate was set at a fair level, and the extent to which the economic benefits will reach the local peoples whose knowledge of medicinal properties is so central to making the deal work.[28]

It remains to be seen how much of a growth industry bio-

prospecting will prove to be. Some observers argue that the large number of samples that need to be screened to yield a commercially valuable product makes the cost of bioprospecting prohibitive for the private sector. It is also possible that scientific advances such as new chemical techniques that enable molecules to be synthesized in laboratories will reduce the pharmaceutical industry's reliance on natural storehouses.[29]

Nonetheless, a number of other bioprospecting programs are now taking shape—some of which offer more equitable models for the distribution of revenues than the INBio venture. A bioprospecting initiative in Suriname, for instance, involves a number of different partners, including indigenous healers, a Surinamese pharmaceutical company, the U.S.-based Bristol-Myers Squibb company, the environmental group Conservation International, and the Missouri Botanical Garden. Royalties from any drugs developed will be channeled into a range of local institutions, including nongovernmental organizations, the national pharmaceutical company, and the forest service. In addition, a Forest Peoples Fund has been established to support small-scale development projects that benefit local indigenous peoples.[30]

Some countries are also trying to put a price tag on another valuable service provided by standing forests—absorbing and storing carbon. A hectare of moist tropical primary forest in Brazil can hold over 300 tons of carbon, while a hectare of mature Douglas fir forest in Canada can retain over 600 tons. Under the Kyoto Protocol to the climate change treaty (see Chapter 6), countries may be permitted to in effect charge for this service by selling carbon permits to companies or countries interested in offsetting their own carbon emissions with forest preservation projects.[31]

A number of experiments with this approach have already been launched. For example, in January 1997 Costa Rica sold some credits for 200,000 tons of carbon at a price

of $10 per ton to the Norwegian government, a consortium of Norwegian companies, and a Chicago-based trading company. The proceeds are being channeled into forest regeneration and protection programs. Some analysts estimate that carbon offset projects could eventually generate tens of billions of dollars annually for forest preservation.[32]

But complicated technical issues must still be resolved if trading in carbon sequestration is to prove meaningful and practical as a strategy for combating climate change. Many all-important details of the Kyoto Protocol are still under negotiation. As currently written, the protocol offers credits for carbon sequestered by planting forests, but does not require debiting for carbon released into the atmosphere as a result of commercial timber operations unless the logging results in the permanent conversion of forestland to other uses. The protocol also does not currently distinguish between monoculture tree plantations and biologically rich natural forests. In a worst-case scenario, the protocol could thus provide a perverse incentive for countries to harvest natural forests and replace them with uniform plantations.[33]

Putting a price tag on nature can help create an incentive to preserve it. But the value of intact ecological systems is in the end beyond measure. Creating a global economy that protects rather than destroys natural wealth is both a moral imperative and a practical necessity as we enter the new century.

CHAPTER 3

THE BIOTIC MIXING BOWL

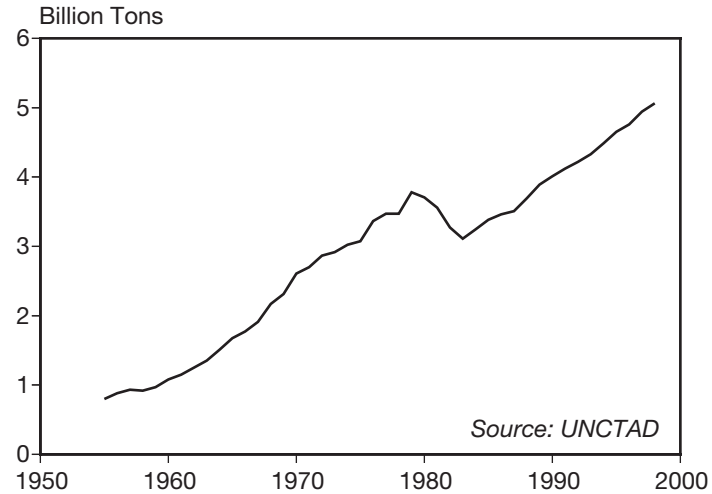
For most of history, natural boundaries such as mountains, deserts, and ocean currents have served to isolate ecosystems and many of the species they contain. But these physical barricades are now becoming permeable as people and organisms spread around the globe, leading to ecological disruptions with damaging and unpredictable consequences.

Ecological integration has accelerated dramatically in recent decades, as trade and travel have skyrocketed. More than 5 billion tons of goods were shipped across the world's oceans and other waterways in 1998, more than six times as much as in 1955. (See Figure 3–1.) International air travel is also soaring. More people are flying greater distances than ever before, with 2 million people now crossing an international border every day. Since 1950, the number of passenger-kilometers flown has increased at an average annual rate of 9 percent, reaching over 2.6 trillion in 1998. (See Figure 3–2.)[1]

The rapid growth in the movement of human beings and their goods and services around the world has provided convenient transportation for thousands of other species of

FIGURE 3–1

International Seaborne Trade, 1955–98



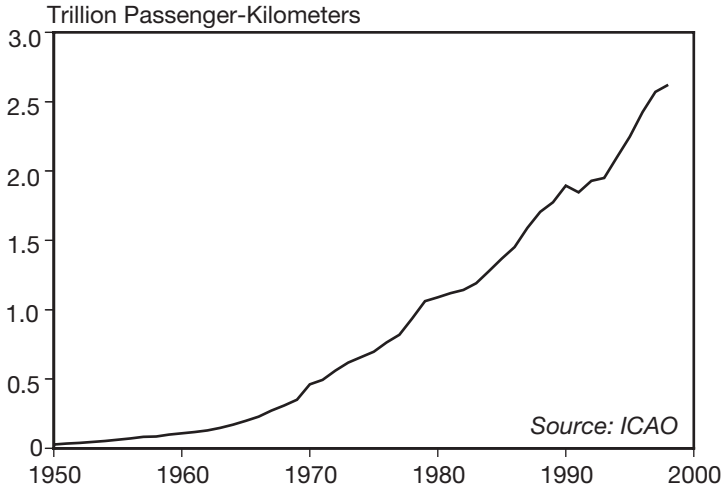
plants and animals that are now taking root on foreign shores. This explosion in the movement of species and microbes across international borders poses a major threat to both the planet's biological diversity and the health of its human inhabitants.[2]

THE BIOINVASION THREAT

The world community is just beginning to awaken to the pervasive danger posed by the spread of non-native "exotic" species, a process dubbed bioinvasion. Once exotics establish a beachhead in a given ecosystem, they often proliferate, suppressing native species. Invasive species are a major threat to the diversity of life on Earth. Nearly 20 percent of the world's endangered vertebrate species are threatened by exotics, and almost half of all species in danger of extinction in the United States are imperiled at least in part by non-native species.[3]

FIGURE 3–2

World Air Travel, 1950–98



Ballast water from international shipping is a major culprit in the spread of aquatic species. On any given day, some 3,000–10,000 aquatic species are moving around the world in ship ballasts. When the ballast water is discharged, so are the organisms, after which they often cause incalculable damage. For example, a ballast water–induced invasion of the Black Sea by the Atlantic jellyfish in the early 1980s was instrumental in the collapse of the fisheries there by the end of that decade.[4]

The U.S. Great Lakes have also been hard hit by bioinvasions over the last several decades. A recent villain is the zebra mussel, which probably originated in the Caspian Sea and was likely first released into the Great Lakes from a ship's ballast water tank in the mid-1980s. Zebra mussels have now spread widely throughout the lakes and other waterways of eastern North America, where they have wreaked havoc with delicate ecological systems by ingesting

large quantities of algae—a fundamental component of aquatic food webs. Zebra mussels also multiply rapidly, clogging water intake pipes and encrusting aquatic infrastructure and boats. The associated economic losses are enormous—they are expected to add up to a cumulative figure of at least $3.1 billion within the next few years.[5]

Terrestrial ecosystems are no less at risk. The damage wrought by the pesticide-resistant whitefly is a warning of the high stakes involved. The whitefly caused tens of billions of dollars of agricultural damage in California in the early 1990s before moving on to South America, where it has helped spread crop viruses that led to the abandonment of more than 1 million hectares of cropland. In the United States, the aggressive purple loosestrife plant has become a widely known symbol of the broader threat. It is thought to have first been accidentally introduced into North America in the late eighteenth century in wool imports and solid ship ballast, and then deliberately imported for ornamental and likely for medicinal purposes during the nineteenth century. Today, it has taken over more than 600,000 hectares of temperate and boreal wetland, crowding out native vegetation that is used by wildlife for food and shelter.[6]

The bioinvasion problem cries out for an international response. Among the steps that could be taken are inspections, limits on ballast water discharges, and the adoption of a precautionary approach that prohibits the knowing introduction of exotic species unless they have been shown to be benign. Some 23 different international treaties make at least some mention of exotic species, including the 1951 International Plant Protection Convention, the 1982 Law of the Sea, and the 1992 Convention on Biological Diversity. Although many of these agreements are quite weak, some of them include important commitments. The 1959 Antarctic Treaty, for one, banishes all exotics from the region unless they are specifically listed on an annex of exceptions or the bearer is

granted an import permit. Besides legally binding treaties, a range of "soft law" instruments such as codes of conduct and action plans also address the bioinvasion threat.[7]

Tougher international agreements are needed to address this problem adequately, yet any accord stringent enough to alter today's rising tide of biotic mixing could run into conflicts with world trade rules. In what may be a foreshadowing of controversies to come, the Chinese government (which is not yet a member of the World Trade Organization, although it hopes to join soon) has complained that a ban imposed by the United States in late 1998 on the import of goods in untreated wooden packing crates amounts to an unfair trade barrier. The U.S. government imposed the ban after determining that Chinese packing crates were a primary culprit in the recent introduction of the voracious Asian long-horned beetle, an invasive insect that poses a major threat to the health of U.S. hardwood forests. The European Union recently placed similar restrictions on Chinese packaging, while China in turn limited the use of U.S. and Japanese crates made from coniferous trees after discovering wood-eating worms in some of them.[8]

TRADING IN WILDLIFE

Although habitat loss and the introduction of invasive species are the world's leading causes of diminishing biological diversity, for some species that are particularly prized on the international market—such as the tiger and the black rhinoceros—trade in the species itself is a major threat.[9]

The global trade in wildlife is a booming business. Each year, some 40,000 monkeys and other primates are shipped across international borders, along with some 2–5 million live birds, 3 million live farmed turtles, 2–3 million other live reptiles, 10–15 million raw reptile skins, 500–600 million ornamental fish, 1,000–2,000 raw tons of corals, 7–8 million cacti, and 9–10 million orchids. China, Europe, Japan, parts of Southeast Asia, and the United States are major consumers of wildlife and associated products for use as pets, in zoos, as clothing and ornamentation, and in medicine and horticulture. The wildlife trade is valued at some $10–20 billion annually, at least a quarter of which is thought to be illegal.[10]

Governments took an important step toward controlling the wildlife trade with the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which 146 countries are now party to. This convention bans trade (with a few narrow exceptions) in more than 800 species in danger of extinction, such as the giant panda, Asian and African elephants, rhinos, sea turtles, and many species of monkeys, birds of prey, parrots, lizards, crocodiles, orchids, and cacti. Through a requirement for export permits, it also restricts trade in some 29,000 other species that are at risk of becoming threatened. This category includes hummingbirds, birds of paradise, black and hard corals, and birdwing butterflies. CITES is generally credited with substantially reducing trade in many threatened species, including gorillas, chimpanzees, cheetahs, leopards, and crocodiles.[11]

In one notable though controversial case, the members of CITES agreed to ban trade in ivory in 1990 in the face of rapidly declining elephant populations. Poaching declined dramatically after the ban, and many elephant populations have begun to recover. But several southern African states with good track records in elephant protection have long objected to the ban. These countries argue that limited and regulated ivory trade can in fact create an incentive to protect rather than decimate elephants, as it enables elephants to "pay their own way" in countries where elephants and impoverished peoples are often on a collision course.[12]

In response to pressure from these countries, CITES

members agreed in 1997 to allow for a limited one-time trade in stockpiled ivory between Japan and Botswana, Namibia, and Zimbabwe. This sale took place in the spring of 1999. It was intended as an experiment that, if successful, might pave the way for a broader resumption of controlled ivory commerce. But critics worry that allowing any trade at all will open a Pandora's box, fueling resumed poaching. Preliminary indications are that poaching is in fact on the rise. Elephant poaching in Kenya reportedly has increased fivefold since the ban was lifted. Zimbabwe has also experienced an upsurge in poaching, with at least 84 elephants slaughtered in 1999.[13]

Despite some notable CITES successes, unchecked trade in many threatened species continues apace. Nearly half of the world's turtle species face possible extinction, due in large part to the growing demand for turtles for both food and medicinal ingredients. In China, where turtles are thought to confer wisdom, health, or longevity, certain species now fetch up to $1,000 apiece. Many of the turtles sold in China actually originated in Viet Nam, Bangladesh, and Indonesia, as well as in the United States.[14]

The United States has become a major center of reptile trafficking in recent years—both legal and illegal. More than 2.5 million live reptiles were brought into the country in 1995, and in 1996 some 9.5 million reptiles were exported or re-exported, mainly to Europe and East Asia, according to estimates by TRAFFIC, a nonprofit wildlife trade monitoring group. Species such as the Komodo dragon lizard of Indonesia, the plowshare tortoise of northeast Madagascar, and the tuatara (a small lizard-like reptile from New Zealand) reportedly sell for as much as $30,000 each on the U.S. black market.[15]

On the other side of the world, Yemen is a major importer of African rhinoceros horn, which is sought after for use in the handles of traditional daggers known as *jambiyas*. TRAFFIC estimates that at least 75 kilograms of rhino horn were smuggled into Yemen each year from 1994 to 1996, and that horns from more than 22,000 rhinos may have been imported into the country since 1970. Fewer than 10,000 rhinos now remain in the wild in Africa, down from 70,000 in 1970.[16]

Wildlife trade is becoming a globally integrated industry, with air travel making it possible for popular pet species to be bred far from their native ranges, and then flown to pet stores on the other side of the world. When these exotics escape to the outside world, as they inevitably do, they can cause considerable damage to local ecological systems. Aquarium fish are one of the biggest culprits, but reptiles are also often complicit in biological pollution. A turtle known as the red-eared slider accounts for more than 80 percent of all reptile exports from the United States. Conservationists worry that turtles introduced for both pets and food will outcompete native turtle species in many parts of the world, particularly in East and Southeast Asia.[17]

MICROBES ACROSS BORDERS

In the first centuries of the Roman empire, growing commerce between Mediterranean civilizations and Asia precipitated the "great plague" of A.D. 165. Believed to have been smallpox, this epidemic claimed the lives of a quarter of the population of the Roman empire. In the fourteenth century, bubonic plague swept through Europe—the "Black Death." This epidemic, to which a third of Europe's population succumbed, was introduced into China as the Mongol empire expanded across central Asia, and from there spread by caravan routes to the Crimea and the Mediterranean.[18]

As the twenty-first century begins, the process of globalization is dramatically accelerating the pace at which microbes travel the globe. As the late AIDS researcher

Jonathan Mann of Harvard University explained, "The world has rapidly become much more vulnerable to the eruption and…to the widespread and even global spread of both new and old infectious diseases. This new and heightened vulnerability is not mysterious. The dramatic increase in worldwide movement of people, goods, and ideas is the driving force behind the globalization of disease." Only by looking out for the health of people everywhere is it now possible to promote healthy societies anywhere.[19]

The rapid growth in international air travel is a particularly potent force for global disease dissemination, as air travel makes it possible for people to reach the other side of the world in far less time than the incubation period for many ailments. At the same time, adventure tourism and other pursuits are drawing people to ever more remote locations, increasing the chance that microbes will be introduced to vulnerable populations.[20]

Environmental degradation is another powerful contributor to many of today's most pressing global health threats. The World Health Organization (WHO) estimates that nearly a quarter of the global burden of disease and injury is related to environmental disruption and decline. For certain diseases, the environmental contribution is far greater. Some 90 percent of diarrheal diseases such as cholera, which kill 3 million people a year altogether, result from contaminated water. And 90 percent of the 1.5–2.7 million deaths caused by malaria annually are linked with underlying environmental disruptions such as the colonization of rainforests and the construction of large open-water irrigation schemes, both of which increase human exposure to disease-carrying mosquitoes. A recent analysis by Cornell University ecologist David Pimentel and his colleagues reached an even starker conclusion—that some 40 percent of all deaths worldwide are attributable to environmental decline.[21]

When globalization and environmental decline join

forces, the health implications can be staggering. The power of this combination is demonstrated by the tragic history of the AIDS pandemic. As of 1999, the HIV virus had infected 50 million people worldwide, killing more than 16 million of them. In particularly hard hit countries in Africa, as much as a quarter of the population harbors the virus.[22]

The epidemic initially came to light at roughly the same time in the early 1980s in Africa, the Caribbean, and North America. The question of where the virus had originated was politically charged, with WHO skirting the issue for many years by maintaining that the virus had emerged simultaneously on at least three continents. "Few scientists accepted that position, recognizing it for what it was—a political compromise," notes author Laurie Garrett in her book *The Coming Plague*. "If humanity hoped to prevent its next great plague, it was vital to understand the origins of this one." In the last few years, scientists have made important strides toward getting to the bottom of this controversial question.[23]

It is now widely believed that HIV was originally harbored in chimpanzees inhabiting the West African rainforest, crossing over into human populations as early as the 1940s. Although exactly how this occurred will never be known, scientists speculate that it resulted from hunters cutting themselves while harvesting their kill, or perhaps through the direct consumption of raw meat. The epidemic thus may have had its origins in intermingling between humans and chimpanzees as a result of human incursion into previously remote forests. According to a theory put forth by Jaap Goudsmit of the University of Amsterdam, the decline in chimpanzee populations resulting from the human invasion might have created a biological imperative for the simian immunodeficiency viruses (SIV) to seek out new hosts—humans.[24]

Scientists believe that saving Africa's imperiled chimpanzees may be crucial for discovering a way to stave off the

deadly HIV infection in humans, as the chimpanzees are immune from HIV's most lethal effects. But Africa's primates are under siege, with many on the verge of extinction. One major threat is the thriving "bushmeat" trade. As logging roads penetrate remote forests, loggers and hunters snare chimpanzees, gorillas, monkeys, bush pigs, snakes, and other prey. They either eat the meat themselves or transport it to West African cities, where bushmeat is considered a delicacy. "These chimps are information we need," warns Dr. Beatrice Hahn of the University of Alabama, who led a team that recently confirmed the link between AIDS and chimps. "Killing them for the pot is like burning a library full of books you haven't read yet."[25]

Another major outstanding question related to the origins of the AIDS epidemic is how HIV, once it was transferred from chimps to humans, made the leap from being an isolated condition confined to Africa's remote hinterlands to its current status as a global pandemic. Although many links in this chain are unknown, a range of phenomena are thought to have contributed, including warfare near the region from which the virus is thought to have first emerged; the paving of the TransAfrica highway, which provided an easy route for carrying HIV across the continent; population growth and urbanization; and, ultimately, burgeoning international travel and migration.[26]

As the movement of people into remote parts of West Africa's forests continues to pick up speed thanks to logging and hunting, scientists warn that other dangerous viruses may make the jump from primates to people. An even broader issue is at stake as well. "AIDS is trying to teach us a lesson," noted Jonathan Mann. "The lesson is that a health threat in any part of the world can rapidly become a health threat to many or all."[27]

Numerous other urgent global health challenges loom. Over the past two decades, more than 30 infectious diseases

have been identified in humans for the first time, including AIDS, Ebola, Hantavirus, and hepatitis C and E. In a recent case that aroused widespread concern in the United States, health experts confirmed in October 1999 that at least five people in New York City and surrounding areas died from a new strain of the African West Nile virus, a rare mosquito-borne disease never before seen in the western hemisphere. They attribute the emergence of the disease to the steady rise in international trade and travel, concluding that the disease was transmitted either by a smuggled exotic bird or by an infected human who carried it into the country from abroad.[28]

Environmental disruption is also a potent contributor to today's microbial migrations. According to WHO, "environmental changes have contributed in one way or another to the appearance of most if not all" of the newly emerging diseases. Land use changes such as deforestation or the conversion of grasslands to agriculture that alter long-established equilibria between microbes and their hosts are sometimes to blame. In other cases, changes in human behavior are the culprit, such as careless disposal of food and beverage containers or car tires, which can create new breeding sites for disease-carrying organisms such as mosquitoes. Movements of pathogens themselves or the organisms that carry them are also sometimes the cause.[29]

An added problem is the reemergence of microbes thought to have been vanquished in some parts of the world. Cholera's reappearance in Latin America is a case in point. Until 1991, there had been no epidemic outbreaks of this deadly disease in this region for nearly a century. But the disease erupted with a vengeance in Peru that year, ultimately infecting some 322,000 people and killing at least 2,900 of them. The outbreak was catastrophic for the country's economy, causing importers to ban Peruvian fish and fruit from their markets, and tourists to avoid the country. All told, the

economic costs to Peru's economy added up to $770 million—almost one fifth of normal export earnings. The outbreak quickly spread beyond Peru, contaminating the water supply of every country on the continent but Paraguay and Uruguay before it gradually wound down two years later. Across the Americas, the disease infected more than a million people and killed 11,000 during the first half of the 1990s.[30]

Scientists are trying to understand why cholera is now reemerging with such force. A number of factors seem to be at work. One theory is that the cholera bacteria was discharged from the ballast water of ships arriving in Peruvian ports from South Asia. Poor sanitation also undoubtedly played a major role, as cholera is often spread by contact with food or water that has been contaminated by human waste containing the bacteria. Another theory is that El Niño may have contributed to the outbreak by causing warmer ocean temperatures that encourage large blooms of plankton that can harbor the organism.[31]

If El Niño was in fact a key piece of the puzzle, then the cholera epidemic of the early 1990s was likely just a harbinger. Scientists project that climate change will lead to a surge in infectious diseases, both by increasing the range of disease-carrying organisms and by inducing a growing numbers of extreme weather events such as floods and hurricanes, which tend to leave epidemics in their wake. "There are strong indications that a disturbing change in disease patterns has begun and that global warming is contributing to them," notes Paul Epstein, Associate Director of Harvard Medical School's Center for Health and the Global Environment.[32]

Already, dengue fever and malaria both appear to be expanding their reach northward into cooler climates—locally contracted cases of malaria have been reported in recent years in Florida, Georgia, Texas, Virginia, New York, New Jersey, Michigan, and even Ontario. The record number

of extreme weather events experienced in 1998 exacted a heavy toll on human health. Epstein reports that heavy flooding in East Africa led to large increases in the incidence of malaria, Rift Valley fever, and cholera; that delayed monsoons in Southeast Asia contributed to the region's wildfires, causing widespread respiratory ailments; and that Central American countries slammed by Hurricane Mitch experienced an increase in cholera, dengue fever, and malaria.[33]

Although the global interdependence of human and ecological health is creating frightening vulnerabilities, it is also generating an imperative for countries of the North and South to work together to confront shared perils.

Faced with raging transcontinental epidemics of cholera and plague in the mid-nineteenth century, European governments convened 12 International Sanitary Conferences between 1851 and World War I that forged a series of international health agreements covering issues such as quarantines, trade restrictions, and procedures for disease notification and inspection. In 1946, these and later efforts culminated in the creation of the World Health Organization, which has had a number of important successes in its first half-century, perhaps most notably the eradication of smallpox in 1977.[34]

This system provides a firm foundation on which to build the new biological controls needed to protect people and ecosystems from the introduction of disruptive exotic species and diseases. Although economic globalization dominated headlines at the close of the twentieth century, ecological integration may pose even greater challenges for international cooperation in the decades ahead.

Chapter 4

GLOBAL GROCERS

On New Year's Day 1994, a ragtag group of rebels calling themselves the Zapatista National Liberation Army took control of large areas of the impoverished Mexican state of Chiapas. Their armed rebellion was to protest a pattern of economic development that was enriching a few large landowners engaged in coffee production and ranching while denying the state's impoverished majority the land reform once promised by the country's constitution. It was no coincidence that the insurrection occurred on the same day that the North American Free Trade Agreement (NAFTA) entered into force. Among its many other effects, NAFTA was projected to put hundreds of thousands of Mexican peasant farmers out of business by undercutting them with cheaper, subsidized corn from the United States.[1]

The Chiapas uprising was indicative of broader insecurities playing themselves out around the world as a result of sweeping transformations under way in the world's agricultural markets. The last several decades have seen agriculture rapidly transformed in response to both technological change

and economic restructuring. As it becomes a globally integrated enterprise, farmers from poor countries find themselves in direct competition with the mechanized agribusiness of the U.S. Corn Belt. In response to these pressures, traditional small farmers on every continent are rapidly being supplanted by large farms linked to the global marketplace.

Agriculture is integrally linked with the basic human right to food security. It is also an important economic activity in most of the world—in low-income countries, agriculture accounts for an average of 30 percent of economic output and over 60 percent of employment. But agriculture is far more than an economic sector, and food is not just a product like televisions and tires. Agriculture is also "a pillar of rural life, of the environment, of conserving old ways," as a Japanese trade negotiator recently put it. For this reason, today's agricultural upheavals have far-reaching implications for the welfare of billions of people as well as the health of the natural world.[2]

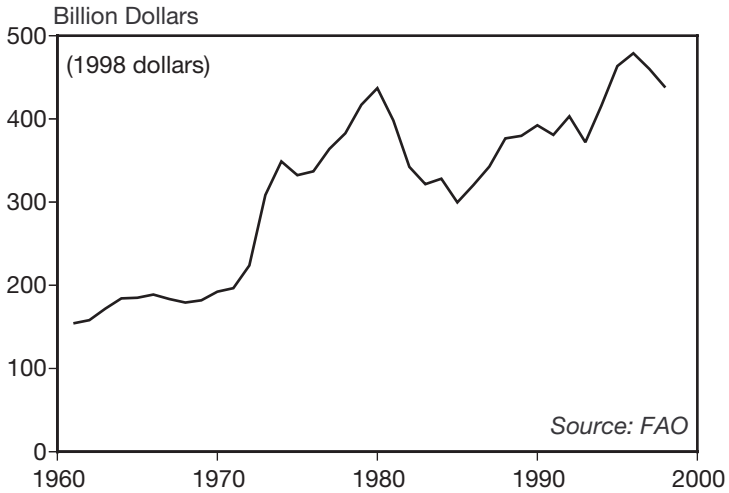
THE AGRICULTURAL TRADE BALANCE

The value of world agricultural trade has soared in recent decades, nearly doubling between 1972 and 1998 alone—from $224 billion to $438 billion. (See Figure 4–1.) Agriculture accounts for 11 percent of the value of all world exports. For some continents, this share is even higher—25 percent of Latin America's exports are agricultural, as are 18 percent of Africa's. Trade in basic food grains such as wheat, rice, and corn dominates international agricultural exports in volume terms, although nonessentials such as flowers, coffee, and sugar dominate in value terms.[3]

Nearly 240 million tons of grain were exported in 1998—some 13 percent of total world production. But global aggregates mask great variations in export and import dependence among countries and regions. Australia, for

FIGURE 4–1

World Exports of Agricultural Products, 1961–98



instance, exports nearly 63 percent of its grain production, and Japan imports 75 percent of its consumption. The U.N. Food and Agriculture Organization (FAO) has identified more than 80 "low-income food deficit countries," which it defines as poor countries that are net importers of food for at least three years in a row. More than half of these countries are in Africa. Collectively, they are home to the majority of the world's chronically undernourished people.[4]

Trade in food is intertwined with the course of human history. As far back as Roman times, grain imports from northern Africa helped sustain the empire. Europe became a net importer of grain during the Industrial Revolution in the nineteenth century, and the United States emerged as its primary breadbasket. By the middle of the twentieth century, North America was exporting 23 million net tons of grain per year, while Western Europe was importing 22 million tons. Asia was also beginning to rely on the grain trade, importing

some 6 million net tons. Over the course of the next few decades, Australia and New Zealand emerged as important exporters, while imports surged in Asia, Eastern Europe and the former Soviet Union, Africa, and Latin America.[5]

During the 1980s, Europe's international grain position was turned on its head as its population stabilized and agricultural production surged in response to new technologies and generous governmental subsidies. For decades a major grain importer, by the early 1990s Western Europe was a net exporter of more than 20 million tons per year. (See Table 4–1.)[6]

The vast majority of internationally traded corn and soybeans is destined for the huge livestock feedlots of the industrial world, as well as for the smaller but growing livestock industries in developing countries. Direct trade in meat is also on the rise. Total meat exports—including beef, chicken, and pork—grew more than sixfold between 1961 and 1998, increasing from 3.5 million to 22 million tons. As with grain, industrial countries dominate the international meat trade: the United States, Canada, Australia, and the countries of the European Union between them account for 70 percent of the total. But a few developing countries are also significant exporters, including Brazil, China, and India.[7]

The developing world is a net importer of basic foodstuffs such as grain and meat, but it is a major exporter of many cash crops, such as bananas, coffee, cotton, soybeans, sugarcane, and tobacco. As of 1998, developing countries accounted for 95 percent of the exports of palm oil, 90 percent of cocoa, 88 percent of coffee, and 85 percent of bananas. Recent decades have seen particularly rapid growth in so-called nontraditional exports—principally flowers, fruits, and vegetables. These crops tend to command far higher prices than traditional agricultural exports, which have been in decline in recent decades. Exports of nontraditional crops

TABLE 4–1

The Changing Pattern of World Grain Trade, 1950–98[1]

Region	1950	1960	1970	1980	1990	1998
			(million tons)			
North America	+ 23	+ 39	+ 56	+125	+101	+ 86
Western Europe	– 22	– 25	– 28	– 7	+ 27	+ 19
Eastern Europe and Former Soviet Union	0	+ 3	0	– 45	– 29	+ 3
Latin America	+ 1	0	+ 6	+ 8	– 1	– 5
Africa	0	– 1	– 4	– 16	– 27	– 38
Asia and Middle East	– 6	– 17	– 33	– 63	– 71	– 81
Australia and New Zealand	+ 3	+ 8	+ 12	+ 12	+ 15	+ 21

[1]Plus sign indicates net exports; minus sign, net imports. Imports and exports do not balance out due to differences in export and import data and lags in shipment times.

SOURCE: Based on Lester R. Brown, *Who Will Feed China?* (New York: W.W. Norton & Company, 1995), derived and updated from U.S. Department of Agriculture, Economic Research Service, *Production, Supply, and Distribution*, electronic database, Washington, DC, November 1994 and December 1999.

from Central America increased in value by an average of 17 percent annually between 1985 and 1992, and exports of these crops from South America (excluding Brazil) increased at 48 percent a year over this period. Chile has pursued this export path with particular abandon. Chilean fruit exports—including table grapes, apples, pears, peaches, avocados, citrus fruits, berries, and melons—rose 16-fold in value between 1994 and 1997 alone. By 1997, they were bringing in $1.6 billion—10 percent of total export earnings.[8]

The average distance that food travels as it makes its way from farm to table has climbed steadily in recent decades as

agriculture has become globally integrated. A study by the London-based National Food Alliance found that food consumed in the United Kingdom on average traveled more than 50 percent further over the last two decades. A small jar of strawberry yogurt eaten in Germany has components that travel more than 3,000 kilometers, according to a report by the Wuppertal Institute. Though the milk is available locally, the strawberries are grown in Poland, and the packaging materials come from Austria and Switzerland.[9]

In the new century, water scarcity will increasingly shape the pattern of the world grain trade. Water shortages have become a major constraint on agricultural productivity in many regions of the world in recent decades, as human numbers have climbed and as agriculture has become increasingly water-intensive owing to the widespread adoption of fertilizer-intensive, high-yielding varieties. Because water itself is difficult and expensive to transport long distances, countries facing water shortages generally import grain rather than water. "With each ton of grain representing about 1,000 tons of water, countries in effect balance their water books by purchasing grain from other countries rather than growing it themselves," explains Sandra Postel of the Global Water Policy Project.[10]

This grain-for-water strategy is workable so long as enough countries have surpluses available to export, and so long as the grain-importing countries have enough foreign exchange to pay the bill. But the large number of countries that are expected to become net grain importers over the next several decades owing to water scarcity, growing populations, and other factors may undermine this assumption. Postel projects that the number of people living in countries where water is sufficiently scarce to necessitate grain imports will climb from about 470 million today to more than 3 billion by 2025, most of whom will live in highly impoverished countries in Africa and South Asia. Growing world demand could

cause food prices to spike, exacerbating social pressures in impoverished food-importing nations.[11]

Despite the difficulty of transporting water internationally, a number of proposals are afoot for ambitious efforts to ship large quantities of water across international borders. In one controversial recent case, the Canadian province of Ontario granted a permit in 1998 to a company called the Nova Group to transport some 600 million liters of Lake Superior water to Asia in bulk tankers. After a storm of protest, the provincial environment ministry revoked the permit. Continued pressure from private companies who want to enter the water export business has led the U.S.-Canadian International Joint Commission to convene public hearings exploring the implications of possible bulk water exports from the Great Lakes.[12]

Concern is rising among Canadian activists that provisions of NAFTA and of the World Trade Organization (WTO) will impede their efforts to restrict large-scale water export schemes. Already, the California-based Sun Belt Inc. has sued Canada under NAFTA, claiming it is entitled to $10.5 billion in compensation for a ban on water exports imposed by British Columbia several years ago. Sun Belt's Canadian partner was one of six companies granted export licenses during a drought in California in the 1980s.[13]

COUNTING ENVIRONMENTAL AND SOCIAL COSTS

Agricultural exports have helped fill foreign-exchange coffers in developing countries, but they have also imposed heavy social and environmental costs. As governments and international lending institutions promote cash crops at the expense of subsistence agriculture, women and the poor often lose out because of their relative lack of access to land, credit, and other resources. And social structures can be severely disrupted as farming communities are broken apart to service large and distant export markets.[14]

The clearing of land for export-oriented cash crops is a major cause of deforestation. Wildfires in Indonesia in recent years were sparked by fires deliberately set to clear land for palm oil and pulpwood plantations. Palm oil exports from Indonesia more than doubled between 1991 and 1997, climbing from 1.4 million to nearly 3 million tons. With the encouragement of the International Monetary Fund, the Indonesian government is planning to boost exports further in the years ahead as part of its strategy for climbing out of economic crisis. (See Chapter 8.) On the other side of the globe, in the Amazon basin, efforts to boost soybean exports have set in motion plans to construct an extensive network of canals, highways, and railroads in order to get the crop to market—principally in Asia and Europe. Environmentalists worry that these projects will fuel further deforestation of the region's unique and diverse ecosystems.[15]

Cash crops are often grown with heavy doses of pesticides, imperiling the health of both agricultural workers and food consumers. Nontraditional exports such as flowers and fruit are doused with particularly high doses of toxic pesticides, in part to meet importers' desires for "blemish-free" produce. The flower industry is the most lethal of all for workers, as flowers are not ingested and are thus not subject to food safety requirements. A study of nearly 9,000 workers at Colombian flower plantations found exposure to 127 different pesticides. Some 20 percent of the pesticides used on these plantations are either banned or unregistered in the United Kingdom or the United States. Two thirds of Colombian flower workers report suffering headaches, nausea, impaired vision, and other symptoms as a result of pesticide exposure, according to the Colombian Human Rights Committee in Washington, DC. Colombia has surpassed California as the principal supplier of roses, carnations, chrysanthemums, and

other flowers to the U.S. market, accounting for two thirds of all fresh-cut flowers sold there today.[16]

Beyond its tragic toll on the health of farm workers, pesticide dependence also poses health risks for importing countries and economic risks for exporters. Between 1984 and 1994, the U.S. Food and Drug Administration detained more than 14,000 shipments of fruits and vegetables from 10 Latin American and Caribbean countries because of excessive pesticide residues, according to a World Resources Institute analysis. The associated economic losses to the exporting countries added up to $95 million.[17]

The global trade in meat also causes environmental destruction. In Central America, the lure of the export market for beef spurred a massive clearing of the rainforest for cattle ranching during the 1960s and 1970s, a period when the region was exporting large amounts of beef to North America to satisfy the U.S. appetite for hamburgers and steak. In Botswana, heavy dependence on beef exports has resulted in land degradation from overgrazing; half of the country's beef production is exported, much of it bound for the European market. And in Somalia, research by ecologist Bruce Byers concluded that rapid growth in exports of sheep, goats, and cattle over the last several decades contributed to a tragic breakdown of the country's traditional, ecologically balanced nomadic system of livestock rearing. The result has been overgrazing, soil erosion, and the degradation of rangelands, all of which diminish the ability of the land to provide sustenance for the Somali people.[18]

FISHERIES AT RISK

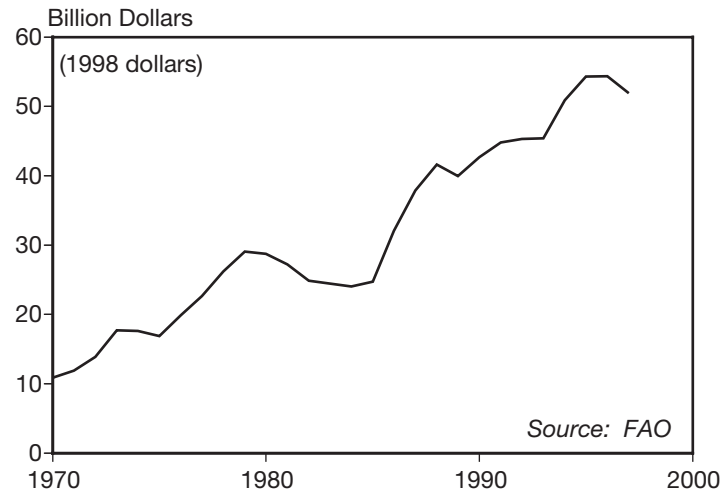
Just as small farmers around the world are threatened by the integration of agricultural markets, many fishing communities are struggling under strains imposed in part by global-

ization. More than 200 million people around the world are economically dependent on fishing in one way or another. And nearly 1 billion people worldwide, most of them in Asia, rely on fish as their primary source of animal protein. But the world's fisheries are under siege as a result of habitat destruction, pollution, and overexploitation, with 11 of the world's 15 major fishing grounds and 70 percent of the primary fish species either fully or overexploited.[19]

The lure of international markets is a driving force behind this growing crisis. Fish exports have climbed nearly fivefold in value since 1970, reaching $52 billion in 1997. (See Figure 4–2.) By volume, nearly half the fish caught today are traded, up from only 32 percent in 1970. Industrial countries dominate global fish consumption, accounting for more than 80 percent of all imports by value. Developing countries, on the other hand, contribute nearly half of all exports. Their share of the total has risen steadily in recent

FIGURE 4–2

World Fish Exports, 1970–97



decades as fleets have turned south in search of fish in response to the overfishing of northern waters. In 1970, developing countries accounted for 37 percent of all fish exports, measured by value; by 1997, their share had risen to 49 percent. Chile, China, Indonesia, and Thailand are all now among the world's top 10 fish exporters. (See Table 4–2.) Exports from these four countries alone quadrupled in value between 1980 and 1997.[20]

The 1982 Law of the Sea treaty granted coastal states the right to control resource development within 200-mile Exclusive Economic Zones off their shores. Subsequent access agreements have spelled out the terms by which foreign fleets could ply distant water. Ships from Europe, Japan, Russia, South Korea, and Taiwan have entered into agreements with African countries to fish for tuna, hake, octopus, squid, and shrimp, many of which are now fully or overexploited. The African countries involved have often granted

TABLE 4–2

Top 10 Fish Exporters and Importers, 1997

Country	Exports (billion dollars)	Share of World Total (percent)
Norway	3.4	7
China	2.9	6
United States	2.9	6
Denmark	2.6	5
Thailand	2.3	5
Canada	2.3	4
Chile	1.8	3
Taiwan	1.8	3
Indonesia	1.6	3
Spain	1.5	3
World	51.0	100

access to their fisheries for cut-rate prices, and the people and fishing communities most affected by these agreements have generally been left out of the negotiations and received little of benefit. Similar agreements stipulate the terms of access for fleets from the United States, Taiwan, Japan, and South Korea to the rich tuna fisheries of Pacific island nations such as the Solomon Islands and Kiribati.[21]

With many Third World fisheries now becoming depleted as well, overfishing for export markets means depriving small-scale fishers of their catch. Demand from foreign markets also drives up the price of domestically available fish to the point where they are beyond the means of local people. In Senegal, for instance, species once commonly eaten throughout the country are now either exported or available only to the elite.[22]

Exports of farmed fish have proved particularly lucrative for many countries over the last few years—but also partic-

TABLE 4–2 *(continued)*

Country	Imports (billion dollars)	Share of World Total (percent)
Japan	16.0	28
United States	8.1	14
Spain	3.1	5
France	3.1	5
Italy	2.6	5
Germany	2.4	4
United Kingdom	2.1	4
Hong Kong	2.1	4
Denmark	1.5	3
China	1.2	2
World	56.0	100

SOURCE: U.N. Food and Agriculture Organization, *Fishery Statistics Yearbook*, vol. 85 (Rome: 1999).

ularly costly ecologically and socially. One in five fish produced today comes from a farm. Although aquaculture has the potential to alleviate pressure on natural fish stocks, the industry also has a number of liabilities of its own. It is often land- and water-intensive. And many of the higher-value farmed species, such as shrimp and salmon, are themselves carnivores, which means that large numbers of lower-value fish are sacrificed to feed them. For each kilogram of farmed salmon and shrimp, 5 kilograms of wild oceanic fish are harvested and ground into high-protein pellets.[23]

Shrimp aquaculture has grown particularly fast in many developing countries over the last few decades. In Thailand, shrimp and prawn production surged from 61,000 tons in 1970 to a peak of 389,000 tons in 1995, with exports accounting for 60 percent of the 1995 total. Nearly 70 percent of the country's shrimp harvest in 1995 was farmed rather than caught from the sea. Thai shrimp production has since declined as a result of the Asian financial crisis, though it is expected to rebound as the economy recovers. Other countries where shrimp aquaculture has taken off include Bangladesh, Ecuador, India, Indonesia, Malaysia, and Viet Nam. The revenues are substantial: in 1997, shrimp exports accounted for nearly 16 percent of Ecuador's total export earnings. But the repercussions are also grave, including coastal pollution, the displacement of local people from their land, and the clearing of large tracts of coastal mangrove forests.[24]

Once regarded as wastelands, mangrove ecosystems are now recognized as playing a critical role in protecting coastlines and serving as spawning grounds for oceanic fisheries, thereby providing sustenance for local people. Yet they are rapidly being felled to make way for shrimp farms. More than a million hectares of mangrove forests have been lost to fish farms over the last decade. In Thailand alone, some 253,000 hectares of the country's original 380,000 hectares of mangrove forests have already been destroyed by shrimp farms, according to the country's National Economic and Social Development Board.[25]

FROM GREEN REVOLUTION TO "GENE" REVOLUTION?

Over the ages, farmers have relied upon diverse crop varieties as protection from pests, blights, and other forms of crop failure. Where traditional agriculture is still practiced, farmers often have extensive knowledge of the attributes of diverse varieties: the Ifugao people on the island of Luzon in the Philippines can name more than 200 varieties of sweet potato, for instance. Modern agriculture still depends on this rich storehouse of biological knowledge, as plant breeders and genetic engineers turn to traditional varieties for the genetic raw material needed to increase yields and produce seeds with attributes such as pest or disease resistance.[26]

The last century has seen a steady erosion of genetic diversity in agriculture as farmers have gradually replaced traditional varieties with more uniform crops. FAO estimates that 75 percent of crop genetic diversity has been lost over this century. This process accelerated in the 1960s with the widespread introduction of high-yielding Green Revolution varieties in many parts of the world. In the United States, more than 70 percent of all cornfields are now planted in just six varieties of corn. In India, farmers grew as many as 30,000 varieties of rice 50 years ago; today, three fourths of India's rice fields are planted with fewer than 10 varieties. And in Mexico, only 20 percent of the corn varieties that were cultivated in the 1930s can still be found today. The rapid pace at which plant genetic diversity is disappearing is leaving the world vulnerable to multibillion-dollar crop losses and reducing the storehouse from which future agricultural strains can be derived.[27]

Just as the Green Revolution transformed the practice of agriculture worldwide in the 1960s, the world may now be on the verge of a "Gene Revolution." Transgenic seeds (those that include genes transplanted from other species) have been in the research pipeline for decades, but it is only within the last few years that they have begun to be widely commercialized. As of 1999, some 40 million hectares of cropland worldwide had already been planted with transgenic varieties, more than triple the area they covered in 1997, and more than 20 times as much as in 1996. The United States dominates these statistics, accounting for 72 percent of the total acreage. Still, 11 nations besides the United States already have at least some land dedicated to transgenics. In much of the rest of the world, widespread public concern about the health and ecological impacts of eating and growing bioengineered crops has slowed their adoption. The area planted in transgenic seeds may level off over the next few years, as farmers try to gauge to what extent public concern and government regulation will cut into the global market for this food. (See Chapter 7.)[28]

Proponents of using genetic engineering in agriculture argue that it can be harnessed to wean farmers from their dependence on chemicals by producing plant varieties that are pest- and disease-resistant. They also envision the development of salt- and drought-resistant varieties that might permit production on marginal lands, as well as the creation of even higher-yielding varieties than those produced by the Green Revolution. Yet skeptics worry that the new herbicide-resistant varieties will entrench rather than reduce reliance on chemicals. They also worry about broader ecological disruption as bioengineered traits are accidentally but unavoidably passed on to neighboring plants through cross-pollination.[29]

The seed varieties of the Green Revolution were generated by public-sector research institutions and made freely

available to farmers and researchers to be adapted to local circumstances and needs. The use of these seeds was thus consistent with the millennia-old agricultural practice of seed-saving, whereby farmers save and replant their seeds from year to year, gradually selecting the hardiest, best-adapted strains. Today's Gene Revolution, in contrast, is commercially driven and defined by patent rights. Biotechnology companies have successfully lobbied for increasingly strong—and increasingly global—patent protection, in some cases making it illegal for farmers to save and replant seeds. Prohibitions against replanting seeds and efforts to develop a technology that can prevent harvested seed from germinating have raised a storm of protest, particularly in the developing world, where more than 80 percent of all crops are grown from saved seeds.[30]

Recent years have seen biotechnology firms lay claim to a wide range of plant varieties though patenting. Governments have granted patents on transgenic soybeans, cotton, and rice varieties, as well as on traditional crops such as the Neem tree, which has long been cultivated for medicinal and agricultural uses in India, and on quinoa, a high-protein cereal eaten by millions of indigenous people in the Andes. The quest for patents has set off a wave of consolidation in the biotechnology and seed industry over the last few years, as industry giants such as Monsanto, DuPont, and Novartis have bought up other companies and their patents.[31]

Many people in the developing world view the patenting of indigenous knowledge for commercial gain as a form of theft—or "bio-piracy." They argue that if anyone deserves compensation for protecting and perfecting seeds, it is the farmers who have cultivated and selected them over thousands of years. These "farmers' rights" were implicitly affirmed in the 1992 U.N. Convention on Biological Diversity, as well as in earlier declarations negotiated under the auspices of FAO. But the 1993 Uruguay Round of trade talks

that created the World Trade Organization paid little heed to these earlier agreements. Rather, heavy industry pressure led to requirements that countries pass legislation to bestow intellectual property protection on plant breeders and biotechnology corporations, while providing no such protection to farmers.[32]

THE WTO AND FOOD SECURITY

Because of agriculture's social and cultural importance, countries have historically been hesitant to bring the sector within the bounds of world trade rules. But the Uruguay Round of trade negotiations subjected the sector to trade disciplines for the first time.[33]

The impetus for the WTO's foray into agriculture dates back to the 1980s, when the European Union and the United States both began to pour billions of dollars into agricultural export subsidies in a bid to outcompete each other in overseas markets. Besides draining national treasuries, these export subsidies and related domestic agricultural policies spurred intensive agricultural techniques, which caused overproduction and associated environmental stress. "Driven by these incentives, farmers adopt chemical-intensive monocultures that lead to more soil erosion, chemical runoff, loss of biological diversity, and conversion of once-natural ecosystems to cropland than would otherwise have taken place," argues economist Robert Repetto.[34]

The subsidy-induced agricultural surpluses also had adverse social repercussions, particularly in the developing world. Excess supplies of basic commodities such as corn and wheat caused world prices to stagnate. The depressed prices harmed other agricultural exporters who could not afford to compete in the agricultural subsidy "arms race" between Europe and the United States. Argentina's export earnings, for instance, fell by 40 percent between 1980 and 1987 due to falling world prices for cereals and oilseeds. Farmers serving local rather than export markets also suffered, as cheap imported grain flooded their markets.[35]

By taking aim at agricultural export subsidies, the Uruguay Round's agricultural agreement could have been a net plus for both the environment and poor farmers in the developing world. But in the end, power politics prevailed. The European Union and the United States agreed to only minor subsidy reductions that they were able to largely avoid through the choice of the baseline year and the use of other escape hatches. The agreement allowed industrial countries to continue to support their farmers by converting export subsidies into direct income payments. But it required developing countries to phase down the agricultural import restrictions that are their primary tool for protecting domestic farmers from being forced out of business by subsidized imported grain. The results threaten to devastate millions of poor farmers. "For us, the price we get for yellow corn is a matter of life and death. It shapes our lives, our health and our future," explains Rosa Laranjo, a farmer from the island of Mindanao in the heart of the Philippines' "corn basket."[36]

Given these high stakes, it is hardly surprising that agriculture was a contentious issue at the Seattle WTO meeting. The Marrakesh accord of 1994 that created the WTO called for new negotiations on agriculture at the end of 1999. The United States and other agricultural exporters, including many from the developing world, are pushing hard for more access to overseas markets. But some countries that protect their farmers from international competition, including Japan and South Korea, worry that cheap imported grain will put their own farmers out of business. Walden Bello of the Bangkok-based Focus on the Global South warns that further agricultural liberalization "will drive the [Asian] region's small farmers over the edge."[37]

CULTIVATING GREENER GARDENS

The current direction of global agribusiness is ecologically unsustainable and socially disruptive. But farmers around the world are experimenting with a range of alternatives that could be scaled up to form the basis for a more sustainable future.

One way to counter the adverse effects of agricultural globalization is to support local agriculture. Many people are doing just that, as evidenced by a renaissance of urban gardening as well as the growing popularity of farmers' markets and other forms of community-based agriculture. Nonetheless, there remains a role for international agricultural commerce—if it can be radically overhauled.[38]

Particularly promising are alternative forms of agricultural trade that generate revenue for impoverished countries and communities while at the same time promoting environmental sustainability and social equity. This approach was pioneered in the 1970s by the "fair trade" movement, which promotes trade in goods that conform to social criteria, including adequate working conditions and a price for producers that compensates for stagnant commodity prices, and which ensures that profits are not lost to middlemen. The Netherlands' Max Havelaar Foundation was an early pioneer, launching a brand of "fair trade" coffee from Mexico in 1988. Imports of this coffee into the Netherlands rose steeply, climbing from just 253 kilos in 1988 to more than 3,000 by the late 1990s. The coffee is now produced by 200 cooperatives in 18 different countries in Africa and Latin America. It is sold in 90 percent of Dutch supermarkets and is widely available in several other European countries, including Belgium, Denmark, France, Germany, and Switzerland. A similar coffee, TransFair, can be found in eight nations, including Austria, Canada, Germany, Italy, Japan, and the United States.[39]

These fair trade coffee initiatives include general requirements aimed at encouraging environmentally sound cultivation. But a range of other initiatives now stipulate far more specific environmental commitments. Organically certified coffee is in growing demand worldwide, and several Central and Latin American countries already have significant amounts of land dedicated to producing it, including El Salvador, Guatemala, Mexico, and Peru. Coffee certified as "shade-grown" has also recently soared in popularity in northern markets, driven by growing awareness that traditional "shade-grown" coffee plantations—an important source of habitat for threatened bird populations—are rapidly being replaced in many areas by sun-grown, intensive coffee cultivation. Several U.S.-based environmental organizations, including the American Birding Association, Conservation International, and the National Audubon Society, are now promoting signature brands of shade-grown coffees.[40]

International trade in environmentally friendlier commodities has moved far beyond coffee. Spurred by growing consumer demand for food that is both healthy and environmentally sound, organic agriculture has become a growth industry in many parts of the world. The overall global market for organic food is now worth an estimated $11 billion annually, and is predicted to increase to $100 billion over the next 10 years, with most of the growth in the United States, Europe, and Japan. Organic sales in North America more than quadrupled between 1990 and 1998, when they reached some $4.7 billion. U.S. organic farmers have found a thriving market for their wares in Japan, where an estimated 3–5 million consumers regularly purchase organic produce.[41]

Many developing countries have moved to tap into the international organic market, beckoned by consumers willing to pay "green premiums" that can run as high as 50–200 percent above regular prices. Mexico has been particularly

quick to leap at this opportunity. It now has some 10,000 organic farms on 15,000 hectares of land, most of them run by small farmers. In addition to their mainstay, organic coffee, Mexican farmers cultivate a range of other organic products as well, including apples, avocados, coconuts, cardamom, honey, and potatoes.[42]

Argentina has also rapidly moved into organic production—since 1992, the area devoted to organic farming has increased nearly 50-fold, reaching almost 231,000 hectares in 1997 (although organic production still only accounts for less than 1 percent of the country's total agricultural output). Sales of organic items such as fresh fruits, beef, milk, cheese, chicken, and olive oil rose from $1.5 million in the early 1990s to $20 million by mid-decade, and were expected to surpass $100 million by 2000. Some 74 percent of the organic production is exported, with nearly 83 percent of it going to Europe, 17 percent to the United States, and less than 1 percent to Japan.[43]

Certification programs are proliferating to help spur a transition to environmental and social sustainability in global agricultural markets. The New York–based Rainforest Alliance runs a Better Banana Project that gives certified bananas an ECO-OK label. To earn the mark, producer plantations must agree, among other things, not to clear any virgin forests and to monitor rivers and wells for pesticide residues. More than a quarter of all banana production in Costa Rica is now from certified lands, as is 41 percent of Panama's. The program works with both small and large growers. In a major victory, Chiquita Brands has now certified all company-owned farms in Costa Rica and is working to cover the rest—including farms in Panama, Colombia, Guatemala, and Honduras—by early 2000. The program has been criticized in some quarters, however, for paying insufficient attention to social concerns. A competing Fair Trade Banana was launched in Europe in 1996 by the Max Havelaar Foundation. Despite the controversy, the Rainforest Alliance is also setting itself up to certify producers of other commodities, including coffee, cacao, and oranges.[44]

Similar efforts are afoot to transform the world's seafood markets. In 1996, the World Wide Fund for Nature teamed up with one of the world's largest seafood product manufacturers, Anglo-Dutch Unilever, to create a Marine Stewardship Council (MSC)—modeled on the Forest Stewardship Council—to devise criteria for sustainable fish harvesting. The MSC is now an independent organization whose members include fishers' organizations, fish processors and buyers, food retailers, environmental groups, governments, and business leaders. The MSC symbol is expected to make its debut on packaged fish in early 2000. Unilever, which buys 25 percent of the world's white fish every year, has pledged not to buy any fish products after 2005 that are not certified as sustainably harvested.[45]

One looming worry is that these certification programs could be challenged as trade barriers at the World Trade Organization, because they distinguish between products based on how they were produced. WTO rules generally frown on such distinctions. (See Chapter 7.) To promote a transformation of world agriculture, governments will need to not only protect certifications from WTO challenges, but also actively support them through government procurement programs and other initiatives.

A range of other reforms are also needed if world trade is to support rather than undermine sustainable agriculture, including redirecting remaining agricultural subsidies in support of small-scale, low-input producers. Farmers' groups from around the world were out in force at the WTO meeting in Seattle, with many of them pushing for policies to promote environmental sustainability and social cohesion in the world's agricultural markets.[46]

The failure to find common ground on agriculture in

Seattle contributed to the overall breakdown of the talks. Governments are scheduled to revisit agricultural issues in WTO negotiations over the next few years. The acrimony in Seattle suggests that agriculture will be a divisive issue on the world stage for some time to come.[47]

Chapter 5

THE EXPORT OF HAZARD

On the night of December 2, 1984, a storage tank at a pesticide plant in Bhopal, India, owned in part by the U.S.-based Union Carbide corporation burst open, sending a cloud of poisonous methyl isocyanate gas toward the Jayaprakash Nagar shantytown that bordered the plant, and from there on to the rest of the city. "Slowly, the people of Bhopal in India's Hindi-speaking heartland began to awaken to horror and death," writes former *New York Times* correspondent Sanjoy Hazarika. "The city began to cough, to choke and heave, as tens of thousands woke to a suffocating, acrid white-yellow mist….Then the panic began as people saw husbands, wives, parents and children struck down—gasping for breath, clutching at burning, hurting eyes and chests, frothing at the mouth…and then choking on their own vomit and blood." The accident would claim more than 6,000 lives within a week and over 16,000 to date, going down in history as one of the world's worst environmental disasters.[1]

Due to a globalized world economy, developing countries

are trying to cope with thousands of hazardous industrial chemicals they did not invent, and that they have little capacity to regulate adequately. Although the chemicals have a range of important economic uses, Bhopal shows the Faustian bargain they often represent.

The only silver lining to the tragedy was the international spotlight it placed on chemical hazards and on the multinational companies sometimes implicated in generating them. Sparked by the horror of Bhopal and other industrial catastrophes, the world community has made some progress over the last few decades in crafting international rules to govern the commerce in hazardous wastes, products, and industries. But gaping holes remain in the global safety net.

TOXIC TRADE

A few years after Bhopal, world attention was once again focused on international toxic threats when a string of high-profile attempts to export hazardous waste received widespread publicity. Waste disposal costs were soaring at that time in many industrial countries in response to tighter regulations as well as shortages of landfill capacity, prompting several efforts to ship waste to poor developing countries desperate for cash.

In one notorious incident, the U.S. city of Philadelphia decided to solve a problem it was having by loading toxic ash from its municipal incinerators onto a ship called the *Khian Sea*, which set sail in August 1986 searching for someone to take the waste. But the strategy backfired. The ship initially toured the Caribbean Sea for a year and a half trying to find a country willing to accept its load. It finally dumped some of the wastes on a Haitian beach, provoking an uproar. It pulled up anchor once again, and after touring five continents and changing its name three times, the ship finally discharged the rest of its load in an undisclosed location in

late 1988, according to its owners. Greenpeace, which has played a leading role in monitoring and exposing the waste trade, suspects that the ash was eventually dumped in the Indian Ocean in November of 1988.[2]

That same year, the small Nigerian fishing village of Koko found itself in the international spotlight when 8,000 drums of highly toxic waste, including methyl melamine, dimethyl formaldehyde, ethylacetate formaldehyde, and about 150 tons of polychlorinated biphenyls (PCBs) in the backyard of villager Sunday Nana began leaking. Visitors to the site described drums "popping from the sun" and smoking, while acid fumes reportedly engulfed the village. But the villagers were ignorant of the dangers. "The odor comes to my compound. It is everywhere," Nana told the *African Concord*, a weekly Nigerian newspaper. "But, to be sincere, it has not worried my health. I even walk in some places with bare feet. My children do the same." An Italian waste disposal firm was eventually held responsible, and the waste was returned to Italy. But the damage had already been done. Many of the Nigerian workers who helped remove the waste were hospitalized with severe chemical burns, nausea, vomiting of blood, and partial paralysis, and one person fell into a coma. Two years later, Nana himself passed away, although the Nigerian government claimed that he succumbed to a respiratory failure unrelated to the dumping.[3]

These shocking incidents spurred the international community to action. Many developing countries unilaterally banned waste imports at around that time: 33 countries had done so by 1988. And the U.N. Environment Programme (UNEP) accelerated negotiations toward an international agreement to regulate the waste trade. In 1989, the Basel Convention on hazardous waste export was finalized, requiring exporters to notify the recipient nation of a shipment and to receive approval for it before proceeding. But many observers found this little cause for celebration, con-

tending that the accord legitimized a trade that should have been banned outright. In its early years, the treaty appeared to do little to stem the waste trade tide. Greenpeace estimated that more than 2.6 million tons of hazardous wastes were shipped from industrial countries to the South or the East between 1989 and 1994. Over roughly this same period, at least 299 dumpings were documented in Eastern Europe, 239 in Asia, 148 in Latin America, and 30 in Africa.[4]

As pressure mounted to strengthen the accord, the number of countries unilaterally deciding to ban waste imports climbed steadily—more than 100 had done so by 1994. Finally, the Basel Convention was itself strengthened in March of that year to ban all waste exports from industrial to developing countries—a victory for the South and a decision that Greenpeace hailed as "The Pride of the Basel Convention." But the ban will only have legal force when the 1994 amendment has been ratified by 62 countries. So far, only 17 countries have taken this step, although most are already respecting its terms. Still, a few key governments continue to object to some provisions of the ban, including Australia, Canada, New Zealand, and the United States.[5]

Despite the progress made in recent years in controlling the hazardous wastes trade, the problem remains far from solved. UNEP estimates that some 440 million tons of hazardous wastes are generated worldwide every year, about 10 percent of which is shipped across international borders. Illegal trade is believed to be flourishing, although it is impossible to quantify, given that most such trade never comes to light. "We presume that organized crime is behind it….We fear we don't hear too much about it because it is much like the illegal arms or drug trade," says Pierre Portas of the Basel Convention secretariat. Nonetheless, officials have intercepted illegal shipments originating in the United States that were bound for Ecuador, Guinea, Haiti, Malaysia,

Mexico, Panama, and Sri Lanka.[6]

In one horrifying case, in December 1998 nearly 3,000 tons of mercury-contaminated concrete waste produced in Taiwan by the Formosa Plastics Corporation were dumped in plastic shipping bags with no warning labels in a field outside the Cambodian port city of Sihanoukville. Unsuspecting local people initially scavenged among the materials, believing the bags could be used for floor mats or tarpaulins, and that the crushed concrete might become fertilizer. A worker who had unloaded the material from the ship died after suffering symptoms consistent with mercury poisoning, as did a villager who slept on one of the shipping bags. As local people became aware that the material was toxic, riots erupted among citizens angry at the officials believed to be responsible, and more than 10,000 residents fled the city in fear.[7]

Ironically, the growing strength of the environmental movement in Taiwan was partly to blame for the situation. In a replay of the situation in the United States and other industrial countries in the 1980s, growing environmental awareness in many rapidly industrializing Asian countries in the 1990s has made it difficult to dispose of waste domestically, creating a strong incentive for companies to look overseas. After the uproar in Cambodia, Formosa Plastics eventually agreed to remove the waste. It had initially planned to ship it to the United States for disposal, but the U.S. Environmental Protection Agency (EPA) decided to reconsider its initial approval after activists charged that plans to dispose of the waste in a low-income, predominantly Latino community in southern California amounted to environmental racism. Community concerns also thwarted subsequent efforts to dump the waste in the states of Idaho, Nevada, and Texas. As of November 1999, the mercury-tainted waste was still impounded at Taiwan's Kaohsiung Port, after having also been rejected by France.[8]

CIRCLES OF POISON

Ever since the publication of Rachel Carson's *Silent Spring* in 1963, concern over the effects of toxic chemicals on the health of both people and wildlife has been a driving concern of the environmental movement. But only in recent years have we begun to understand the ease with which hazardous chemicals move across international borders, catapulting the issue from the national to the global plane.

One of the most vivid demonstrations of the global reach of today's chemical world comes from the Arctic. Research over the last few decades has revealed that some persistent organic chemicals travel thousands of miles from their source before reaching this remote part of the world. These chemicals "evaporate from soils as far away as the tropics, ride the winds north, then condense out in the cold air of the Arctic as toxic snow or rain," explains Fred Pearce of the *New Scientist*. Certain harmful chemicals are particularly likely to follow this route, including PCBs, hexachlorocyclohexane, toxaphene, and chlordane. Scientists believe that these chemicals can circle the globe at a rapid rate, traveling as far as from India to the Arctic in as little as five days.[9]

The long-range transport of hazardous substances leads to the ironic result that people and wildlife in some of the world's most remote places are being exposed to some of the highest levels of chemical contamination anywhere on Earth. PCBs as well as a range of harmful pesticides have built up in the Arctic food chain, reaching ever higher concentrations further up in the chain—for example, from fish to seals to polar bears to whales and ultimately to people.[10]

Researchers began to understand this phenomenon in the mid-1980s, when scientists were looking for a control sample of breast milk from Inuit women in the Canadian Arctic. They had assumed that this milk would be completely pure, and thus useful to compare with the breast milk of women

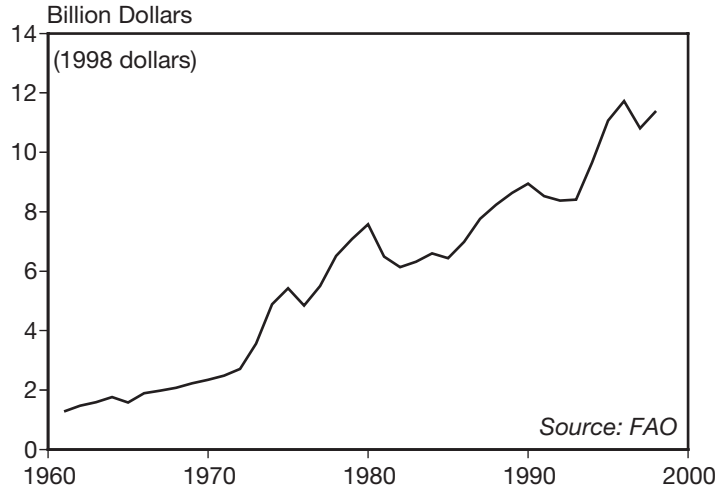
living in the midst of the industrial heartland. Instead, the researchers were stunned to measure PCB levels in the milk of Inuit women from Broughton Island in northeastern Canada that were the highest ever found in any human population except those who had been exposed to industrial accidents. Subsequent research has revealed similar contamination in many other parts of the vast Arctic.[11]

Besides wind and water currents, international commerce is another potent mechanism through which hazardous chemicals move about the world. The pesticides trade is a case in point. Over the last 50 years, pesticide use has surged more than 50-fold, increasing from 50 million kilograms a year in 1945 to some 2.7 billion kilograms a year today. And today's pesticides are more than 10 times as toxic as those used in the 1950s. Exports of pesticides have surged nearly ninefold since 1961, reaching $11.4 billion in 1998. (See Figure 5–1.) Since the 1970s, growing awareness of the dangers of pesticides has led over 90 countries to ban the domestic use of various compounds, including the "dirty dozen"—particularly harmful pesticides such as DDT, endrin, and chlordane. Yet in a phenomenon that has come to be known as the "circle of poison," banned pesticides that are exported to other countries sometimes return to their country of origin on imported food.[12]

Developing countries are particularly vulnerable to health and environmental damage from pesticides, as many of them lack the regulatory mechanisms needed to evaluate risks thoroughly or to ensure that chemicals are used according to instructions. Protective gear for pesticides is often not worn, as it is not suitable for tropical climates. And warning labels on imported pesticides are often non-existent, vague, or written in languages that farm workers cannot read. The World Health Organization (WHO) estimates that these deficiencies cause some 25 million agricultural workers in the developing world to suffer at least one inci-

FIGURE 5–1

World Pesticide Exports, 1961–98



dent of pesticide poisoning per year, resulting in as many as 20,000 deaths annually.[13]

In a number of documented cases over the years, pesticides exported from industrial countries have been implicated in health disasters in the developing world. Use of the extremely toxic pesticide DBCP has been linked with sterility in more than 26,000 farm workers in Costa Rica, the Philippines, and 10 other countries. Costa Rica, for one, imported 5 million kilograms of DBCP from the United States between 1966 and 1973—more than 2 kilograms per citizen—for use on banana plantations either owned by Del Monte, Dole, or Chiquita or producing bananas for them.[14]

In 1994, a group of farm workers from these 12 countries filed a class action suit in U.S. courts seeking damages from the U.S. companies that produced or used DBCP after it was already known to have caused sterility among U.S. farm workers. (The chemical was banned for use in the United States in 1979.) Five of six defendant companies have settled the case, agreeing to pay $52 million in damages, while admitting no liability. Dole Fresh Fruit Co. is the sole remaining defendant. Barry Levy, an adjunct professor with Tufts University's Department of Family Medicine and Community Health, warns that the DBCP debacle "may be just the 'tip of the iceberg' of a series of such catastrophes" around the world.[15]

Despite widespread attention to the "circle of poison" phenomenon, the export of pesticides not approved for domestic use is rising rather than falling—at least from the United States. The Foundation for Advancements in Science and Education (FASE), a Los Angeles–based public interest communications and research group, recently conducted an in-depth review of U.S. pesticide exports. They found that more than 312 million kilograms of pesticides were exported from U.S. ports in 1996—a 40-percent increase since 1992. A substantial share of these were shipped without identification of specific chemical names in the public shipping documents, making it difficult to quantify what proportion were either banned or restricted for domestic use. Nonetheless, FASE conservatively estimates that at least 10 million kilograms of such pesticides were exported from the country in 1995 and 1996. Perhaps even more alarming, 13 million kilograms of pesticides that WHO classifies as "extremely hazardous" to agricultural workers were exported in 1996, a more than fivefold increase over 1992 levels.[16]

U.S. exports of pesticides that are thought to disrupt the endocrine system, which regulates the secretion of hormones into the bloodstream, are also on the rise. Suspected endocrine disrupters exported from the United States in significant quantities in recent years include alachlor, chlordane, heptachlor, and metribuzin. Nearly 33 million kilograms of pesticides in this category were exported from U.S. ports in 1996—an average rate of some 100 tons per

day. This marked a 28-percent increase over the average daily exports of such chemicals over the previous four years. Most of the shipments were bound for Argentina, Belgium, Brazil, India, Japan, and the Philippines.[17]

Many countries now find themselves saddled with growing stocks of obsolete and unused pesticides. The U.N. Food and Agriculture Organization (FAO) estimates that several hundred thousand tons of obsolete pesticides are piling up worldwide, with more than 100,000 tons in the developing world. A sizable share of the chemicals were originally donated under foreign aid programs. They include highly toxic and persistent chemicals such as aldrin, DDT, dieldrin, lindant, and parathion. The pesticides can no longer be used, either because they have deteriorated while in storage, because they have by now been banned, or because the country no longer needs them.[18]

In many cases, the chemicals are being stored in hazardous conditions. For instance, drums are often out in the open, where exposure to sunlight and rain can cause them to leak and corrode. In some areas, they are being stored near markets, where they are easily accessible to children. They are also contaminating soils, groundwater, irrigation, and drinking water. FAO estimates that it would cost $80–100 million in Africa alone to dispose of the accumulated stocks adequately.[19]

In addition to pesticides, numerous other dangerous products are disseminated through trade—sometimes because of their hazardous properties. In Canada, for instance, when domestic sales of asbestos declined due to public health concerns, the industry collaborated with the government to promote sales abroad. Canada is now the world's leading exporter and second-largest producer of white asbestos. Ninety-six percent of the asbestos Canada produces is now exported—the majority of it to the Third World. Worried that a growing number of bans on asbestos

production in Europe will devastate its asbestos industry, Canada has tried to protect its market by turning to the World Trade Organization (WTO), where it has lodged a complaint against France, arguing that France's 1996 ban on the production of white asbestos breaks international trade rules because it was imposed with insufficient scientific evidence of adverse health effects. The European Union as a whole has now followed France's lead in banning white asbestos, which may ignite an even larger WTO showdown.[20]

In an effort to crack down on the export of hazardous materials, more than 50 countries gathered in Rotterdam in September 1998 to finalize an international treaty that puts in place a system of prior informed consent for trade in 22 pesticides and 5 industrial chemicals when these substances are banned or restricted in the exporting country. This accord builds on an earlier FAO nonbinding code of conduct on the distribution and use of pesticides. Negotiations now under way on a convention on persistent organic pollutants are aimed at banning altogether 12 particularly hazardous chemicals.[21]

POLLUTION HAVENS?

Not only is trade in hazardous products thriving, but recent decades have also seen hazardous industries themselves become widely dispersed around the planet. In many cases, these industries are becoming concentrated in the developing world, where safety practices and environmental enforcement and monitoring are often rudimentary at best.

The asbestos industry is a case in point. Asbestos production has plunged in most industrial countries over the last 25 years as evidence has accumulated that breathing asbestos fibers causes lung cancer. But production and use continue to climb in many countries, including Brazil, China, India, Indonesia, Poland, South Africa, South Korea,

and Thailand. In Brazil, domestic asbestos consumption is increasing 7 percent annually. The country also exports some 70,000 tons of asbestos per year, principally to Angola, Argentina, India, Mexico, Nigeria, Thailand, and Uruguay. The surge in asbestos use in the developing world is expected to cause anywhere from 30,000 to several million deaths over the next 30 years.[22]

Although they sound innocuous enough, many "recycling" operations in developing countries also pose grave environmental dangers. For example, millions of used car batteries are sent from the United States every year to smelters in Brazil, China, India, Japan, Mexico, and South Africa, among other countries, to be melted down for lead recovery. But the smelting process exposes workers to dangerous lead levels, causing classic symptoms of lead poisoning, including headaches, dizziness, stomach cramps, and kidney pains. Excessive exposure to lead can cause more serious long-term health problems, including kidney damage, reproductive problems, and brain impairment in children. Scrap recovery businesses based on imported materials often cause similar contamination problems.[23]

Over the last few decades, the developing world has become home to a growing share of the hazard-laden petrochemical industry. In 1980, 11 percent of all chemicals were produced in developing countries; by 1996, this figure had grown to 18 percent. Much of this expansion involves joint ventures with multinational firms. For example, the chemical industry's share of total U.S. foreign direct investment (FDI) in manufacturing in developing countries increased from 18 to 34 percent between 1990 and 1998. Approximately 41 percent of U.S. FDI in the Philippines in 1998 was in chemicals, as was 22 percent of such investment in Colombia.[24]

High-tech industries such as computers and electronics have also gone global in recent years. And despite their early

reputation as relatively clean, these high-tech industries often exact heavy environmental costs. Semiconductor manufacturing, in particular, is a toxic-laden business. The manufacturing process employs hundreds of chemicals, including arsenic, benzene, and chromium, all of which are known carcinogens. California's Silicon Valley is a testament to the industry's dangers: it is home to 29 sites listed on EPA's Superfund list of the country's most contaminated toxic dumps, giving it the dubious distinction of hosting the largest concentration of such sites in the country.[25]

As high-tech industry spreads around the world, it is bringing its environmental liabilities along with it. The industry has grown particularly rapidly in Southeast Asia. In the Philippines, for example, exports of electronics equipment surged from just over $1 billion in 1985 to above $10 billion in 1996—more than half of the country's total export earnings. Semiconductors accounted for nearly 80 percent of this sum. A 1996 review of 22 computer-related companies based in industrial countries by the Silicon Valley Toxics Coalition of San Jose, California, found that more than half of the manufacturing and assembly operations—processes intensive in their use of acids, solvents, and toxic gases—are now located in developing countries.[26]

A debate has raged over the years about the extent to which industries might be fleeing tightening environmental regulations in industrial countries by seeking out "pollution havens" in the developing world. Studies suggest that industries are generally drawn to overseas locations by a range of factors, including the cost and quality of labor, the availability of natural resources, and the access to large markets. In most cases, environmental control costs alone are not high enough to be a determining factor in location decisions. But even if companies move to the developing world for other reasons, they may well take advantage of lax environmental laws and enforcement once there.[27]

In a few instances, moreover, relaxed environmental enforcement does appear to have been a motivating factor in companies' location decisions. The controversy over the 1993 North American Free Trade Agreement (NAFTA) put the spotlight on one notoriously polluted region where this seems to have been the case for some firms—the border between northern Mexico and the United States. That area is the site of some 3,200 mostly foreign-owned manufacturing plants known as *maquiladoras*. In the city of Mexicali, near the California border, more than a quarter of the factory operators surveyed in the late 1980s said that Mexico's lax environmental enforcement influenced their decision to locate there.[28]

These and other companies helped make the area an environmental disaster zone. A survey conducted by the U.S. National Toxics Campaign in the early 1990s found toxic discharges at three quarters of the *maquiladoras* sampled. Chemicals known to cause cancer, birth defects, and brain damage were being emptied into open ditches that ran through the shantytowns around the factories. High rates of severe birth defects and other health problems have been detected along the border. Particularly horrifying have been elevated rates of spina bifida, a spinal-nerve defect, and anencephaly, a fatal condition in which babies are born with incomplete or missing brains, in the heavily polluted area that straddles Brownsville in Texas and Matamoros in Mexico. Despite the environmental side agreement that accompanied NAFTA, conditions have improved little and may even have deteriorated in the years since, as more U.S. companies have flocked to the region.[29]

The *maquiladoras* region is but one of some 850 export or special processing zones worldwide that collectively employ some 27 million workers. These zones normally permit goods to be imported duty-free, on the condition that they then be used to produce exported products. A range of other inducements encourage companies to locate production in these zones, including tax holidays and free land or reduced rent. There is considerable evidence that one lure is often a casual attitude toward substandard labor practices, such as dangerous working conditions and restrictions on the right to organize.[30]

Although no comprehensive data on the question have been gathered, environmental abuses are undoubtedly also common. In the coastal Cavite province near Manila, for instance, local fishers accuse Taiwanese- and Korean-owned factories located in the special economic zones adjacent to Manila Bay of dumping pollutants that are responsible for killing thousands of fish. And the Chinese National Environmental Protection Agency has accused firms from Taiwan and South Korea of setting up shop in China in order to flee tougher environmental regulations at home.[31]

A CLEANER PATH

A few decades ago, developing countries often argued that pollution was the price of progress. But the last several years have brought an environmental awakening to most corners of the globe. Environmental laws and enforcement are gradually being strengthened in response.

Rather than setting themselves up as pollution havens, many developing countries are recognizing that they have an opportunity to learn from the mistakes of the industrial world, and leapfrog directly to the technologies of tomorrow. Such products and processes will be far cleaner and more efficient in their use of energy and raw materials than the equipment typically in use today—and thus far healthier for the people that use or live among them.

International investment can help expedite this transition, as many companies bring advanced technology with them when they undertake new investments abroad. The

lure of selling into "greener" international markets can also have a salutary impact on environmental performance in the developing world. Shi Yonghai, a Senior Researcher at the Chinese Academy of International Trade and Economic Cooperation, maintains that "if Chinese traders don't pay attention to environmental protection and ecology when producing or purchasing goods for export, it will be impossible for China's export sector to grow, or even to maintain its current levels."[32]

Limited evidence also suggests that the recent move of many governments to privatize state-owned factories by selling them to domestic or foreign private investors sometimes promotes cleaner industrial processes. One reason is that privatization eliminates the conflict of interest that arises when the government is both producer and regulator. In addition, the pressure to turn a profit introduces an incentive to adopt manufacturing techniques that reduce energy and materials use and thus diminish pollution.[33]

While international markets have often spread environmental horrors, they can also be harnessed on behalf of the transition to cleaner technologies that use resources efficiently and produce little if any hazardous waste. But stronger environmental rules of the road will be needed if the globalization process is to support this shift.

Chapter 6

SHARING THE AIR

In May 1985, a team of British scientists stunned the world with an article in *Nature* magazine that reported a remarkable 40-percent loss of stratospheric ozone over Antarctica between September and October 1984. Despite extensive research on the subject, no such precipitous decline had been predicted by the atmospheric models the scientists relied on. Indeed, the ozone losses were so unexpected that the investigators at first suspected instrument error and delayed the release of the data. But subsequent satellite readings confirmed the presence of this massive ozone "hole"—which covered an area the size of the continental United States. The findings revealed that during the Antarctic spring, ozone levels were becoming low enough to present serious risk of cancer, cataracts, and other health problems in New Zealand and other southern countries.[1]

When the "ozone hole" revelations hit the headlines, international negotiations aimed at limiting the use of chlorofluorocarbons (CFCs), the chemicals suspected of thinning Earth's protective ozone layer, were well under

way—but badly stalemated. Scientists had warned for years that without international action, depletion of the ozone layer would increase the intensity of ultraviolet (UV) radiation and cause millions of additional skin cancer cases, sharply diminish agricultural yields, and kill aquatic organisms. But industry leaders had persuaded governments that the cost of replacing the chemicals was too high.[2]

As the negotiations approached a crucial stage, news of the massive hole in the ozone layer—accompanied by dramatic, computer-generated color images—provided clear evidence that ozone depletion was a more unpredictable and dangerous phenomenon than most scientists thought. This turned ozone depletion from a scientific abstraction to a tangible threat, profoundly altering the atmosphere of the talks. The accumulating scientific evidence of ozone depletion also spurred industries that produce and use the CFCs that cause ozone depletion to accelerate their research into practical, affordable alternatives. Some even realized that those who moved fastest to the new chemicals might actually gain market share as the older chemicals were phased out by international agreement.[3]

Suddenly the plodding negotiations turned into an avalanche of key decisions. Just over two years after the discovery of the ozone hole, on September 16, 1987, negotiators meeting in Montreal finalized a landmark in international environmental diplomacy: the Montreal Protocol on Substances That Deplete the Ozone Layer. This treaty mandated far-reaching restrictions in the use of CFCs as well as halons, another group of ozone-damaging chemicals.[4]

Ozone depletion is a quintessentially global problem: CFCs released mainly in northern industrial countries are destroying a protective layer of the atmosphere nearly everywhere—and doing so most dramatically in the remotest and supposedly unpolluted "upper" and "lower" corners of the world. But ozone depletion is global for another reason: the

technologies that cause it are a twentieth-century invention that spread rapidly around the world as a result of the acceleration of global trade and investment that marked the final decades of the century. The response to ozone depletion has also been global, with diplomats around the world—advised by scientists, and lobbied by businesses and environmental organizations from dozens of countries—breaking new ground in international law and diplomacy in order to turn the problem around.

The leading role of international scientists, the constructive efforts of multinational companies, the concerted pressure of environmental groups from a range of countries—and the dramatic results—all suggest that the Montreal Protocol was a high point for environmental globalization. But the biggest test is likely to come with another atmospheric problem, and an even more global issue: climate change.

For 12 years, government leaders from around the world have struggled to forge an effective international agreement to slow the emission of carbon dioxide (CO_2) and other greenhouse gases that are steadily building in the atmosphere, thanks in large measure to the fossil fuels that powered the twentieth century. Although a first effort at a climate convention was ratified in the early 1990s, and the subsequent Kyoto Protocol received preliminary approval in 1997, the world is still far from an agreement that has the far-reaching effects of the Montreal Protocol—and even further away from a real solution to the problem. Resistance to change by leading industries and political bickering among key governments are preventing the kind of commitment that is needed to solve this most global of problems.[5]

Even as globalization has helped fuel the unprecedented buildup of greenhouse gases in recent decades, so must a new approach to globalization be realized if that growth is to be slowed. In their efforts to overcome this impasse in the

next few years, the world's governments will reveal much about whether the positive potential of globalization can overcome its negative effects in the early decades of the twenty-first century.

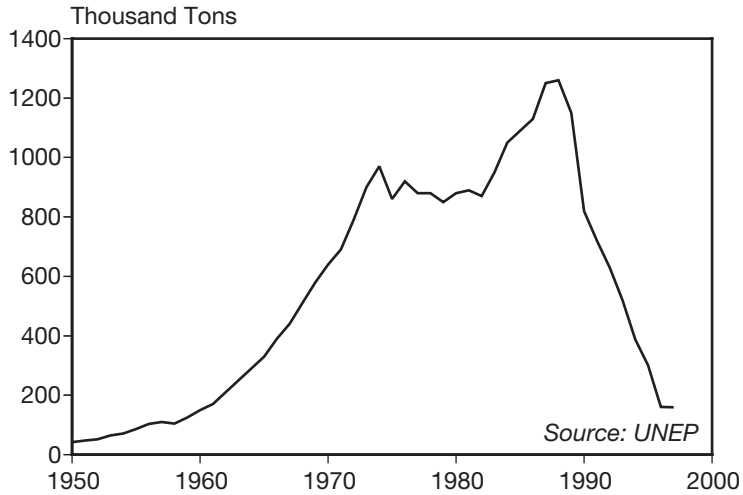
MEDDLING WITH THE ATMOSPHERE

The successful conclusion of the ozone treaty negotiations in Montreal was widely hailed at the time as a historic event. The protocol was the most ambitious attempt ever to combat environmental degradation on an international scale. Governments from poor countries as well as rich, from the East as well as the West, were involved in the talks. The protocol they agreed on would have extensive effects on the multibillion-dollar global industry that produced the offending chemicals, as well as on the numerous businesses that manufactured products dependent on them, such as the rapidly growing computer chip industry. Billions of consumers also faced changes in products they had grown accustomed to, such as foam coffee cups and car air conditioners. The accord was signed on the spot by 24 nations and the European Community, and has since been ratified by more than 170 countries.[6]

In the years since the Montreal meeting, the accord has been strengthened several times to require deeper emissions cuts and coverage of more chemicals. It has succeeded in setting in motion myriad responses by national governments, international organizations, scientists, private enterprises, and individual consumers—with decisive results. January 1, 1996, was an important milestone, as the protocol required CFC production for domestic use in industrial countries to be phased out altogether by then. By 1997, global production of the most significant ozone-depleting substance—CFCs—was down 87 percent from its 1987 level. (See Figure 6–1.)[7]

FIGURE 6–1

World Production of Chlorofluorocarbons, 1950–97



Despite the encouraging decline in CFC production, the world is currently suffering through the period in which the ozone layer will be most severely damaged. This is due to the long time lag between when CFCs and other ozone-depleting compounds are released and when they reach the stratosphere. And once there, CFCs can persist for centuries. The largest "ozone holes" on record have developed above the Antarctic over the last few years. Ozone losses over mid to high latitudes in both the northern and southern hemispheres have also increased rapidly, leading to higher levels of UV radiation over populated and agriculturally productive corners of Earth, such as Canada, Chile, and Russia.[8]

The increased levels of UV radiation reaching Earth are thought to be having the expected range of adverse effects on human and ecological health, including impaired immune systems, elevated skin cancer rates, and disruption of aquatic ecosystems. Current estimates suggest that if all

countries comply with the Montreal Protocol, the ozone shield will gradually begin to heal within the next few years, but a full recovery to pre-1980 levels is not expected until about 2050.[9]

The climate change treaty, in contrast, is not yet strong enough to put a meaningful dent in the buildup of greenhouse gases in the atmosphere. Global emissions of carbon dioxide, the most important of these, have increased nearly fourfold since 1950, and CO_2 concentrations in the atmosphere are more than 30 percent above preindustrial levels, reaching their highest level in 160,000 years. If the world continues on its current fossil-fuel-intensive course, scientists estimate that CO_2 concentrations will double by the year 2100, increasing the average temperature at Earth's surface by 1.0–3.5 degrees Celsius (3–8 degrees Fahrenheit).[10]

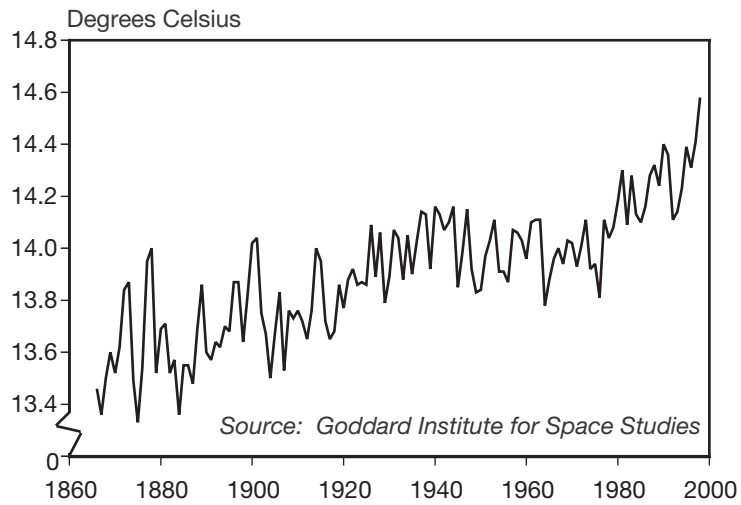
Even assuming that the commitments made in December 1997 at Kyoto are fully implemented, they are only projected to slow the buildup of CO_2 concentrations modestly. Under the Kyoto accord, industrial countries agreed to collectively reduce their emissions of greenhouse gases to 6–8 percent below 1990 levels between 2008 and 2012. Because emissions from developing countries are not yet limited by the accord, projections suggest that global CO_2 levels could reach as much as 30 percent above 1990 levels over the next 15 years, even with the commitments currently stipulated in the accord. Yet scientists estimate that emission cuts on the order of 60–80 percent below current levels will likely be required to eventually stabilize CO_2 concentrations in the atmosphere.[11]

Most climate scientists believe that global warming has begun. The Intergovernmental Panel on Climate Change (IPCC), a group of 2,500 scientists from around the world that advises the climate negotiators—and modeled on the international scientific process used to guide the ozone negotiations—reported in 1995 that "a discernible human influence on global climate" could already be detected. Record-breaking temperatures over the last several years have supported this conclusion: 14 of the warmest years since recordkeeping began have occurred since 1980. The temperature increase in 1998 was particularly pronounced, making that year the warmest on record. (See Figure 6–2.)[12]

Although it is difficult to predict the precise effects of climate change, the international scientific community has warned that they can be expected to be serious. In its 1995 assessment, the IPCC warned that a doubling of CO_2 concentrations would cause enough warming to raise sea levels by between 15 and 95 centimeters over the next century. The resulting flooding of coastal areas would turn millions of people into environmental refugees in low-lying areas of the world, and cause several island nations to disappear altogether. The IPCC also predicted that doubled CO_2 concentrations would cause a dramatic increase in extreme weather

FIGURE 6–2

Global Average Temperature at Earth's Surface, 1866–1998



events such as storms and hurricanes, disrupt ecosystems worldwide, and precipitate a surge in the transmission of infectious diseases such as malaria. Climate change is expected to exacerbate water scarcity in arid regions such as the Middle East, and to diminish agricultural productivity in many of the world's poorest countries. One recent study found that climate change–induced drought could increase the share of Africa's population at risk of hunger by as much as 18 percent by the 2050s.[13]

SHOWDOWN IN KYOTO

The world community took a tentative first step toward confronting climate change at the June 1992 Earth Summit, when the U.N. Framework Convention on Climate Change was finalized. The treaty's deliberately ambiguous language urges but does not require industrial nations to hold total emissions of greenhouse gases to 1990 levels or below by 2000. In addition, all signatories, including developing countries, are obligated to conduct emissions inventories, submit detailed reports of national actions taken to implement the convention, and work to take climate change into account throughout their social, economic, and environmental policies.[14]

Within a few years, it became clear that the Convention urgently needed strengthening, just as happened in the case of ozone depletion, when the original 1985 Vienna Convention was rapidly superseded by scientific, technological, and political developments. Few industrial countries were on track to meet the greenhouse gas stabilization target. Even if they had been, further efforts would be needed to achieve the treaty's broader aim, which is to stabilize atmospheric concentrations at a level that will prevent "dangerous… interference with the climate system."[15]

It was against this backdrop that negotiators arrived in Kyoto in December 1997. Most industrial countries

appeared ready to accept legally binding reduction targets. But it was not yet clear how large they would be, and how they would be distributed among nations. Another controversial issue cast a long shadow over Kyoto: whether and how developing countries should participate in the agreement. Two years earlier, discussions of developing-country commitments had been explicitly excluded from the negotiating mandate for Kyoto. It was generally agreed that industrial countries should be the first to take on reduction commitments, as per capita carbon emissions levels in these countries are on average six times higher than in the developing world. But the U.S. Senate passed a unanimous resolution prior to Kyoto saying it would not ratify any agreement that did not contain binding targets for developing countries. The U.S. government thus arrived in Kyoto determined to secure commitments from the developing world.[16]

It looked as though the stage had been set for stalemate. But on the final day of the conference, negotiators struck a last-minute deal mandating the 6–8 percent reduction from 1990 levels by 2008–12. On the surface, this seemed to be a significant step forward. Disaster in Kyoto appeared to have been averted, and the protocol was widely hailed as historic. But it quickly become clear that celebration was premature. The accord papered over serious differences among countries, and left critical details still to be resolved.[17]

Although the headlines out of Kyoto focused on the 6–8 percent reduction goal, the devil lay in the details. In particular, a crucial Annex A detailed how the collective emissions goal was to be shared among industrial nations. For most countries, the goal hovered around 8 percent. But there were notable exceptions, such as an 8-percent increase in emissions granted to Australia. Further complicating the situation was the variation in emissions trends since the 1990 base year. Owing to economic collapse, Russia's 1995 emis-

sions were 29 percent below 1990 levels, and Ukraine's 1997 emissions were down by 49 percent. And in 1997 the European Union's emissions were 4 percent below while U.S. emissions were 11 percent above 1990 levels.[18]

These discrepancies in national targets took on particular significance because the protocol created a path-breaking yet controversial emissions trading scheme that allows countries and companies to purchase emissions credits from one another. Countries such as Russia and Ukraine, which under the protocol can now increase their emissions substantially (see Table 6–1), as they are already well below the 1990 level, were by the stroke of the pen granted carbon emissions credits potentially worth billions of dollars annually. Critics pointed out that this system was creating what they dubbed "hot air"—marketable emissions rights that were the result of reductions already achieved.[19]

The "hot air" option allows major emitters such as the United States to meet most of their reduction commitment by purchasing credits from abroad for reductions that have already taken place. Emissions trading is based on sound economic theory, providing an incentive for reducing emissions where it can be done most cost-effectively. But trading of "hot air" would undermine the legitimacy of this system, making it more an arena for political horse-trading than a market mechanism. An added problem is the lack of institutions at the international level to conduct the monitoring and verification needed to make a complex emissions trading system work.[20]

Besides the uncertainties over emissions trading, another shadow hovering over Kyoto was the failure to reach agreement on the question of how to involve developing countries in the treaty. This led the U.S. government to announce that it would not submit the accord for Senate ratification until it could convince key developing countries to agree to "meaningful participation" in the protocol. As of late 1999, only 18

TABLE 6–1

Greenhouse Gas Commitments and Emissions Trading Potential for Selected Countries Under the Kyoto Protocol[1]

Country	Emissions, 1997[2] (million tons of carbon equivalent)	Emissions Commitment for 2008–12[3] (million tons of carbon equivalent)	Emissions Commitment for 2008–12[3] (percent change from base year)	Trading Potential as of 1997[4] (million tons of carbon equivalent)
Industrial Countries				
Australia	121	122	+ 8	+ 1
Canada	186	154	– 6	– 33
Eur. Union[5]	945	904	– 8	– 42
Japan	349	311	– 6	– 38
Norway	15	14	+ 1	– 1
United States	1807	1516	– 7	–291
Countries in Transition				
Bulgaria	23	34	– 8	+ 11
Czech Rep.	43	48	– 8	+ 5
Estonia	6	10	– 8	+ 4
Latvia	4	9	– 8	+ 5
Poland	116	145	– 6	+ 28
Romania	45	66	– 8	+ 22
Russian Fed.	586	828	0	+243
Ukraine	127	250	0	+123

[1]Includes emissions of the six gases designated in the Kyoto Protocol: CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. Excludes emissions removal from land use change and forestry. [2]Data for Spain and Russian Federation are for 1995; data for Australia, Belgium, Greece, and Romania are for 1996. [3]Emissions commitments are here expressed in relation to the base year of 1990; under the protocol, however, some Parties actually use earlier base years: Bulgaria (1988), Poland (1988), and Romania (1989). [4]Plus sign indicates emissions available for potential export, minus sign indicates potential emissions imports. [5]European Union (EU) data exclude Italy, Luxembourg, and Portugal. The emissions commitments for the 15 EU countries were initially listed as –8 for each, but subsequently revised under the "bubbling" provision of Article 4, which groups these countries as one and allows them to redistribute their individual emissions commitments in ways that preserve the collective total.
SOURCE: See endnote 18.

countries had agreed to be bound by the protocol, far fewer than the 55 required to give it legal force.[21]

ATMOSPHERIC POLITICS

During the run-up to Kyoto in 1997, television viewers throughout the United States were subjected to a steady barrage of advertisements paid for by an organization with an innocuous name—the Global Climate Information Project. But protecting Earth's climate is low on the priority list of this group, whose members include industries and unions that feel far more threatened by action to combat climate change than by climate change itself. Among the members of the coalition are the American Petroleum Institute, the American Plastics Council, the National Mining Association, and the AFL-CIO, a federation of labor unions representing some 13 million workers.[22]

In an ominous tone, the ads warned that the pending Kyoto accord would inflict enormous economic pain on the U.S. economy. They then professed to clue viewers in on a shocking fact—that U.S. economic competitors in China and other developing countries would not be included in the Kyoto targets. (Not mentioned was the fact that the average American is responsible for nearly eight times as much carbon per capita as the average Chinese.) The punch line was designed to stick: "This UN Treaty Isn't Global and It Won't Work."[23]

At the same time that the advertisements were running in the United States, Lee R. Raymond, Chairman of Exxon, gave a speech in China on behalf of the American Petroleum Institute in which he questioned whether climate change was a real problem and urged developing countries to increase rather than limit their fossil fuel consumption. Raymond also issued a veiled threat: "Competition among countries eager to develop petroleum reserves is at an all-time high." He then advised developing countries to offer tax concessions as well as "rational environmental standards" in order to attract foreign investment.[24]

These two arguments provide an unusually potent prescription for political impasse—on the one hand, convince the U.S. Congress to block the Kyoto Protocol unless developing countries also adopt carbon targets, then convince these same countries that targets would hinder their development. The result: ensuring that ratification of any accord to emerge from Kyoto would be tied up for years to come. The strategy was devious and the advertisements highly misleading. But the process underscored an important political reality: climate change is inextricably linked with broader insecurities about economic welfare in a global age. Until these anxieties are addressed head-on, there will be little hope of ensuring climate stability in the twenty-first century.

Concerns about international competitiveness are hardly new in environmental diplomacy. They were a prominent feature of early ozone diplomacy. But in the ozone case, worries about competitiveness were effectively turned on their head and used as an argument for cooperative international action rather than an excuse for intransigence.

In the mid-1980s, it appeared increasingly likely that the United States was going to move forward with stringent domestic restrictions on ozone-depleting substances. This pressure for action was driven by several factors. High on the list was growing public concern about the health impacts of ozone depletion—in particular, the projected growth in skin cancer rates. The companies that produced CFCs worried that they might find themselves with both tarnished public images and mounting legal liabilities. CFC producers and other affected industries were also concerned about an ongoing lawsuit in which the Natural Resources Defense Council was suing the Environmental Protection Agency (EPA) for not implementing provisions of the U.S. Clean Air Act that

required the agency to take action on ozone depletion. U.S. businesses feared being held to a tougher standard than their international competitors. In order to avoid this outcome, the industry-backed Alliance for Responsible CFC Policy did an abrupt about-face in late 1986 and began to advocate international controls on CFCs.[25]

European industry was slower to come around, partly because of less public attention to the issue in Europe, which made companies there uninclined to view regulation as inevitable. Furthermore, some Europeans apparently believed that research into substitutes was more advanced in the United States, which they feared would put European firms in a vulnerable position in the battle for dominance of CFC-substitute markets. Eventually, however, the European calculus shifted. One impetus may have been the pending U.S. ozone legislation, which would have imposed trade restrictions on the imports of countries that had not undertaken comparable domestic action. The Europeans also apparently realized that it would be easier for them than for the United States to implement the production targets being proposed for the Montreal meeting, as European countries had not yet eliminated the use of CFCs in aerosols—a sector for which alternatives were both cheap and readily available. Armed with this knowledge, the Europeans changed course and eventually supported decisive action to reduce and eventually eliminate the use of CFCs.[26]

With climate change—which results from the actions of hundreds of different industries as well as billions of consumers—the industrial politics are more complex. Large, powerful industries such as coal, oil, chemicals, steel, and automobiles continue to sponsor the kind of misleading ads described earlier, while many other companies and industries are beginning to take the kind of constructive approach that ultimately drove the ozone negotiations to success. As with ozone depletion, these companies argue that the effort

to replace fossil fuels with new energy technologies will create at least as many economic opportunities as it threatens. But so far, these voices of industrial reason are being drowned out by those who fear they will be losers in the race to reduce greenhouse gas emissions.[27]

In a transatlantic about-face from the earlier situation with ozone, some European industrialists are skittish about the European Union getting out in front of the United States on climate change, as they fear their competitiveness will be harmed if European companies are required to make investments in climate-friendly technologies while their U.S. competitors are not.[28]

Today's controversies about the participation of developing countries in the climate change accord also have antecedents in ozone history. When the Montreal Protocol was first negotiated, developing countries used only small quantities of CFCs. Yet their consumption was projected to grow rapidly in the years ahead as they strove to raise living standards by providing refrigerators, air conditioning, and other amenities. If these countries did not participate in the accord, growth in developing-world CFC consumption would likely soon swamp any reductions in industrial countries. China and India were of particular concern. Though neither was at the time a significant CFC consumer, together they accounted for nearly 40 percent of the world's population—and both had plans to increase dramatically the production of consumer goods that could contain CFCs. Developing countries were reluctant to accept apparent constraints on development for a problem not of their own making.[29]

In response to these concerns, the Montreal accord granted developing nations a 10-year grace period to meet the protocol's terms, and stipulated that industrial countries should provide funding and technology to help others make the transition. After the accord was finalized, however, it became increasingly clear that these provisions alone would

likely be insufficient to convince many developing countries to join in. After some tough bargaining, an unprecedented global deal was struck in London in 1990: industrial countries agreed to reimburse developing countries for "all agreed incremental costs" of complying with the protocol—in other words, all additional costs above and beyond any they would expect to incur in the absence of the accord.[30]

Studies conducted by EPA indicated that these costs were relatively low—and paled in comparison with those that a damaged ozone layer would impose. The initial agreement called for the creation of a $240-million Interim Multilateral Fund. Key developing countries—including China and India—expressed satisfaction with the outcome, and announced their intention to join in the accord as a result. In 1992, governments agreed to make the Interim Multilateral Fund permanent. The fund has subsequently been replenished several times. As of mid-1999, industrial countries had contributed nearly $1 billion total, financing some 3,000 projects in 116 countries.[31]

Besides the "carrot" of funding, the Montreal Protocol also used the "stick" of possible trade restrictions. The negotiators were concerned about the potential for "CFC havens" to be created in countries that were not signatories—a development that could have seriously undermined the accord's effectiveness. To prevent this from happening, the protocol included provisions that forbade treaty members to trade in CFCs and products containing them with countries that have not joined the accord. Although effective in encouraging widespread participation, these provisions have become controversial in recent years, as international trade experts have questioned whether they would be permitted under the rules of the World Trade Organization. (See Chapter 7.)[32]

International trade and investment have had a significant impact on the move to phase out ozone-depleting substances in the developing world. Export-oriented developing countries have tended to be ahead of the phaseout curb, as selling goods in industrial countries requires keeping pace with developments there. China learned this lesson the hard way: its refrigerator exports declined by 58 percent between 1988 and 1991 as demand in industrial countries for refrigerators with CFCs plummeted. The government then moved aggressively to develop ozone-friendly refrigerators, and has said it will phase CFCs out faster than required under the protocol. Nonetheless, China is currently the world's largest CFC producer, accounting for some 30 percent of remaining CFC production, as well as more than 70 percent of halon use.[33]

The effort to reduce CFC use in developing countries has been aided by a tendency for multinational corporations to adopt the same ozone practices in their overseas operations as they use at home. In the Philippines, for instance, many foreign-owned electronics manufacturers had already eliminated most uses of ozone-depleting substances as solvents by 1995. Similarly, usage in Kenya fell by two thirds between 1989 and 1993, due at least in part to changes instituted by companies based in industrial countries.[34]

Although the jury is still out on the effectiveness of the North-South ozone partnership, preliminary signs are encouraging. The protocol required developing countries to freeze CFC consumption in mid-1999, and to phase it out altogether by 2010. As a group, developing countries are ahead of schedule. Their use of CFCs and halons increased by some 16 percent from 1986 to 1995, but the growth trend reversed in 1996, when usage fell by 6 percent. Botswana, Cameroon, Colombia, and Malta have already completely phased out CFCs, and Indonesia, the Philippines, Thailand, and Viet Nam have reportedly stopped using them except for servicing refrigerators and other essential uses.[35]

The ozone story offers some hope that the impasse over developing-country participation in the climate change treaty will yet be overcome. Foreign investment is in some

cases already helping developing countries make the transition to a more climate-benign development path. Compact fluorescent light bulbs, for example, first produced in the United States, are increasingly manufactured in the developing world. In 1997, China made about 100 million of these energy-efficient bulbs—more than any other country. The funding and technology came in part through joint ventures with lighting firms based in Hong Kong, Japan, the Netherlands, and Taiwan. Compact fluorescents produced by joint ventures consistently outrank those of domestic companies in meeting performance standards such as efficiency and durability.[36]

Renewable energy components are also now being made in developing countries. India, for instance, has become a major manufacturer of advanced wind turbines with the help of technology obtained through joint ventures and licensing agreements with Danish, Dutch, and German firms. It has become the world's fifth largest wind power producer, with an installed capacity of nearly 1,000 megawatts.[37]

Despite the failure to broker a political deal on climate change, many developing countries are in fact already moving ahead with innovative policies and programs. Brazil recently eliminated oil subsidies, saving 4 million tons of carbon as well as more than $2 billion. Mexico has distributed 1.7 million efficient compact fluorescent light bulbs, offsetting 32,000 tons of carbon annually. And Costa Rica enacted a 15-percent carbon tax, with a third of its revenues channeled into tree planting projects by farmers.[38]

Perhaps the most encouraging news comes from China. Already the world's second largest emitter of carbon dioxide, projections suggest that China will surpass the United States and climb into first place within the next two decades. China's CO_2 emissions climbed steadily at a rate of some 4 percent a year over the last two decades, but in the last few years this trend turned around. In 1998, China's emissions dropped by 3.7 percent, despite robust economic growth of 7.2 percent. One important factor in the decline was a recent $14-billion cut in annual coal subsidies.[39]

FORGING A CLIMATE-FRIENDLY GLOBAL ECONOMY

As negotiators work to complete many details of the Kyoto Protocol by the end of 2000, it is becoming clear that climate change will be far more difficult to solve than ozone depletion was. CFCs were produced by a handful of major international companies that were able to switch with relative ease to even more profitable substitute chemicals. But carbon dioxide emissions are a ubiquitous byproduct of modern life. Sharply limiting them will require not only far-reaching technological transformations, but also lifestyle changes on the part of billions of people. Steady growth in purchases of sport utility vehicles as well as the size of homes in the United States are among the many factors driving CO_2 emissions on their upward course.[40]

Despite the many differences between the two problems, the Montreal accord does provide a key precedent for action on climate change. As Richard Benedick, chief U.S. negotiator for the Montreal Protocol, explains it, "by providing CFC producers with the certainty that their sales were destined to decline, the protocol unleashed the creative energies and considerable resources of the private sector in the search for solutions. The treaty at one stroke changed the market rules and thereby made research into substitutes economically worthwhile." If it is to succeed, the Kyoto Protocol will have to have a similar effect on the world's energy economy.[41]

The last few years have brought some encouraging signs that such a transformation is beginning to take hold. Markets for wind and solar power are booming at double-digit

growth rates, while new industrial equipment and residential appliances are becoming steadily more efficient. In another promising development, most major auto makers have recently announced accelerated plans for the introduction of low-emission electric and fuel cell vehicles.[42]

And since 1997, even major fossil fuel companies, including British Petroleum, Royal Dutch Shell, and ARCO are beginning to figure Kyoto into their investment plans. British Petroleum has committed to building up its wind and solar energy businesses to at least $1 billion in annual sales over the next decade, and Shell has announced plans to invest $500 million over five years in renewable energy development. Both companies have also said they plan to cut their own greenhouse gas emissions by 10 percent, and have withdrawn from the Global Climate Coalition, an alliance of business groups that actively opposes the Kyoto Protocol. Mike Bowlin, the CEO of ARCO, went so far as to predict at a 1999 petroleum conference in Houston that "the last days of the age of oil" were near, and that oil companies should therefore broaden their energy investments.[43]

Despite these dramatic defections, major U.S. industry groups have continued efforts to sway public opinion against the climate change accord, in part by recruiting scientists to cast doubts on prevailing views about the seriousness of the problem. And despite studies indicating that the climate change treaty could lead to a net addition of nearly 800,000 new U.S. jobs, the AFL-CIO, which represents workers in industries such as mining and auto making, is maintaining its staunch opposition to the Kyoto Protocol, warning that it could have a "devastating effect on the U.S. economy and American workers."[44]

Although the stalemated climate politics of the past few years have led many observers to doubt whether the Kyoto Protocol will ever go into effect—and to question whether this may just be a problem so big that human society is not yet equipped to deal with it—the history of the Montreal process offers a sliver of optimism. As the ozone experience shows, scientific evidence can emerge unexpectedly and with dramatic effect, and politics can shift even more suddenly. The late 1990s already brought clear evidence that glaciers are melting worldwide, with scientists reporting a significant thinning in Greenland's ice sheet. Also, 1998's record temperatures appear to have precipitated a massive die-off in the world's ecologically rich coral reefs, with up to half now showing signs of temperature-induced "bleaching." The unprecedented storm damage of 1998 caused both untold human suffering and $92 billion in economic losses. Climate instability now threatens to rival financial instability for economic headlines in the early part of the new millennium.[45]

Even with such disturbing scientific developments, it may well be that it is the global economy rather than the global atmosphere that determines the outcome of the climate negotiations. At some point, key industries and governments may come to the same conclusion they reached with ozone depletion—that a major industrial transition is about to occur, and that the economic rewards will go to companies and countries that lead the way.

NOTES

CHAPTER 1. ONE WORLD?

1. Suzanne Pardee, "Demonstrators Swarm WTO Ministerial Meeting," *Environment News Service*, <www.ens.lycos.com/ens/nov99/1999L-11-30-01.html>, 30 November 1999; Bill McKibben, "Making Sense of the Battle in Seattle," 1 December 1999, available at <www.gristmagazine.com/grist/maindish/mckibben120199.stm>; Joseph Kahn and David E. Sanger, "Trade Obstacles Unmoved, Seattle Talks End in Failure," *New York Times*, 4 December 1999.

2. Steven Pearlstein, "Trade Theory Collides With Angry Reality," *Washington Post*, 3 December 1999.

3. For different takes on the meaning of globalization, see, for example, Wolfgang H. Reinicke, *Global Public Policy* (Washington, DC: Brookings Institution Press, 1998); David C. Korten, *When Corporations Rule the World* (West Hartford, CT: Kumarian Press, 1995); George Soros, *The Crisis of Global Capitalism* (New York: PublicAffairs, 1998); and Thomas L. Friedman, *The Lexus and the Olive Tree* (New York: Farrar, Straus and Giroux, 1999).

4. Table 1–1 based on the following sources: exports of goods from a Worldwatch data series derived from export values and the export unit value index (EUVI) supplied by Neil Austriaco,

Research Assistant, Statistics Division, International Monetary Fund (IMF), e-mails to Lisa Mastny, Worldwatch Institute, 14 December 1999; services data from Andreas Maurer, World Trade Organization (WTO), e-mail to Lisa Mastny, Worldwatch Institute, 20 January 1999, deflated using the EUVI; foreign direct investment (FDI) inflows from Lizanne Martinez, statistical assistant, U.N. Conference on Trade and Development (UNCTAD), e-mail to Lisa Mastny, 30 June 1999, and from UNCTAD, "Global Foreign Direct Investment Boomed in 1998, Fuelled By Mergers and Acquisitions," press release (Geneva: 22 June 1999); capital flows to developing countries from World Bank, *Global Development Finance 1999* (Washington, DC: 1999); number of transnational corporations (TNCs) from Joshua Karliner, *The Corporate Planet* (San Francisco, CA: Sierra Club Books, 1997), and from UNCTAD, *World Investment Report 1998* (New York: U.N., 1998); TNC sales from "Worldbeater, Inc.," *The Economist*, 18 January 1998, and from UNCTAD, *World Investment Report 1998*, op. cit. this note; world shipping from UNCTAD, *Review of Maritime Transport* (Geneva: various years), and from UNCTAD, "World Seaborne Trade Slows Down," press release (Geneva: 22 February 1999); unit cost of shipping from U.N. Development Programme (UNDP), *Human Development Report 1999* (New York: 1999); air transport data from Attilio Costaguta, Chief, Statistics and Economic Analysis Section, International Civil Aviation Organization (ICAO), e-mail to Lisa Mastny, Worldwatch Institute, 2 November 1998, and from ICAO, "World Airline Passenger Traffic Growth To Pick Up Through To 2001" (Montreal: 21 July 1999); air revenue from UNDP, op. cit. this note; tourism growth from Rosa Songel, Department of Statistics and Economic Measurement of Tourism, World Tourism Organization, e-mail to Lisa Mastny, Worldwatch Institute, 25 November 1999; 2 million crossing borders daily from Institute of Medicine, *America's Vital Interest in Global Health* (Washington, DC: National Academy Press, 1997); international refugees from U.N. High Commissioner for Refugees, "UNHCR by Numbers," <www.unhcr.ch/un&ref/numbers/table1.htm>, viewed 6 January 1999; total refugees from Michael Renner, "Refugee Numbers Drop Again," in Lester R. Brown, Michael Renner, and Brian Halweil, *Vital Signs 1999* (New York: W.W. Norton & Company, 1999); phone lines from International Telecommunication Union (ITU), *World Telecommunication Indicators on Diskette* (Geneva: 1996), and from ITU, "Telecommunications Industry at a Glance," <www.itu.int/ti/industryoverview/index.htm>, viewed 14 December 1999; phones in developing countries from ITU, *Indicators on Diskette*, op. cit. this note, from ITU, *Challenges to the Network: Telecoms and the Internet* (Geneva: September 1997), and from ITU, *World Telecommunication Development Report* (Geneva: 1999); phone cost from UNDP, op. cit. this note; Internet growth (measured by number of host computers) from Network Wizards, "Internet Domain Surveys, 1981–1999," <www.nw.com>, updated January 1999; 1998 users is a Worldwatch estimate of individuals who use the Internet on a weekly basis, based on Nua Ltd., "How Many Online?" <www.nua.ie>, updated February 1999, and on Computer Industry Almanac, Inc., *Internet User Forecast 1990–2005* (Arlington Heights, IL: 1999); on-line spending from Barry Parr, Internet and e-commerce analyst, International Data Corporation, Framingham, MA, discussion with Payal Sampat, Worldwatch Institute, 23 February 1999; Internet access from Computer Industry Almanac, Inc., op. cit. this note; unit cost of computing from UNDP, op. cit. this note; number of nongovernmental organizations from Union of International Associations, *Yearbook of International Organizations 1998–99* (Munich: K.G. Saur Verlag, 1999); survey of 22 nations from Lester M. Salamon and Helmut K. Anheier, *The Emerging Sector Revisited: A Summary of Initial Estimates* (Baltimore, MD: The Johns Hopkins University Center for Civil Society Studies, 1998).

5. Jared Diamond, *Guns, Germs, and Steel* (New York: W.W. Norton & Company, 1997); Clive Ponting, *A Green History of the World* (New York: Penguin Books, 1991); on earlier periods of globalization compared with today's, see Friedman, op. cit. note 3.

6. Figures on growth in world economy derived from Worldwatch data series for gross world product based on purchasing power parity, which is derived from Angus Maddison, *Monitoring the World Economy, 1820–1992* (Paris: Organisation for Economic Co-operation and Development (OECD), 1995), from Angus Maddison, *Chinese Economic Performance in the Long Run* (Paris: OECD, 1998), and from IMF, *World Economic Outlook and Interna-*

tional Capital Markets Interim Assessment, October 1999 (Washington, DC: 1999); exports and Figure 1–1 based on a Worldwatch data series derived from Austriaco, op. cit. note 4; share of exports in world economy based on these two series, versions of which are published in Brown, Renner, and Halweil, op. cit. note 4.

7. FDI from Martinez, op. cit. note 4, and from UNCTAD, "Global Foreign Investment Boomed in 1998," op. cit. note 4, with figures deflated using U.S. GNP Implicit Price Deflator, from U.S. Department of Commerce, *Survey of Current Business*, July 1999; TNCs from Karliner, op. cit. note 4, and from UNCTAD, op. cit. note 4; households from Investment Company Institute, "Mutual Fund Developments in 1998," in *Mutual Fund Factbook* (Washington, DC: May 1999); $16 billion from John Rea, "U.S. Emerging Market Funds: Hot Money or Stable Source of Investment Capital?" Investment Company Institute, December 1996; 1996 from Investment Company Institute, *Mutual Fund Factbook* (Washington, DC: 1997).

8. Ted C. Fishman, "The Joys of Global Investment," *Harper's Magazine*, February 1997.

9. Arctic contamination from Arctic Monitoring and Assessment Programme, *Arctic Pollution Issues: A State of the Arctic Environment Report* (Tromso, Norway: 1997).

10. Wood consumption figures from U.N. Food and Agriculture Organization (FAO), *FAO Forest Products Yearbook 1983–1994* (Rome: 1996); sixfold increase in paper use calculated from 46 million tons in 1950 from International Institute for Environment and Development, *Towards a Sustainable Paper Cycle* (London: 1996), and from 299 million tons in 1997 from Miller Freeman, Inc., *International Fact and Price Book 1999* (San Francisco: 1998); fivefold increase in fish consumption from FAO, *Yearbook of Fishery Statistics: Catches and Landings* (Rome: various years); water consumption from Sandra Postel, *Last Oasis*, rev. ed. (New York: W.W. Norton & Company, 1997); grain consumption figures from FAO, *The State of Food and Agriculture 1995* (Rome: 1995); steel use figures from International Iron and Steel Institute, *Steel Statistical Yearbook* (Brussels: various years); fossil fuel burning figures based on T.A. Boden, G. Marland, and R.J. Andres, *Estimates of Global, Regional and National Annual CO_2 Emissions From Fossil Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1950–92,* electronic database, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, TN, December 1995, and on British Petroleum, *BP Statistical Review of World Energy 1997* (London: Group Media & Publications, 1997); population figures for 1950 from U.S. Bureau of the Census, International Programs Center (IPC), *International Data Base*, electronic database, <www.census.gov/ipc/www/idbnew.html>, updated 28 December 1998, and for 1999 from U.S. Bureau of the Census, IPC, "World POPClock Projection," <www.census.gov/cgi-bin/ipc/popclockw>, viewed 23 November 1999.

11. Figure 1–2 and carbon dioxide concentrations from Seth Dunn, "Carbon Emissions Dip," in Brown, Renner, and Halweil, op. cit. note 4; warning on mass extinction from American Museum of Natural History, "National Survey Reveals Biodiversity Crisis—Scientific Experts Believe We Are in Midst of Fastest Mass Extinction in Earth's History," press release (New York: 20 April 1998); plant extinction data from Kerry S. Walter and Harriet J. Gillett, eds., *1997 IUCN Red List of Threatened Plants* (Gland, Switzerland: World Conservation Union (IUCN), 1997); mammal figures from Jonathan Baillie and Brian Groombridge, eds., *1996 IUCN Red List of Threatened Animals* (Gland, Switzerland: IUCN, 1997).

12. Mathis Wackernagel et al., "National Natural Capital Accounting with the Ecological Footprint Concept," *Ecological Economics*, vol. 29 (1999); Mathis Wackernagel and Alejandro Callejas, "The Ecological Footprint of 52 Nations (1995 data)," Redefining Progress, available at <www.rprogress.org>.

13. Dani Rodrik, "The Global Fix," *New Republic*, 2 November 1998.

CHAPTER 2. NATURE UNDER SIEGE

1. Warning on mass extinction from American Museum of Natural History, "National Survey Reveals Biodiversity Crisis—Scientific Experts Believe We Are in Midst of Fastest Mass Extinction in Earth's History," press release (New York: 20 April 1998).

2. Figure 2–1 based on the following sources: map of biodiversity hotspots and tropical wilderness areas provided by Stephen

Nash, State University of New York–Stony Brook, for Conservation International, e-mail to Liz Doherty, Worldwatch Institute, 22 October 1999; logging concessions in Cameroon, Cambodia, Madagascar, Guyana, Republic of Congo, Suriname, Côte d'Ivoire, Papua New Guinea, and Amazon basin from Cheri A. Sugal and Russell A. Mittermeier, "Transnational Logging Investments in the Major Tropical Wilderness Areas," *CI Policy Brief* (Washington, DC: Conservation International, summer 1999); U.S. oil development from Yereth Rosen, "Alaska's Nature Advocates Fret Over Oil Field 'Sprawl' in Arctic," *Christian Science Monitor*, 9 April 1998; Canadian mining from Julian Pettifer, "Arctic Diamonds," *Review* (Rio Tinto), June 1999; Baja saltworks from "Locals Tackle Ecologists Over Mexico Saltworks," *Reuters*, 6 July 1999; Mexican plantations from John Ross, "Big Pulp vs. Zapatistas," *Multinational Monitor*, April 1998; Mexican mining from Koren Capozza, "Mexican Town Protests Canadian Mining Operation," *Environment News Service*, <ens.lycos.com/ens/may99/1999L-05-14-03.html>, 14 May 1999, and from Border Ecology Project, "Environmental/Social Impacts of Multinational Mining Investment in Sonora, Mexico" (Bisbee, AZ: 26 October 1995); Colombian oil from Steven Dudley and Mario Murillo, "Oil in a Time of War," *NACLA Report on the Americas*, March-April 1998; Ecuadorean oil from "Texaco vs Ecuadorean Tribes," *Environment News Service*, <ens.lycos.com/ens/feb99/1999L-02-03-03.htm>, 3 February 1999; Peru from "The Mining Elite," *Tomorrow*, July/August 1998; Bolivia pipeline from Nancy Dunne, "OPIC Set to Approve Bolivian Pipeline Loan," *Financial Times*, 15 June 1999; Guyana mining from Forest Peoples Programme, "Guyana Government Grants 5.1 Million Acre Mining Concession on Indigenous Lands," *Guyana Information Update* (Moreton-in-Marsh, U.K.: 9 November 1998); Suriname mining from Forest Peoples Programme, "Maroon Community Petitions Suriname Government About the Operations of a US-Owned Bauxite Company," *Suriname Information Update* (Moreton-in-Marsh, U.K.: 17 September 1998); Chile mining from James Langman, "Environment Restriction on Mining in Chile Weak, Say Experts, United Nations Report," *International Environment Reporter*, 27 May 1998; Chile forest products from James Langman, "Eco-Activists Fight Projects Doubling

Chile Forest Exports," *Christian Science Monitor*, 4 March 1999; Mediterranean from World Wide Fund for Nature, "WWF Calls for Better Protection of Valuable Mediterranean Forests," press release (Gland, Switzerland: 1 July 1999); Ghana mining from Charles Abugre and Thomas Akabzaa, "Mining Boom—A Gain for Africa?" Third World Network, <www.twnside.org.sg/souths/twn/title/boom-cn.htm>, viewed 9 December 1998; Cameroon-Chad pipeline from "World Bank Completes Chad Oil Study, Waits for Consortium," *Reuters*, 12 November 1999; Philippines from Deborah Johansen, "Digging Upwards," *Tomorrow*, July/August 1998; Papua New Guinea mining from "Mine Closure Threatens Papua Economy Rescue Plans," *Reuters*, 13 August 1999; Papua New Guinea oil from Jared Diamond, "Paradise and Oil," *Discover*, March 1999; Indonesia mining from "Freeport Amends Motion in $6 Billion Suit Alleging Firm's Mine Degraded Environment," *International Environment Reporter*, 12 June 1996; Indonesia plantations from Japan Paper Association, *Pulp & Paper Statistics 1999* (Tokyo: 1999); New Zealand logging from Stephanie Nall and William Armbruster, "US Forest Products Companies Eye New Zealand," *Journal of Commerce*, 19 May 1997; Russia oil and gas from Bruce Forbes, "The End of the Earth," *Wild Earth*, fall 1999.

3. Stuart L. Pimm, "The Value of Everything," *Nature*, 15 May 1997; gross world product of $42 trillion is a Worldwatch estimate for 1998 derived from International Monetary Fund (IMF) figures, based on Lester R. Brown, "Global Economic Growth Slows," in Lester R. Brown, Michael Renner, and Brian Halweil, *Vital Signs 1999* (New York: W.W. Norton & Company, 1999).

4. Species loss from Joby Warrick, "Mass Extinction Underway, Majority of Biologists Say," *Washington Post*, 21 April 1998, and from American Museum of Natural History, op. cit. note 1; ecosystem transformation from Janet Abramovitz, "Ecosystem Conversion Spreads," in Lester R. Brown, Michael Renner, and Christopher Flavin, *Vital Signs 1997* (New York: W.W. Norton & Company, 1997).

5. Convention on Biological Diversity (CBD) Clearing-House Mechanism, "Text of the Convention on Biological Diversity (1992)," <www.biodiv.org/chm/conv/default.htm>, viewed 24 November 1999; ratification figure from United Nations, *The Unit-*

ed Nations Treaty Collection, electronic database, <www.un.org/Depts/Treaty>, viewed 2 December 1999.

6. Forest services from Norman Myers, "The World's Forests and Their Ecosystem Services," in Gretchen C. Daily, ed., *Nature's Services: Societal Dependence on Natural Ecosystems* (Washington, DC: Island Press, 1997); nearly half lost from Dirk Bryant, Daniel Nielsen, and Laura Tangley, *The Last Frontier Forests* (Washington, DC: World Resources Institute (WRI), 1997); 14 million hectares based on estimates in U.N. Food and Agriculture Organization (FAO), *State of the World's Forests 1999* (Rome: 1999).

7. Janet N. Abramovitz, *Taking a Stand: Cultivating a New Relationship with the World's Forests*, Worldwatch Paper 140 (Washington, DC: Worldwatch Institute, April 1998); countries where exports exceed domestic consumption from Nigel Sizer, David Downes, and David Kaimowitz, "Tree Trade: Liberalization of International Commerce in Forest Products: Risks and Opportunities," *Forest Notes* (WRI and Center for International Environmental Law), November 1999; growth of plywood exports in Indonesia and Malaysia are volume figures from FAO, *FAOSTAT Statistics Database*, electronic database, <apps.fao.org>, viewed 22 October 1999.

8. Nigel Dudley, Jean-Paul Jeanrenaud, and Francis Sullivan, "The Timber Trade and Global Forest Loss," *Ambio*, May 1998; frontier forests from Bryant, Nielsen, and Tangley, op. cit. note 6.

9. Figure 2–2 from FAO, op. cit. note 7, viewed 22 October 1999. All data deflated using the U.S. GNP Implicit Price Deflator provided in U.S. Department of Commerce, *Survey of Current Business*, July 1999; factors behind future growth from Victor Menotti, "Forest Destruction and Globalization," *The Ecologist*, May/June 1999.

10. Developing-country exports from FAO, op. cit. note 7; share of global loss from three countries from FAO, op. cit. note 6.

11. Scope of illegal trade from Dudley, Jeanrenaud, and Sullivan, op. cit. note 8, and from Rob Glastra, ed., *Cut and Run: Illegal Logging and Timber Trade in the Tropics* (Ottawa: International Development Research Centre, 1999); Mexico from "Mexico's Monarch Butterflies in Danger," *Environmental News Network*, <www.enn.com/enn-subsciber-news-archive/1999/02/021199/monarch.asp>, 11 February 1999.

12. United Nations Conference on Trade and Development (UNCTAD), *World Investment Report 1992* (New York: United Nations, 1992); Côte d'Ivoire figure from Nigel Dudley, Jean-Paul Jeanrenaud, and Francis Sullivan, *Bad Harvest: The Timber Trade and the Degradation of the World's Forests* (London: World Wide Fund for Nature and Earthscan, 1995); role of Japanese companies in 1970s and 1980s from Joshua Karliner, *The Corporate Planet: Ecology and Politics in the Age of Globalization* (San Francisco: Sierra Club Books, 1997).

13. Asian companies from Greenpeace International, *Logging the Planet: Asian Companies Marching Across Our Last Forest Frontiers* (Amsterdam: 1997), and from Carlos Sergio Figueiredo Tautz, "The Asian Invasion: Asian Multinationals Come to the Amazon," *Multinational Monitor*, September 1997; sale of logging rights from Sugal and Mittermeier, op. cit. note 2; record of timber companies from Nigel Sizer and Richard Rice, *Backs to the Wall in Suriname: Forest Policy in a Country in Crisis* (Washington, DC: WRI, April 1995).

14. Mexico from John Ross, "Treasure of the Costa Grande," *Sierra*, July/August 1996; Brazil from Ashley Mattoon, "Paper Forests," *World Watch*, March/April 1998; Chile from Langman, "Eco-Activists Fight Projects," op. cit. note 2; China from "APRIL Fine Paper's Changshu Mill Starts Production," *pponline.com Daily News*, <www.pponline.com>, viewed 25 March 1999; Indonesia from Lesley Potter and Justin Lee, *Tree Planting in Indonesia: Trends, Impacts and Directions*, Occasional Paper No. 18 (Bogor, Indonesia: Center for International Forestry Research, December 1998); for Argentina, and for a broader discussion of trends in the industry, see Janet N. Abramovitz and Ashley T. Mattoon, *Paper Cuts: Recovering the Paper Landscape*, Worldwatch Paper 149 (Washington, DC: Worldwatch Institute, December 1999); current Japanese investment from Japan Paper Association, op. cit. note 2.

15. Requirements of proposed agreement from "U.S. Says Trade Plan Won't Hurt Forests," *Reuters*, 4 November 1999; U.S. report from Office of the U.S. Trade Representative and White House Council on Environmental Quality, *Accelerated Tariff Liberalization in the Forest Products Sector: A Study of the Economic and*

Environmental Effects (Washington, DC: November 1999). For general discussions of the expected impact of trade liberalization on forests, see David Kaimowitz, "The Potential Environmental Impacts of Trade Liberalisation in Forest Products," *BRIDGES Weekly Trade News Digest*, July/August 1999, and Sizer, Downes, and Kaimowitz, op. cit. note 7.

16. Earthjustice Legal Defense Fund and Northwest Ecosystem Alliance, *Our Forests at Risk: The World Trade Organization's Threat to Forest Protection* (Seattle, WA: Earthjustice Legal Defense Fund, 1999); nontariff trade barriers from Forest Research, "Draft Study of Non-Tariff Measures in the Forest Products Sector in the APEC Economies, Part II: Inventory," study prepared for the Asia-Pacific Economic Cooperation Secretariat, August 1999.

17. John E. Young, *Mining the Earth*, Worldwatch Paper 109 (Washington, DC: Worldwatch Institute, July 1992); gold-to-waste ratio based on U.S. Bureau of Mines data provided in John E. Young, "Gold Production at Record High," in Lester R. Brown, Hal Kane, and David Malin Roodman, *Vital Signs 1994* (New York: W.W. Norton & Company, 1994); frontier forests from Bryant, Nielsen, and Tangley, op. cit. note 6.

18. Indigenous peoples figure from Roger Moody, "The Lure of Gold—How Golden Is the Future?" Panos Media Briefing No. 19 (London: Panos Institute, May 1996).

19. Minerals imports and exports are volume figures from UNCTAD, *Handbook of World Mineral Trade Statistics, 1992–1997* (Geneva: 1995).

20. U.S. mining industry from Christine A. Adamec, "Face Forward," *Mining Voice*, May/June 1996; 70 countries from William C. Symonds, "All that Glitters is Not Bre-X," *Business Week*, 19 May 1997.

21. Oil and gas reserves from BP Amoco, *BP Amoco Statistical Review of World Energy 1999* (London: 1999); *Oil and Gas Journal*, various issues.

22. Forest Stewardship Council (FSC) from FSC, "Who We Are," information sheet, <www.fscoax.org>, viewed 29 June 1999; growing demand from Sheila Polson, "'Green' Consumerism Starts to Benefit Some Forests," *Christian Science Monitor*, 31 March 1999; 17 million, 70 percent, and 30 countries from FSC, "Forests

Certified by FSC-Accredited Certification Bodies," information sheet, <www.fscoax.org/principal.htm>, viewed 11 October 1999; 1 million from "Limited Demand Seen for Goods Certified From Sustainable Forests, U.N. Report Says," *International Environment Reporter*, 28 October 1998; 200 million from World Wildlife Fund and World Bank, "What is the Forest Alliance?" information sheet, <www-esd.worldbank.org/wwf>, viewed 23 November 1999.

23. Trade in nontimber forest products from FAO, *State of the World's Forests 1997* (Rome: 1997); extractive reserves from John C. Ryan, "Goods From the Woods," *World Watch*, July/August 1991, and from Geoff Dyer, "Root and Branch Survival," *Financial Times*, 16–17 October 1999.

24. Crist Inman, "Impacts on Developing Countries of Changing Production and Consumption Patterns in Developed Countries: The Case of Ecotourism in Costa Rica," draft paper prepared for U.N. Environment Programme in conjunction with the Institute for Environmental Studies, Vrije Universiteit, Amsterdam, for "Global Product Chains: Northern Consumers, Southern Producers, and Sustainability," electronic conference hosted by the International Institute for Sustainable Development, <iisd.ca/susprod/ecotour.pdf>, viewed 5 December 1999; tourist arrivals from Rosa Songel, Department of Statistics and Economic Measurement of Tourism, World Tourism Organization, e-mail to Lisa Mastny, Worldwatch Institute, 25 November 1999; nature tourism figures from Fern L. Fillion, James P. Foley, and Andre J. Jaquemot, "The Economics of Global Ecotourism," paper presented at the Fourth World Congress on National Parks and Protected Areas, Caracas, Venezuela, 10–21 February 1992, as cited in The Ecotourism Society, "TES Statistical Fact Sheet," <www.ecotourism.org/tocfr.html>, viewed 14 January 1999, and from World Tourism Organization (WTO), *Yearbook of Tourism Statistics, Vol. 1* (Madrid: 1997); $1.6 billion and quote from WTO, "WTO Picks Hot Tourism Trends for 21st Century," press release (Madrid: 4 June 1998).

25. Environmental impacts of tourism from Dilys Roe, Nigel Leader-Williams, and Barry Dalal-Clayton, *Take Only Photographs, Leave Only Footprints*, IIED Wildlife and Development Series No. 10 (London: International Institute for Environment and Devel-

opment, October 1997); cultural impacts from Raymond Chavez, "Globalisation and Tourism: Deadly Mix for Indigenous Peoples," *Third World Resurgence*, March 1999; whale watching from Tim Padgett and Sharon Begley, "Beware of the Humans," *Newsweek*, 4 March 1996; Marcus Colchester and Fiona Watson, "Impacts of Ecotourism in Venezuela," November 1995, <www.txinfinet.com/mader/planeta/1195/1195ven.html>, viewed 28 April 1999.

26. For an example of possible local benefits from ecotourism, see Erin Trowbridge, "Eco-tourism Profits Find Way Back to Mexican Communities," *The Earth Times*, 4 October 1998; Costa Rica from Inman, op. cit. note 24, and from Costa Rican Tourism Institute, "Certification for Sustainable Tourism," <www.turismo-sostenible.co.cr/EN/home.shtml>, viewed 12 October 1999; Zimbabwe from Cheri Sugal, "The Price of Habitat," *World Watch*, May/June 1997; Rwanda from Rainforest Action Network, "Can Ecotourism Save the Rainforests?" information sheet, <www.ran.org/ran/info_center>, viewed 9 December 1998.

27. Background on bioprospecting from Walter V. Reid et al., *Biodiversity Prospecting: Using Genetic Resources for Sustainable Development* (Washington, DC: WRI, May 1993), and from Colin Macilwain, "When Rhetoric Hits Reality in Debate on Bioprospecting," *Nature*, 9 April 1998; CBD Clearing-House Mechanism, op. cit. note 5.

28. Reid et al., op. cit. note 27; Jeffrey A. McNeely, "Achieving Financial Sustainability in Biodiversity Conservation Programs," in *Investing in Biodiversity Conservation, Workshop Proceedings* (Washington, DC: Inter-American Development Bank, July 1997).

29. Macilwain, op. cit. note 27.

30. Suriname from Layla Hughes, Conservation International, letter to Payal Sampat, Worldwatch Institute, 1 October 1997. For descriptions of other bioprospecting programs, see, for example, "Access to Genetic Resources: An Evaluation of the Development and Implementation of Recent Regulation and Access Agreements," Environmental Policy Studies Working Paper #4, prepared for the Biodiversity Action Network by the Environmental Policy Studies Workshop, 1999 (New York: Columbia University School of International and Public Affairs, June 1999), and Julie M. Feinsilver, "Biodiversity Prospecting: A New Panacea for Development?" *Cepal Review*, December 1996.

31. Michael Totten, *Getting It Right: Emerging Markets for Storing Carbon in Forests* (Washington, DC: Forest Trends and WRI, 1999).

32. Ibid.

33. Ashley Mattoon, "Bogging Down In The Sinks," *World Watch*, November/December 1998; German Advisory Council on Global Change, *The Accounting of Biological Sinks and Sources Under the Kyoto Protocol: A Step Forwards or Backwards for Global Environmental Protection* (Bremerhaven, Germany: 1998).

CHAPTER 3. THE BIOTIC MIXING BOWL

1. Figure 3–1 based on U.N. Conference on Trade and Development (UNCTAD), *Review of Maritime Transport* (Geneva: various years), and on UNCTAD, "World Seaborne Trade Slows Down," press release (Geneva: 22 February 1999); Figure 3–2 based on International Civil Aviation Organization (ICAO), cited in Lisa Mastny, "Air Traffic Soaring," in Lester R. Brown, Michael Renner, and Brian Halweil, *Vital Signs 1999* (New York: W.W. Norton & Company, 1999), with 1998 figure from ICAO, "World Airline Passenger Traffic Growth to Pick Up Through to 2001," press release (Montreal: 21 July 1999).

2. This theme is fully set forth in a pioneering book by my colleague Chris Bright, which I have drawn on for this chapter; see Chris Bright, *Life Out of Bounds* (New York: W.W. Norton & Company, 1998), and Christopher Bright, "Invasive Species: Pathogens of Globalization," *Foreign Policy*, Fall 1999.

3. Bright, *Life Out of Bounds*, op. cit. note 2; world's vertebrates from World Resources Institute (WRI), *World Resources 1998–99* (New York: Oxford University Press, 1999); "almost half" from David S. Wilcove et al., "Quantifying Threats to Imperiled Species in the United States," *BioScience*, August 1998.

4. Bright, *Life Out of Bounds*, op. cit. note 2; John Yaukey, "Ships Carry Life, Chaos to Foreign Waters," *Gannett News Service,* 30 December 1998.

5. Bright, *Life Out of Bounds*.

6. Ibid.

7. Ibid.; WRI, op. cit. note 3; Lyle Glowka and Cyrille de Klemm, "International Instruments, Processes, Organizations and Non-Indigenous Species Introductions: Is a Protocol to the Convention on Biological Diversity Necessary?" in Odd Terje Sandlund, Peter Johan Schei, and Aslaug Viken, eds., *Proceedings of the Norway/UN Conference in Alien Species, Trondheim, 1–5 July 1996* (Trondheim, Norway: Directorate for Nature Management and Norwegian Institute for Nature Research, 1996).

8. Joby Warrick, "In U.S., An Asian Beetle Instills Full-Bore Economic Fear," *Washington Post*, 19 October 1998; Tom Baldwin, "Beetle Threat Could Force Change in Import Packaging," *Journal of Commerce*, 17 September 1998; European and Chinese restrictions from "China to Tighten Quarantine Rules on Wood Packing," *Reuters*, 2 November 1999.

9. World Wildlife Fund (WWF-US), "WWF Unveils Fourth 10 'Most Wanted' List," press release (Washington, DC: 3 June 1997).

10. Estimate of $10 million does not include timber and fisheries trade. This and species trade figures from TRAFFIC North America, "World Trade in Wildlife," information sheet (Washington, DC: July 1994); leading consumers from Peter H. Sand, "Commodity or Taboo? International Regulation of Trade in Endangered Species," in Helge Ole Bergesen and Georg Parmann, eds., *Green Globe Yearbook 1997* (Oxford: Oxford University Press, for the Fridtjof Nansen Institute, 1997); China and Southeast Asia from "Bear Parts Still in Demand in Asia," *Associated Press*, 26 October 1999, from Wendy Williams, "Turtle Tragedy," *Scientific American*, June 1999, and from Amy E. Vulpio, "From the Forests of Asia to the Pharmacies of New York City: Searching for a Safe Haven for Rhinos and Tigers," *Georgetown International Environmental Law Review*, vol. 11, no. 463 (1999); higher estimate of $20 million, illegal trade, and primate numbers from Statement by Shafqat Kakakhel, Deputy Executive Director, U.N. Environment Programme (UNEP), on behalf of the Executive Director, at UNEP Workshop on Enforcement and Compliance with Multilateral Environmental Agreements, Geneva, 12 July 1999.

11. Total of 146 countries from Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Secretariat, "What is CITES?" <www.cites.org/CITES>, viewed 2 December 1999; species bans and trade restrictions from TRAFFIC North America, "CITES," information sheet (Washington, DC: October 1997); banned and restricted totals from CITES Secretariat, "Protected Species," <www.cites.org/CITES>, viewed 18 November 1999; CITES successes from Sand, op. cit. note 10, and from Organisation for Economic Co-operation and Development, "Experience With the Use of Trade Measures in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)" (Paris: 1997).

12. History and effects of ivory ban from Caroline Taylor, "The Challenge of African Elephant Conservation," *Conservation Issues* (WWF-US), April 1997, and from TRAFFIC North America, "Elephant Ivory Trade," information sheet (Washington, DC: January 1997); recovery from "Kenyan Elephant Herd Recovering Slowly," *Environmental News Network*, <www.enn.com/news/wire-stories/1999/02/022299/elephants.asp>, 22 February 1999.

13. One-time trade from TRAFFIC International, "Ivory Trade Decisions at the 41st Meeting of the CITES Standing Committee," press release (Cambridge, U.K.: 11 February 1999); Kenya from "Call For Total Ban of Ivory Trade," *Panafrican News Agency,* 22 November 1999; Zimbabwe from Christopher Munnion, "Rangers Fear Rise in Ivory Poaching," *London Telegraph*, 24 November 1999.

14. "Half of World's Turtles Face Extinction, Scientists Say," *Environmental News Network*, <www.enn.com/news/enn-stories/1999/08/082699/freshturtle_5269.asp>, 26 August 1999; Williams, op. cit. note 10; TRAFFIC North America, "United States Supplies the World With Turtles," *Traffic North America Newsletter*, September 1998.

15. TRAFFIC North America, "Explosive Growth in US Live Reptile Trade Raises Conservation Fears," press release (Washington, DC: 10 September 1998); $30,000 from Michael Grunwald, "U.S. Bags Alleged Trafficker In Reptiles," *Washington Post*, 16 September 1998.

16. TRAFFIC International, "Yemeni Demand For Rhino Horn Daggers Continues," press release (Cambridge, U.K.: 7 May 1998).

17. On the role of the pet trade in bioinvasion, see Bright, *Life Out of Bounds*, op. cit. note 2; red-eared slider from TRAFFIC North America, op. cit. note 14.

18. Clive Ponting, *A Green History of the World* (New York: Penguin Books, 1991).

19. Mann quoted in Laurie Garrett, *The Coming Plague* (New York: Farrar, Straus, and Giroux, 1994).

20. Institute of Medicine, *America's Vital Interest in Global Health* (Washington, DC: National Academy Press, 1997).

21. World Health Organization (WHO), *Health and Environment in Sustainable Development: Five Years after the Earth Summit* (Geneva: 1997); David Pimentel et al., "Ecology of Increasing Disease," *BioScience*, October 1998.

22. HIV figures from Joint U.N. Programme on HIV/AIDS (UNAIDS), *AIDS Epidemic Update: December 1999* (Geneva: December 1999); Africa from UNAIDS, *Report on the Global HIV/AIDS Epidemic* (Geneva: June 1998).

23. Garrett, op. cit. note 19.

24. AIDS origins from "How AIDS Began," *The Economist*, 7 February 1998, and from Feng Gao et al., "Origin of HIV-1 in the Chimpanzee *Pan troglodytes troglodytes*," *Nature*, 4 February 1999; AIDS crossover from Donald G. McNeil, Jr., "The Great Ape Massacre," *New York Times Magazine,* 9 May 1999; human incursion from Jaap Goudsmit, "The Real Cause of the AIDS/HIV Epidemic: Destruction of Monkey and Ape Habitats in the African Rainforest," scientific abstract for presentation at the American Museum of Natural History's Spring Symposium on The Value of Plants, Animals, and Microbes to Human Health, 17–18 April 1998.

25. Bushmeat from Anthony L. Rose, The Bushmeat Project, "Growing Illegal Commerce in African Bushmeat Destroys Great Apes and Threatens Humanity," prepared for the American Zoo Association, 1999, <biosynergy.org/bushmeat/bmcommerce 199.htm>, viewed 23 June 1999; Hahn quoted in McNeil, op. cit. note 24.

26. Garrett, op. cit. note 19.

27. Mann quote from ibid.

28. New diseases from WHO, *Report on Infectious Diseases: Removing Obstacles to Healthy Development* (Geneva: 1999); Lynne Duke, "A Watch is Posted for Dead Crows," *Washington Post*, 29 September 1999; Andrew C. Revkin, "Mosquito Virus Exposes the Hole in the Safety Net," *New York Times*, 4 October 1999.

29. Quote and environmental changes from WHO, op. cit. note 21.

30. Rohit Burman, Kelly Kirschner, and Elissa McCarter, "Infectious Disease as a Global Security Threat," *Environmental Change and Security Project Report* (Woodrow Wilson Center), spring 1997; Peru and Americas infection and mortality figures from Pan American Health Organization, *Cholera Situation in the Americas* (Washington, DC: updated 24 July 1997); figure of $770 million from WHO, op. cit. note 28.

31. WHO, op. cit. note 28; WRI, op. cit. note 3.

32. Climate change from Paul R. Epstein, *Global Warming: Health and Disease* (Washington, DC: WWF-US, 1999); Epstein quoted in WWF-US, "Health Effects of Warming Could Be Devastating, WWF Report Finds," press release (Washington, DC: 5 November 1998).

33. Epstein, op. cit. note 32; "Extreme Weather's Effect on Health Measured," *Environmental News Network*, <www.enn.com/news/enn-stories/1999/02/021699/health.asp>, 16 February 1999.

34. History of international health cooperation from Richard N. Cooper, "International Cooperation in Public Health as a Prologue to Macroeconomic Cooperation," in Richard N. Cooper et al., *Can Nations Agree?* (Washington, DC: The Brookings Institution, 1989).

CHAPTER 4. GLOBAL GROCERS

1. Chiapas uprising from Michael Renner, "Chiapas: The Fruits of Despair," *World Watch*, January/February 1997; effects of North American Free Trade Agreement (NAFTA) on farmers from U.N. Development Programme (UNDP), *Human Development Report 1997* (New York: Oxford University Press, 1997).

2. Importance of agriculture from Walden Bello, "Asia, Asian Farmers, and the WTO," *Focus on the Global South*, July 1999; figures on agriculture's importance in low-income countries from "Further Liberalization in Agriculture Will Be Pushed By Develop-

ing Countries; Other Ag Trade Issues," *BRIDGES Weekly Trade New Digest*, 3 May 1999, and from U.N. Food and Agriculture Organization (FAO), *FAOSTAT Statistics Database*, electronic database, <apps.fao.org>, viewed 5 December 1999; Japanese negotiator quoted in Elizabeth Olson, "Serious Issues Behind Divisions as WTO Searches for a Leader," *New York Times*, 15 May 1999.

3. Figure 4–1 from FAO, op. cit. note 2, viewed 17 November 1999, with figures deflated using U.S. GNP Implicit Price Deflator from U.S. Department of Commerce, *Survey of Current Business*, July 1999; 11 percent and continental breakdown from World Trade Organization (WTO), *Annual Report 1998* (Geneva: 1998); relative importance of food grains versus nonessentials from FAO, op. cit. note 2, viewed 3 December 1999.

4. Grain trade statistics from U.S. Department of Agriculture (USDA), *Production, Supply, and Distribution*, electronic database, Washington, DC, updated 9 April 1999; FAO low-income food-deficit countries from FAO, Special Programme for Food Security, "Low-income Food-deficit Countries," information sheet, <www.fao.org/spfs/lifdc-e.htm>, viewed 22 November 1999.

5. Grain trade during Roman empire from Susan Raven, *Rome in Africa* (New York: Routledge, 1993); historical trends from Lester R. Brown, *Who Will Feed China?* (New York: W.W. Norton & Company, 1995), derived and updated from USDA, op. cit. note 4, November 1994 and December 1999.

6. Brown, op. cit. note 5.

7. FAO, op. cit. note 2, viewed 6 December 1999.

8. Developing countries' share of exports (by volume) from ibid.; long-term decline in commodity prices from World Bank, *Global Development Finance 1999* (Washington, DC: 1999); Central and South America from Lori Ann Thrupp, *Bittersweet Harvests for Global Supermarkets* (Washington, DC: World Resources Institute (WRI), 1995); Chile from Nick Robins and Sarah Roberts, *Unlocking Trade Opportunities: Case Studies of Export Success from Developing Countries*, prepared for the U.N. Department of Policy Co-ordination and Sustainable Development (London: International Institute for Environment and Development, 1998).

9. Angela Paxton, *The Food Miles Report: The Dangers of Long-Distance Food Transport* (London: National Food Alliance, 1994); Wuppertal Institute, *Road Transport of Goods and the Effects on the Spatial Environment*, July 1993, cited in Richard Douthwaite, *Short Circuit* (Devon, U.K.: Green Books, 1996).

10. Sandra Postel, *Pillar of Sand* (New York: W.W. Norton & Company, 1999).

11. Ibid.

12. For a discussion of proposals for international water transport, see Peter H. Gleick, *The World's Water: The Biennial Report on Freshwater Resources 1998–1999* (Washington, DC: Island Press, 1998); Canadian case from Anthony DePalma, "Free Trade in Fresh Water? Canada Says No," *New York Times*, 7 March 1999; International Joint Commission, "IJC to Hold Public Hearings on Uses, Diversions, and Bulk Exports of Great Lakes Water," press release (Washington, DC: 22 February 1999).

13. On the implications of NAFTA and the WTO, see Maude Barlow, *Blue Gold: The Global Water Crisis and the Commodification of the World's Water Supply* (San Francisco, CA: International Forum on Globalization, June 1999); on the Sun Belt case, see "Canada's Efforts to Protect Water Hit Turbulence," *Reuters*, 2 December 1999.

14. For implications of agricultural transformations on women, see, for example, Jodi Jacobson, *Gender Bias: Roadblock to Sustainable Development*, Worldwatch Paper 110 (Washington, DC: Worldwatch Institute, September 1992); Vandana Shiva, *Staying Alive: Women, Ecology and Survival in India* (New York: St. Martin's Press, 1989); and FAO, "Women Feed the World," prepared for World Food Day, 16 October 1998 (Rome: 1998). For a discussion of the social fallout of export agriculture in Costa Rica, see Alicia Korten, *A Bitter Pill: Structural Adjustment in Costa Rica* (Oakland, CA: Institute for Food and Development Policy, June 1995).

15. Recent fires from "Indonesian Fires Blamed on Plantations," *Reuters*, 10 August 1999, from "With Nothing Left to Burn, Fires Mostly Out," *Washington Post*, 25 April 1998, and from "Asian Nations Reach Accord on Fighting Haze," *Washington Post*, 24 December 1997; palm oil exports from FAO, op. cit. note 2, viewed 6 December 1999; effects of International Monetary Fund program on Indonesia's forests from William D. Sunderlin, Con-

sultative Group on International Agricultural Research, "Between Danger and Opportunity: Indonesia's Forests in an Era of Economic Crisis and Political Challenge" (Bogor, Indonesia: Center for International Forestry Research, 11 September 1998); Amazon Basin from Atossa Soltani and Tracey Osborne, *Arteries for Global Trade, Consequences for Amazonia* (Malibu, CA: Amazon Watch, April 1997), and from Peter May, Ana Célia Castro, and Antonio Barros de Castro, "Expansion and Technical Innovation in Brazil's Soybean-Based Agroindustrial Complex," in Bradford S. Gentry, ed., *Private Capital Flows and the Environment: Lessons from Latin America* (Cheltenham, U.K.: Edward Elgar Press, 1998).

16. Colombian study and 20 percent reported in Thrupp, op. cit. note 8; Colombia Human Rights Committee study cited in Pesticide Action Network North America, "Colombian Flower Worker Dismissed from Job Following U.S. Tour," press release (San Francisco, CA: 26 May 1993); U.S. market from Larry Rohter, "Foreign Presence in Colombia's Flower Gardens," *New York Times*, 8 May 1999.

17. Thrupp, op. cit. note 8.

18. Central American beef from Cary Fowler and Pat Mooney, *Shattering: Food, Politics and the Loss of Genetic Diversity* (Tucson: University of Arizona Press, 1990); U.S. appetite from Alan B. Durning, "Fat of the Land," *World Watch*, May/June 1991; Botswana land degradation from Alan B. Durning and Holly B. Brough, *Taking Stock: Animal Farming and the Environment*, Worldwatch Paper 103 (Washington, DC: Worldwatch Institute, July 1991); Botswana beef exports from FAO, op. cit. note 2, viewed 6 December 1999; Somalia from Bruce Byers, "Roots of Somalia's Crisis," *Christian Science Monitor*, 24 December 1992.

19. Economic dependence on fish from Anne Platt McGinn, *Rocking the Boat: Conserving Fisheries and Protecting Jobs*, Worldwatch Paper 142 (Washington, DC: June 1998); share of animal protein from Edmondo Laureti, *Fish and Fishery Products: World Apparent Consumption Statistics Based on Food Balance Sheets (1961–1995)* (Rome: FAO, November 1998); 1 billion and Asian dependence from WRI, *World Resources 1996–97* (New York: Oxford University Press, 1996); fishing grounds from Maurizio Perotti, Fishery Data, Information, and Statistics Unit, FAO Fisheries Department, e-mail to Anne Platt McGinn, Worldwatch Institute, 14 October 1997; overexploitation from FAO, *The State of World Fisheries and Aquaculture, 1996* (Rome: 1997).

20. Data for Figure 4–2 and share of industrial and developing countries from Sara Montanaro, Statistical Clerk, Fishery Information, Data, and Statistics Unit, FAO Fisheries Department, Rome, e-mail to Lisa Mastny, 6 September 1999, and from FAO, *Yearbook of Fishery Statistics*, vol. 45 (Rome: 1978); share of fish traded today (1997 data) from FAO, *Yearbook of Fishery Statistics*, vol. 84 (Rome: 1999), and from FAO, *Yearbook of Fishery Statistics*, vol. 85 (Rome: 1999); share traded in 1970 from FAO, vol. 45, op. cit. this note; four developing countries from FAO, *Yearbook of Fishery Statistics*, vol. 53 (Rome: 1983), and from FAO, vol. 85, op. cit. this note. All figures expressed in 1998 dollars and deflated as described in note 3.

21. Law of the Sea from United Nations, Division for Ocean Affairs and the Law of the Sea, "United Nations Convention on the Law of the Sea," <www.un.org/Depts/los/unclos/closindx.htm>, viewed 23 November 1999; long-distance fleets from World Wide Fund for Nature (WWF International), *The Footprint of Distant Water Fleets on World Fisheries* (Gland, Switzerland: 1998); African access agreements from Gareth Porter, "Euro-African Fishing Agreements: Subsidizing Overfishing in African Waters," in Scott Burns, ed., *Subsidies and Depletion of World Fisheries: Case Studies* (Washington, DC: Endangered Seas Campaign, World Wildlife Fund, April 1997), and from Okechukwu C. Iheduru, "The Political Economy of Euro-African Fishing Agreements," *The Journal of Developing Areas*, October 1995; Pacific access from Lisa K. Bostwick, "Empowering South Pacific Fishmongers: A New Framework for Preferential Access Agreements in the South Pacific Tuna Industry," *Law & Policy in International Business*, vol. 26 (1995).

22. Deprivation of small-scale fishers from George Kent, "Fisheries, Food Security, and the Poor," *Food Policy*, vol. 22, no. 5 (1997), from George Kent, *Nutrition Rights and Fisheries*, prepared for Greenpeace International, 19 September 1994, and from Mahfuzuddin Ahmed, "Fish for the Poor Under a Rising Global Demand and Changing Fishery Regime," *NAGA, The ICLARM Quarterly*, July/December 1997; Senegal from Kelly Haggart,

"Exporting More, Eating Less," *Panoscope*, November 1992, and from Harry de Vries, "The Fight for Fish: Towards Fair Fisheries Agreements" (Brussels: Eurostep, May 1996).

23. Ratio of one to five from FAO, *State of World Fisheries and Aquaculture 1998* (Rome: 1999); other information from McGinn, op. cit. note 19.

24. UNDP, *Human Development Report 1998* (New York: Oxford University Press, 1998); Thai shrimp production from FAO, op. cit. note 2; Ecuadorean and Thai shrimp exports from FAO, vol. 85, op. cit. note 20; Thai shrimp aquaculture production from FAO, *Aquaculture Production Statistics 1988–1997* (Rome: 1999); effects of Asian crisis from "Thailand Sees Lower Shrimp Production in 1999," *Reuters*, 7 June 1999; Ecuadorean export earnings from International Monetary Fund, *International Financial Statistics* (Washington, DC: September 1999); repercussions from Mike Hagler, "Shrimp—The Devastating Delicacy: The Explosion of Shrimp Farming and the Negative Impacts on People and the Environment," *Ecological Economics Bulletin*, Third Quarter 1998.

25. Hagler, op. cit. note 24.

26. Varieties of sweet potato from John C. Ryan, *Life Support: Conserving Biodiversity*, Worldwatch Paper 108 (Washington, DC: Worldwatch Institute, April 1991). For a general discussion of the value of and threats to plant genetic diversity, see John Tuxill, *Nature's Cornucopia: Our Stake in Plant Diversity*, Worldwatch Paper 148 (Washington, DC: Worldwatch Institute, September 1999).

27. Loss of 75 percent of crop diversity and Mexico from FAO, *State of the World's Plant Genetic Resources* (Rome: 1996); role of Green Revolution from Tuxill, op. cit. note 26; U.S. corn from Ryan, op. cit. note 26; India from Reed Karaim, "Variety, the Vanishing Crop," *Washington Post*, 11 April 1999.

28. Clive Jones, *PREVIEW: Global Review of Commercialized Transgenic Crops: 1999* (Ithaca, NY: International Service for the Acquisition of Agri-Biotech Applications, 1999); Scott Kilman, "Once Quick Converts, Farmers Begin to Lose Faith in Biotech Crops," *Wall Street Journal*, 19 November 1999.

29. For various perspectives on biotechnology's role, see

Brian Halweil, "The Emperor's New Crop," *World Watch*, July/August 1999; FAO, "Biotechnology," Item 7 of the Provisional Agenda for the 15th Session of the FAO Committee on Agriculture, held in Rome, 25–29 January 1999, <www.fao.org/unfao/bodies/COAG/COAG15/X0074E.htm>, viewed 21 May 1999; and John Madeley, "Genetic Engineering Will Not Feed Hungry, Say Africans," *Financial Times*, 16 March 1999.

30. Halweil, op. cit. note 29; 80 percent from Steve Suppan, "Biotechnology's Takeover of the Seed Industry," information sheet (Minneapolis, MN: Institute for Agriculture and Trade Policy (IATP), 13 July 1998).

31. Controversial patents from Genetic Resources Action International, "Patenting Life: Progress or Piracy?" *Global Biodiversity*, spring 1998; consolidation and industry giants from Halweil, op. cit. note 29, and from "Private Parts: Privatisation and the Life Industry," *Development Dialogue*, Special Issue 1996.

32. Tuxill, op. cit. note 26; Kristin Dawkins and Steve Suppan, *Sterile Fields: The Impacts of Intellectual Property Rights and Trade on Biodiversity and Food Security* (Minneapolis, MN: IATP, November 1996); Geoff Tansey, "Trade, Intellectual Property, Food and Biodiversity," a discussion paper commissioned by Quaker Peace and Service, London, in association with Quaker United Nations Office, Geneva, February 1999.

33. For a description of the WTO's Agreement on Agriculture, see Jeffrey S. Thomas and Michael A. Meyer, *The New Rules of Global Trade* (Scarborough, ON, Canada: Carswell Thomas Professional Publishing, 1997).

34. Historical backdrop from WWF International, *Agriculture in the Uruguay Round: Implications for Sustainable Development in Developing Countries* (Gland, Switzerland: January 1995); Robert Repetto, *Trade and Sustainable Development*, UNEP Environment and Trade Series No. 1 (Nairobi: U.N. Environment Programme, 1994).

35. Caroline LeQuesne, *Reforming World Trade: The Social and Environmental Priorities* (Oxford: Oxfam Publications, 1996).

36. The least developed countries are exempt from the requirements to phase out import restrictions, per LeQuesne, op. cit. note 35, and Thomas and Meyer, op. cit. note 33; information

on agriculture agreement from these sources and from WWF International, op. cit. note 34; Laranjo quoted in Kevin Watkins, "Free Trade and Farm Fallacies: From the Uruguay Round to the World Food Summit," *The Ecologist*, November/December 1996.

37. Bello, op. cit. note 2. See also "Japan to Take Food Security Stance in WTO Ag Talks," *BRIDGES Weekly Trade News Digest*, 26 July 1999, and "Agricultural Subsidies Again Emerge as Top Priority of New WTO Round," *BRIDGES Between Trade and Sustainable Development*, April 1999.

38. On the benefits of local agriculture, see Richard Douthwaite, *Short Circuit: Strengthening Local Economies for Security in an Unstable World* (Foxhole, Dartington, U.K.: Green Books, 1996), and Molly O'Meara, *Reinventing Cities for People and the Planet,* Worldwatch Paper 147 (Washington, DC: Worldwatch Institute, June 1999).

39. Background on fair trade movement from Vicki Elkin, "Fairer Trade," *World Watch*, July/August 1992, and from Bert Beekman, "Fair Trade and Trade Development," *ILEIA Newsletter*, December 1998; Dutch coffee imports from Stichting Max Havelaar, "Essential Points from the 1998 Annual Report Max Havelaar Foundation," information sheet (Utrecht, Netherlands: 1999); TransFair from Robert A. Rice and Justin R. Ward, *Coffee, Conservation, & Commerce in the Western Hemisphere* (Washington, DC: Smithsonian Migratory Bird Center and Natural Resources Defense Council, June 1996).

40. Rice and Ward, op. cit. note 39; Alexandra Marks, "Environmentalists Target Java-Drinkers to Save Birds," *Christian Science Monitor*, 10 July 1997.

41. Value of world organic market from Bernward Geier, "The Organic Market: Opportunities and Challenges," *ILEIA Newsletter*, December 1998; projected growth from Peter Ford, "Organic Farmers Hear a Call: If You Grow It, They Will Buy," *Christian Science Monitor*, 24 March 1999; $4.7 billion from Organic Trade Association, "Organic Trade Association Questions Timing of USDA 'Issue Papers' on Organic Rule," press release (Greenfield, MA: 26 October 1998); 3–5 million consumers is a conservative estimate from Gary Gardner, "Organic Farming Up Sharply," in Lester R. Brown, Christopher Flavin, and Hal Kane, *Vital Signs 1996* (New York: W.W. Norton & Company, 1996).

42. Gardner, op. cit. note 41; Robins and Roberts, op. cit. note 8.

43. Gary C. Groves, "Update on Argentina's Organic Sector 1998," Global Agriculture Information Network Report #AR8066 (Buenos Aires: USDA, Foreign Agricultural Service, 15 October 1998).

44. Andrew Wheat, "Toxic Bananas," *Multinational Monitor*, September 1996; Rainforest Alliance programs from Rainforest Alliance, "The Conservation Agriculture Program," and "Program Description," <www.rainforest-alliance.org/programs/cap>, viewed 13 October 1999; Chiquita Brands, Inc., "Better Banana Project," information sheet, <www.envirochiquita.com>, viewed 13 October 1999; "fair trade banana" from Andrea Spencer-Cooke, "Eco-Labeling Goes Bananas," *Tomorrow*, September/October 1997.

45. Marine Stewardship Council (MSC), "Our Empty Seas: A Global Problem, A Global Solution," information brochure (London: April 1999); membership from MSC, "MSC Signatories," <www.msc.org>, viewed 23 November 1999; Unilever pledge from MSC, "Position Paper Submitted to the Seventh Session of the UN Commission on Sustainable Development 1999 (CSD-7)," New York, 19 April 1999; MSC symbol debut from MSC, "First Certifications in Closing Stages," *MSC News*, October 1999.

46. WWF International, "Directing WTO Negotiations toward Sustainable Agriculture and Rural Development," WWF Discussion Paper (Gland, Switzerland: November 1999); Mark Musick, "Report on NGO Food and Agriculture Day in Seattle," on list serve <road_to_seattle@iatp.org>, posted 13 December 1999.

47. Joseph Kahn and David E. Sanger, "Trade Obstacles Unmoved, Seattle Talks End in Failure," *New York Times*, 4 December 1999.

CHAPTER 5. THE EXPORT OF HAZARD

1. Bhopal events and quote from Sanjoy Hazarika, *Bhopal: The Lessons of a Tragedy* (New Delhi: Penguin Books, 1987); deaths from Satinath Sarangi, "The Union Carbide Disaster In Bhopal—A Report From 1996" (Bhopal, India: Bhopal Group for

Information and Action, 1996).

2. Ash disposal attempts from Hilary F. French, "A Most Deadly Trade," *World Watch*, July/August 1990; eventual dumping from Greenpeace International, "The Basel Ban—The Pride of the Basel Convention" (Amsterdam: September 1995).

3. Nana quote from French, op. cit. note 2; Greenpeace International, op. cit. note 2; Center for Investigative Reporting (CIR) and Bill Moyers, *Global Dumping Ground: The International Traffic in Hazardous Waste* (Washington, DC: Seven Locks Press, 1990).

4. Waste import bans and history of convention from Greenpeace International, op. cit. note 2; 2.6 million tons from Greenpeace International, *The Database of Known Hazardous Waste Exports from OECD to Non-OECD Countries, 1989–March 1994* (Washington, DC: 1994), cited in World Resources Institute (WRI), *World Resources 1998–99* (New York: Oxford University Press, 1999); documented dumpings from Aaron Sachs, *Eco-Justice: Linking Human Rights and the Environment*, Worldwatch Paper 127 (Washington, DC: Worldwatch Institute, December 1995), citing U.N. Environment Programme (UNEP), "Generation of Hazardous Wastes and Other Wastes, 1993 Statistics," paper prepared for the Third Meeting of the Conference of the Parties to the Basel Convention, Geneva, 18–22 September 1995.

5. Unilateral bans and quote from Greenpeace International, op. cit. note 2; requirements for ratification from Camila Reed, "INTERPOL-UNEP Link-Up to Attack Toxic Waste Trade," *Reuters*, 24 February 1999; 13 countries from United Nations, *The United Nations Treaty Collection*, electronic database, <www.un.org/Depts/Treaty>, viewed 5 December 1999; opposition from Basel Action Network (BAN), "Basel Ban Victory at COP4," <www.ban.org>, viewed 5 June 1999.

6. UNEP, "Hazardous Wastes Talks to Consider Liability Regime for Basel Convention," press release (Nairobi: 9 April 1999); Portas quote from Reed, op. cit. note 5; illegal shipments from WRI, op. cit. note 4.

7. Rone Tempest, "Asia's Toxic Formula for Waste," *Los Angeles Times*, 4 March 1999; "WHO Says Waste Dumped in Cambodia May Pose Long-Term Threat to Health," *International Environment Reporter*, 6 January 1999.

8. Taiwanese awareness in Tempest, op. cit. note 7; Environmental Protection Agency reversal from BAN, "Victory for Environmental Justice: Mercury Waste from Taiwan Dumped in Cambodia Will Not Be Re-dumped in California," press release (Seattle, WA: 31 March 1999); other disposal efforts and recent events from BAN, "Asian Poisons to France: Green Groups Condemn Plan of 'Free Trade' In Toxic Waste," press release (Seattle, WA: 30 September 1999), and from Chiu Yu-Tzu, "France Says No to FPG's Toxic Waste," *Taipei Times*, 10 November 1999.

9. Fred Pearce, "Northern Exposure," *New Scientist*, 31 May 1997.

10. Theo Colburn, Dianne Dumanoski, and John Peterson Myers, *Our Stolen Future* (New York: Plume Books, March 1997); Pearce, op. cit. note 9.

11. Colburn, Dumanoski, and Myers, op. cit. note 10; Éric Dewailly et al., "Concentration of Organochlorines in Human Brain, Liver, and Adipose Tissue Autopsy Samples from Greenland," *Environmental Health Perspectives*, October 1999.

12. Pesticide use from David Pimental, Cornell University, e-mail to Brian Halweil, Worldwatch Institute, 15 January 1999; toxicity levels from David Pimentel et al., "Ecology of Increasing Diseases," *BioScience*, October 1998; Figure 5–1 based on data in U.N. Food and Agriculture Organization (FAO), *FAOSTAT Statistics Database*, electronic database, <www.apps. fao.org>, viewed 30 November 1999, with figures deflated using the U.S. G.N.P. Implicit Price Deflator provided in U.S. Department of Commerce, *Survey of Current Business*, July 1999; pesticide bans and "dirty dozen" from Pesticide Action Network North America, "Over 90 Countries Have Banned 'Dirty Dozen' Pesticides," press release (San Francisco: 23 October 1995); "circle of poison" from David Weir and Mark Schapiro, *Circle of Poison : Pesticides and People in a Hungry World* (Oakland, CA: Food First Books, February 1981).

13. Lack of gear and legible labels from Barbara Dinham, *The Pesticide Hazard* (London: Zed Books, 1993); vague labeling from Foundation for Advancements in Science and Education (FASE), *Exporting Risk: Pesticide Exports from US Ports 1995–96* (Los Angeles, CA: spring 1998); World Health Organization estimates of pesticide poisonings cited in Barbara Dinham, "The Success of a

Voluntary Code in Reducing Pesticide Hazards in Developing Countries," in Helge Ole Bergesen and Georg Parmann, eds, *Green Globe Yearbook 1996* (Oxford: Oxford University Press, for the Fridtjof Nansen Institute, 1996).

14. Jim Morris, "Exporting Sterility: Perils of the Pesticide Trade," *U.S. News and World Report*, 10 May 1999; Costa Rican imports from Andrew Wheat, "Toxic Bananas," *Multinational Monitor*, September 1996.

15. Class action suit and Levy quote from Morris, op. cit. note 14.

16. FASE, op. cit. note 13.

17. Ibid.

18. FAO, "FAO Warns of the Dangerous Legacy of Obsolete Pesticides," press release (Rome: 24 May 1999).

19. Ibid.

20. Industry-government collaboration from Jonathan Dahl, "Canada Encourages Mining of Asbestos, Sells to Third World," *Wall Street Journal*, 12 September 1989; Canadian exports from Bill Schiller, "Why Canada Pushes Killer Asbestos," *Toronto Star*, 20 March 1999; World Trade Organization (WTO) and European Union from Daniel Pruzin, "WTO Ruling on France's Asbestos Ban Delayed Until March 2000, EU Official Says," *International Environment Reporter*, 29 September 1999.

21."Treaty on Prior Informed Consent Signed By 57 Countries at Rotterdam Meeting," *International Environment Reporter*, 16 September 1998; FAO Code of Conduct from Dinham, *The Pesticide Hazard*, op. cit. note 13; on negotiations on persistent organic pollutants, see Anne Platt McGinn, "Phasing Out Persistent Organic Pollutants," in Lester R. Brown et al., *State of the World 2000* (New York: W.W. Norton & Company, 2000).

22. Production trends and asbestos deaths from Dennis Cauchon, "The Asbestos Epidemic—A Global Crisis," *USA Today*, 8 February 1999; Brazil from WRI, op. cit. note 4.

23. Car battery exports and health concerns from CIR and Moyers, op. cit. note 3; Brazil, India, and China from Greenpeace International, *Lead Astray Again: The Ongoing Illegal Trade of U.S. Scrap Lead Acid Batteries to Brazil* (Amsterdam: August 1997).

24. Share of production in developing countries from U.N. Industrial Development Organization, *International Yearbook of Industrial Statistics* (Vienna: 1999); U.S. foreign direct investment outflows from U.S. Department of Commerce, *Survey of Current Business*, September 1999.

25. High-tech hazards from Bill Richards, "Semiconductor Plants Aren't Safe and Clean As Billed, Some Say," *Wall Street Journal*, 5 October 1998, and from John E. Young, *Global Network: Computers in a Sustainable Society,* Worldwatch Paper 115 (Washington, DC: Worldwatch Institute, September 1993); 29 sites from Ted Smith, "The Dark Side of High-Tech Development" (San Jose, CA: Silicon Valley Toxics Coalition (SVTC), 11 August 1998).

26. Spread of high-tech and Philippines figures from Chito Salazar, "Semi-Conductors from the Philippines," paper prepared for UNEP and for "Global Product Chains: Northern Consumers, Southern Producers, and Sustainability," electronic conference, hosted by the International Institute for Sustainable Development, <iisd.ca/susprod/semiconduct.pdf>, viewed 14 June 1999; SVTC review from Carlos Plazola, "The Globalization of High Tech: Environmental Injustices Plague Industry" (San Jose, CA: SVTC, 1996), and from SVTC, "Global Manufacturing and Assembly Facilities for the Computer Manufacturing Industry," information sheet (San Jose, CA: April 1997).

27. For a review of the literature on this subject, see WTO, *Trade and the Environment* (Geneva: 1999).

28. For a full though somewhat dated discussion of the role of environmental factors in companies' location decisions, see H. Jeffrey Leonard, *Pollution and the Struggle for the World Product* (Cambridge, U.K.: Cambridge University Press, 1988); on the North American Free Trade Agreement (NAFTA) debate's focus on the border area, see, for example, John Holusha, "Trade Pact May Intensify Problems at the Border," *New York Times*, 20 August 1992; number of manufacturing plants from International Labour Organisation (ILO), "Labour and Social Issues Relating to Export Processing Zones" (Geneva: August 1998); Mexicali from Roberto Sanchez, "Health and Environmental Risks of the Maquiladora in Mexico," *Natural Resources Journal*, Winter 1990.

29. S.J. Lewis et al., *Border Trouble: Rivers in Peril* (Boston: National Toxics Campaign Fund, 1991). On the lack of progress

since NAFTA, see Leslie Crawford, "Hazardous Trades Bring Pollution and Health Fears Down Mexico Way," *Financial Times*, 6 June 1997; Public Citizen, *NAFTA's Broken Promises: The Border Betrayed* (Washington, DC: 1997); and Public Citizen, *NAFTA at Five Years Report Card* (Washington, DC: 22 December 1998). For a more optimistic view, see Commission for Environmental Cooperation, *Assessing Environmental Effects of the North American Free Trade Agreement* (Montreal: 1999). See also "A Greener, or Browner, Mexico?" *The Economist*, 7 August 1999. For a discussion of ongoing institutional initiatives, see Office of the United States Trade Representative, *Study on the Operation and Effects of the NAFTA* (Washington, DC: July 1997).

30. Export processing zone figures from ILO, op. cit. note 28; inducements and attitudes from Alexander Goldsmith, "Seeds of Exploitation," in Jerry Mander and Edward Goldsmith, eds., *The Case Against the Global Economy* (San Francisco, CA: Sierra Club Books, 1996).

31. Cavite information from Keith B. Richburg, "Under Southeast Asia's Haze: More Bad Air," *Washington Post*, 5 October 1997; Chinese accusation from Xia Guang, "Pollution by Foreign Firms Rises," *China Environment News*, 15 February 1997.

32. For positive links between foreign investment and environmental performance, see WTO, op. cit. note 27; Gunnar S. Eskeland and Ann E. Harrison, *Moving to Greener Pastures? Multinationals and the Pollution-Haven Hypothesis* (Washington, DC: World Bank, March 1997); and Global Environmental Management Initiative, *Fostering Environmental Prosperity: Multinationals in Developing Countries* (Washington, DC: February 1999). Yonghai quote from Zhang Yan, "Traders Pay Attention to Environment," *China Daily*, 12 April 1999.

33. On the effect of privatization on the environment, see Pamela Stedman-Edwards et al., *The Private Sector in Latin America* (Washington, DC: World Wildlife Fund, July 1997); Bradford S. Gentry, *Private Investment and the Environment*, Discussion Paper 11 (New York: U.N. Development Programme, undated); and Bradford S. Gentry and Lisa Fernandez, "Mexican Steel," in Bradford S. Gentry, ed., *Private Capital Flows and the Environment: Lessons from Latin America* (Cheltenham, U.K.: Edward Elgar Publications, 1999).

CHAPTER 6. SHARING THE AIR

1. J.C. Farman, B.G. Gardiner, and J.D. Shanklin, "Large Losses of Total Ozone in Antarctica Reveal Seasonal ClO_x/NO_x Interaction," *Nature*, 16 May 1985; Douglas C. Cogan, *Stones in a Glass House* (Washington, DC: Investor Responsibility Research Center, 1988).

2. For a description of the early industry intransigence, see Paul Brodeur, "The Annals of Chemistry," *The New Yorker*, 9 June 1986.

3. The impact of the ozone hole findings on the treaty negotiations is a matter of some debate. On this subject, see Richard Elliot Benedick, *Ozone Diplomacy*, enlarged (Cambridge, MA: Harvard University Press, 1998); Brodeur, op. cit. note 2; and Peter Morrisette, "The Evolution of Policy Responses to Stratospheric Ozone Depletion," *Natural Resources Journal*, vol. 29 (1989). On the positioning of industry, see Benedick, op. cit. this note; Ian H. Rowlands, *The Politics of Global Atmospheric Change* (Manchester, U.K.: Manchester University Press, 1995); and Forest Reinhardt, "DuPont Freon Products Division (A)," Harvard Business School case study (Cambridge, MA: 28 March 1995).

4. Ozone Secretariat, *The 1987 Montreal Protocol on Substances That Deplete the Ozone Layer*, <www.unep.ch/ozone/mont_t.htm>, viewed 2 December 1999.

5. International Institute for Sustainable Development (IISD), "Report of the Third Conference of the Parties to the United Nations Framework Convention on Climate Change: 1–11 December 1997," *Earth Negotiations Bulletin*, 13 December 1997.

6. Benedick, op. cit. note 3; ratifications from United Nations, *The United Nations Treaty Collection*, electronic database, <www.un.org/Depts/Treaty>, viewed 6 December 1999.

7. Phaseout in industrial countries was with the exception of a few "essential uses," and of production of limited quantities in order to meet the basic domestic needs of developing countries; Elizabeth Cook, "Marking a Milestone in Ozone Protection: Learning from the CFC PhaseOut" (Washington, DC: World Resources Institute, January 1996). Figure 6–1 compiled by Worldwatch Institute from the following sources: 1950 and 1955,

estimates based on Chemical Manufacturers Association; 1960–95 from Sharon Getamel, DuPont, Wilmington, DE, letter to Worldwatch, 15 February 1996; and 1996–97 from U.N. Environment Programme (UNEP), *Data Report on Production and Consumption of Ozone Depleting Substances, 1986–1998* (Nairobi: October 1999). Data are measured in tons weighted by ozone depletion potential.

8. UNEP, op. cit. note 7; record ozone holes from World Meteorological Organization (WMO), "Record Ozone Depletion in the Antarctic," press release (Geneva: 1 October 1998), and from UNEP, "Antarctic Ozone Hole as Big as Ever," press release (Nairobi: 17 November 1999).

9. Ozone Secretariat, *Synthesis of the Reports of the Scientific, Environmental Effects, and Technology and Economic Assessment Panels of the Montreal Protocol: A Decade of Assessments for Decision Makers Regarding Protection of the Ozone Layer: 1988–1999* (Nairobi: UNEP, February 1999).

10. Seth Dunn, "Carbon Emissions Dip," in Lester R. Brown, Michael Renner, and Brian Halweil, *Vital Signs 1999* (New York: W.W. Norton & Company, 1999); temperature projections from J.T. Houghton et al., eds., *Climate Change 1995: The Science of Climate Change*, Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Cambridge, U.K.: Cambridge University Press, 1996).

11. Projection of 30 percent from Michael Grubb and Christiaan Vrolijk, "The Kyoto Protocol: Specific Commitments and Flexibility Mechanisms," *Climate Change Briefing No. 11* (London: Royal Institute of International Affairs, April 1998), based on International Energy Agency projections; cuts of 60–80 percent from Houghton et al., op. cit. note 10.

12. IPCC quote from Houghton et al., op. cit. note 10; Figure 6–2 from James Hansen et al., Goddard Institute for Space Studies, Surface Air Temperature Analysis, "Global Temperature Anomalies in .01 C, 1866–1998," as posted at <www.giss.nasa.gov/data/update/gistemp>, viewed 6 December 1999.

13. Robert T. Watson, Marufu C. Zinyowera, and Richard H. Moss, eds. *Climate Change 1995: Impacts, Adaptation, and Mitigation*, Contribution of Working Group II to the Second Assessment Report of the IPCC (Cambridge, U.K.: Cambridge University Press, 1996); Molly O'Meara, "The Risks of Disrupting Climate," *World Watch*, November/December 1997; Hadley Centre for Climate Prediction and Research, *Climate Change and Its Impacts: Some Highlights from the Ongoing UK Research Programme: A First Look at Results from the Hadleys Centre's New Climate Model* (Bracknell, U.K.: November 1998).

14. United Nations, "United Nations Framework Convention on Climate Change, 1992," <www.unfccc.org>, viewed 2 December 1999.

15. Vienna Convention for the Protection of the Ozone Layer discussed in Benedick, op. cit. note 3; industrial countries from Michael Grubb with Christiaan Vrolijk and Duncan Brack, *The Kyoto Protocol: A Guide and Assessment* (London: Royal Institute of International Affairs, 1999); quote from United Nations, op. cit. note 14.

16. Christopher Flavin, "Last Tango in Buenos Aires," *World Watch*, November/December 1998; "A Brief History of the Kyoto Protocol," in IISD, op. cit. note 5; Robert Engelman, *Profiles in Carbon: An Update on Population, Consumption and Carbon Dioxide Emissions* (Washington, DC: Population Action International, 1998).

17. "Kyoto Protocol to the United Nations Framework Convention on Climate Change," <www.unfccc.org/resource/docs/convkp/kpeng.html>, viewed 7 December 1999; on historic nature of Kyoto Protocol, see, for example, World Resources Institute, "WRI President Calls Kyoto Protocol a Historic Step for Humankind," press release (Washington, DC: 11 December 1997); problems with accord from Flavin, op. cit. note 16.

18. Emissions commitments from Grubb with Vrolijk and Brack, op. cit. note 15; emissions levels for 1990 and 1997 from U.N. Framework Convention on Climate Change (UNFCCC) Secretariat, "National Communications from Parties Included in Annex I to the Convention: Greenhouse Gas Inventory Data, 1990–1997" (Bonn: 29 September 1999); 1995 data from UNFCCC Secretariat, "National Communications from Parties Included in Annex I to the Convention: Annual Inventories of National Greenhouse Gas Data for 1996" (Bonn: 4 May 1999).

19. Sources for Table 6–1 are as follows: emissions commit-

ments from Grubb with Vrolijk and Brack, op. cit. note 15; emissions levels for 1990 and 1997 from UNFCCC Secretariat, "Inventory Data, 1990–1997," op cit. note 18; 1995 and 1996 data from UNFCCC Secretariat, "Inventories for 1996," op. cit. note 18. David G. Victor, Council on Foreign Relations, *Why The Kyoto Protocol and Greenhouse Gas Emissions Trading Will Fail, and How to Build a More Effective Global Warming Regime When They Do*, unpublished paper, 10 March 1999.

20. Ibid.

21. "U.S. Seeks Developing Country Participation Before Ratification of Climate Change Treaty," *International Environment Reporter*, 2 January 1998; agreement of 18 countries from United Nations, op. cit. note 6, viewed 7 December 1999; requirement of 55 countries from UNFCCC Secretariat, "Ministers Pledge to Finalize Climate Agreement by November 2000," press release (Bonn, Germany: 5 November 1999).

22. Global Climate Information Project (GCIP), "Ad Campaign Addresses Concerns About Kyoto Protocol," press release, 8 September 1998, <www.sbsc.org/gw>, viewed 2 December 1999; members from GCIP, "GCIP Membership," <www.sbsc.org/gw/gcipmembership.htm>, viewed 2 December 1999; 13 million workers from <www.aflcio.org>, viewed 2 December 1999.

23. Chinese and U.S. emissions from Christopher Flavin and Seth Dunn, *Rising Sun, Gathering Winds: Policies to Stabilize the Climate and Strengthen Economies*, Worldwatch Paper 138 (Washington DC: Worldwatch Institute, November 1997); quote from GGIP, "In Common," <www.sbsc.org/gw>, viewed 2 December 1999.

24. Lee R. Raymond, Chairman and Chief Executive Officer, Exxon Corporation, "Energy—Key To Growth and a Better Environment for Asia-Pacific Nations," remarks at the World Petroleum Congress, Beijing, 13 October 1997.

25. Benedick, op. cit. note 3; Rowlands, op.cit. note 3.

26. Rowlands, op. cit. note 3; Benedick, op. cit. note 3.

27. John J. Fialka, "Kyoto Treaty's Foes In U.S. Could Kill Pact Around the World," *Wall Street Journal*, 19 October 1999; Steve Liesman, "Big Business Produces Some Unexpected Converts," *Wall Street Journal*, 19 October 1999.

28. For an articulation of this concern, see Fialka, op.cit. note 27.

29. Benedick, op. cit. note 3; Armin Rosencranz and Reina Milligan, "CFC Abatement: The Needs of Developing Countries," *Ambio*, October 1990.

30. Benedick, op. cit. note 3; Richard J. Smith, chief U.S. negotiator for the London Amendments, "The Ozone Layer and Beyond—Towards a Global Environmental Diplomacy," remarks to the American Chemical Society, Washington, DC, 24 August 1994.

31. Benedick, op. cit. note 3; replenishments from Secretariat for the Multilateral Fund for the Implementation of the Montreal Protocol, "General Information," <www.unmfs.org>, viewed 2 December 1999.

32. Benedick, op. cit. note 3; Duncan Brack, *International Trade and the Montreal Protocol* (London: Earthscan, for Royal Institute of International Affairs, 1996).

33. UNEP, *1994 Report of the Economic Options Committee for the 1995 Assessment of the Montreal Protocol on Substances That Deplete the Ozone Layer* (Nairobi: 1994); current production and consumption from UNEP, op. cit. note 7.

34. COWIconsult, *Study on the Financial Mechanism of the Montreal Protocol* (Nairobi: UNEP, March 1995).

35. UNEP, op. cit. note 7; Multilateral Fund Secretariat, *Country Programme Summary Sheets* (Montreal: March 1999).

36. Nils Borg, International Association for Energy-Efficient Lighting, Berkeley, CA, e-mail to Molly O'Meara, Worldwatch Institute, 12 February 1998; Steven Nadel et al., *Lighting Energy Efficiency in China: Current Status, Future Directions* (Washington, DC: American Council for an Energy-Efficient Economy, May 1997).

37. Rakesh Bakshi, "Country Survey: India," *Wind Directions*, April 1997; "The Windicator," *Wind Power Monthly*, October 1999.

38. Examples of climate-friendly policies in developing countries from Center for Sustainable Development in the Americas and Worldwatch Institute, "Meaningful Action: A Proposal for Reducing Greenhouse Emissions & Spurring Energy Modernization in Developing Nations" (Washington, DC: unpublished paper, 21 October 1998); Christopher Flavin, "Banking Against Warming," *World Watch*, November/December 1997.

39. Projections for Chinese emissions compared with U.S. emissions from U.S. Department of Energy, *International Energy Outlook 1999* (Washington, DC: April 1999); recent emissions and economic growth trends in China from Christopher Flavin, "World Carbon Emissions Fall," *News Brief* (Washington, DC: Worldwatch Institute, 27 July 1999).

40. UNFCCC Secretariat, op. cit. note 21; Allen R. Myerson, "U.S. Splurging on Energy After Falling Off Its Diet," *New York Times*, 22 October 1998; sport utility vehicles from U.S. Public Interest Research Group, *Danger Ahead: Putting the Brakes on Global Warming Pollution* (Washington, DC: June 1999), and from David Kiley, "Not Your Father's SUV," *American Demographics*, January 1999; home sizes from Daniel Pedersen, "The Garage That Ate Tucson," *Newsweek*, 21 June 1999.

41. Benedick, op. cit. note 3.

42. Growth of wind and solar from Christopher Flavin, "Wind Power Blows to New Record," and Molly O'Meara, "Solar Cells Continue Double-Digit Growth," both in Brown, Renner, and Halweil, op. cit. note 10; International Energy Agency, *Indicators of Energy Use and Efficiency* (Paris: Organisation for Economic Co-operation and Development, 1997); Brad Knickerbocker, "Autos, 'Big Oil' Get Earth-Friendly," *Christian Science Monitor*, 6 October 1998.

43. Annual sales of $1 billion from John Browne, Group Chief Executive, The British Petroleum Company, "Climate Change, The Steps BP is Taking," presented at Stanford University, CA, 19 May 1997, <www.bpamoco.com/speeches/sp_970519.htm>, viewed 25 March 1999; $500 million from Jeroen van der Veer, Managing Director, Shell Group, and Jim Dawson, President, Shell International Renewables, "Shell International Renewables—Bringing Together the Group's Activities in Solarpower, Biomass and Forestry," presented 6 October 1997, <media.shell.com/library/speech/0,1525,2303,00.html>, viewed 25 March 1999; 10 percent from Shell, "Taking Action on Sustainable Development: Climate Change," <www.shell.com/values/content/0,1240,1215-3397,00.html>, viewed 6 December 1999, and from BP Amoco, "Where BP Amoco Stands on Climate Change," <www.bpamoco.com/_nav/hse/index_climate.htm>, viewed 6 December 1999; John J. Fialka, "Global-Warming Treaty's Opposition Is Strained," *Wall Street Journal*, 30 October 1998; Mike R. Bowlin, "Clean Energy: Preparing Today for Tomorrow's Challenges," presented at Cambridge Energy Research Associates 18th Annual Executive Conference, *Globality & Energy: Strategies for the New Millennium*, Westin Galleria Hotel, Houston, TX, 9 February 1999.

44. John H. Cushman Jr., "Industrial Group Plans To Battle Climate Treaty," *New York Times*, 26 April 1998; Energy Innovations, *Energy Innovations: A Prosperous Path to a Clean Environment* (Washington, DC: Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, 1997); AFL-CIO Executive Council, "U.S. Energy Policy," policy statement (Miami, FL: 17 February 1999).

45. "1998 Global Surface Temperature Smashes Record," *Environment News Service*, <ens.lycos.com/ens/jan99/1999L-01-07-06.html>, 7 January 1999; Robert Marquand, "Glaciers in the Himalayas Melting at Rapid Rate," *Christian Science Monitor*, 5 November 1999; Curt Suplee, "Shrinkage Detected in Greenland's Ice," *Washington Post*, 5 March 1999; Joby Warrick, "Hot Year Was Killer for Coral," *Washington Post*, 5 March 1999; damage numbers from Munich Re, "Weather-Related Natural Disasters 1998" (Munich, Germany: 9 February 1999).

INDEX

Academy of International Trade and Economic Cooperation (China), 86
AFL-CIO, 98, 106
Africa, *see* specific countries
Agreement on Trade-Related Intellectual Property Rights, 124
agriculture
  bioinvasion, 35–38
  biotechnology, 31, 61–64
  certification programs, 68–69
  climate change effects, 93–94
  crop diversity, 61–62
  cropland productivity, 31, 61–64
  crop monocultures, 61
  export subsidies, 64–65, 125, 136–37
  farmers' rights, 63–64
  livestock, 51, 56, 111–14
  organic farming, 67–68
  seed stocks, 61–64
  sustainability, 66–70, 161
  trade balance, 49–54, 66–70
  trade barriers, 69–70
  water scarcity, 53–54
  see also food; forest products; forests; grain; pesticides
aid, *see* food; foreign investment; subsidies
AIDS, 43–45
air pollution, 99–100, 145
Alliance for Responsible CFC Policy, 100
Amazon basin, 21, 55, 131
American Birding Association, 67
American Petroleum Institute, 98
American Plastics Council, 98
Anglo-Dutch Unilever, 69
Annan, Kofi, 172, 174
Antarctic Treaty, 37, 146
ARCO, 106
asbestos trade, 80–82
Asia-Pacific Economic Cooperation, 25

Basel Convention, 73–74, 146, 151
beef, 51, 56, 111–14
Bello, Walden, 65
Ben and Jerry's, 29
Benedick, Richard, 105
Bhopal accident, 71–72
biodiversity
  agricultural crops, 61–62
  bioinvasion, 35–38
  bioprospecting, 31–32
  bio-uniformity, 61
  birds, 67, 166
  convention on, 18, 31, 37, 63, 147, 149
  extinctions, 6–7, 15, 18, 29, 38, 107
  fisheries, 36–37, 107
  forest protection, 21
  genetically modified organisms, 61–64, 114–16, 168
  indigenous people, 31–32, 124, 135
  sustainability, 28–29, 155
  wildlife trade, 29, 38–41, 129
  see also conservation; endangered species
Biodiversity Action Network, 167
bioinvasion, 35–38
bioprospecting, 31–32
biotechnology, 31, 61–64
BirdLife International, 166
Bolivia, 136–37
Bowlin, Mike, 106
Brazil
  asbestos use, 82
  deforestation, 21, 55, 131
  economic crisis, 128
  environmental trends, 131
  oil subsidies, 104
Bretton Woods institutions, 153–54
Bristol Myers Squibb, 32
British Petroleum, 106
Byers, Bruce, 56

Callejas, Alejandro, 11
Cambodia, 75, 131
Canada, 80–81
carbon credits, 32–33, 96–97
carbon dioxide, 8, 10, 89, 92, 104
carbon emissions
  energy policies, 104
  global rise, 8, 10, 95–97
  subsidies, 104, 136–37
  taxes, 104
  see also climate change; fossil fuels; renewable energy
carbon storing, 32
Caterpillar, 137
Center for Sustainability Studies (Mexico), 9
Chiapas conflict, 48
China
  bioinvasion, 38
  carbon emissions, 104–05
  chlorofluorocarbon use, 101–03
  floods, 25
  foreign investment, 134–35
  forest management, 25
  National Environmental Protection Agency, 85
  Three Gorges dam project, 137–39
  wildlife trade, 40
Chiquita, 78
chlorofluorocarbons, 87–91, 100–05, 145
cholera, 45–47
chronic disease
  cancer, 88

  lead poisoning, 82
  persistent organic pollutant effects, 76–77, 167
  toxic waste effects, 73–75, 82
Clean Air Act (U.S), 99–100
Clean Development Mechanism, 155–56
Climate Action Network, 164, 166
climate change
  drought, 94, 167
  ecological effects, 93
  El Niño effects, 46
  Framework Convention, 32–33, 89, 94–99, 147
  global warming, 8, 92–93, 107
  jobs impact, 106
  stabilization strategies, 105–07
  storms, 94
  see also carbon emissions
Clinton, Bill, 123, 173
Coalition for Environmentally Responsible Economies, 142
computers, 6, 7, 163
conservation
  energy reform, 104
  forest management, 28–29, 155
  marine, 69, 116–23
  natural areas, 131
  see also biodiversity; endangered species; waste management
Conservation International, 32, 67
Control Risks Group, 168–69
Convention on Biological Diversity, 18, 31, 37, 63, 147, 149
Convention on International Trade in Endangered Species of Wild Flora and Fauna, 39–40, 145–51
Convention on the Law of the Sea, 37, 58, 146–47
Corporate Sunshine Group, 142–43
Costa Rica
  agricultural certification, 68
  carbon credits, 32–33
  environmental taxes, 104
  pesticide use, 78
  tourism, 30
cropland productivity, 31, 61–64

dams, 137–39
DDT, 77–80
deforestation, 19–21, 24–25, 55, 131
Del Monte, 78
dengue fever, 46–47
desertification, 94, 167
developing countries
  asbestos use, 80–82
  carbon emissions, 95–97
  chlorofluorocarbon use, 101–03
  environmental laws, 81–85
  fisheries, 56–59, 116–23
  foreign aid, 5–6, 127–43
  indigenous people, 31–32, 124, 135
  malnutrition, 50
  mining exports, 26–28
  organic farming, 67–68
  pesticide use, 77–78
  toxic waste imports, 72–75
  wildlife trade, 29, 38–41, 129
  see also specific countries
diet, *see* food
disease, *see* chronic disease; infectious disease
Dolan, Mike, 163
Dole Fresh Fruit Co., 78–79
Domini 400 Social index, 141
Dow Jones Index, 141

Dow Jones Sustainability Group Index, 141
drought, 94, 167
DuPont, 63

Earth Negotiations Bulletin, 171
Earth Summit, 18, 94, 112, 160–62, 170
Eco, 171
economy
  agricultural trade balance, 49–54, 66–70, 112–16
  agriculture export subsidies, 64–65, 125, 136–37
  biodiversity value, 31–32
  carbon credits, 32–33, 96–97
  commercial bank lending, 136, 138–39, 142
  cropland productivity, 31, 61–64
  e-commerce, 7, 163
  energy costs, 104, 106, 125
  environment policy, 133, 152–56
  exclusive economic zones, 58
  forest products trade, 19–25, 28–29
  free trade zones, 84
  global economic crisis, 127–32
  grain trade, 49–54, 66–70
  green investment, 85–86, 140–43, 174
  Green Revolution, 61–63
  international financial architecture, 129–33
  international investment, 5–6, 127–43
  jobs, 106, 158–60
  mining costs, 26–27
  private-sector loans, 6, 134–37, 140
  stock market, 138–43
  tariffs, 38, 69–70
  taxes, 104
  tourism, 6, 29–31
  transnational corporations, 5–6, 66, 82–84
  water costs, 53–54
  wildlife trade, 29, 38–41, 129
  world trade, 5
  see also fisheries; subsidies; sustainable development; technology; World Bank
ecosystems
  coral reefs, 107
  freshwater ecosystems, 25, 137–39, 166
  persistent organic pollutant effects, 76–77, 167
  sustainable forest management, 28–29, 155
  see also biodiversity; endangered species; wetlands
ecotourism, 6, 29–31
Elf Aquitaine, 135
El Niño, 46
endangered species
  Act (U.S.), 122
  bioinvasion, 35–38
  convention on, 39–40, 145–51
  extinction rates, 6–7, 15, 18, 29, 38, 107
  fisheries, 107, 116–23
  pollution effects, 6–7, 72, 80
  sustainable forest management, 28–29, 155
  wildlife trade, 29, 38–41, 129
  see also biodiversity
energy
  conservation, 104
  costs, 104, 106, 125
  fossil fuels, 104, 136–37
  policy, 104
  renewable sources, 104, 106

  solar, 106
  subsidies, 104, 136–37
  wind, 104, 106
  see also pollution; renewable energy
Enron, 136
environment
  carbon dioxide effects, 8, 92–93
  dam effects, 137
  desertification, 94, 167
  destruction subsidies, 104, 136–37
  economic value, 54–56
  forest degradation, 19–21, 24–25, 55, 131
  global governance, 144–52, 156–60
  global warming, 8, 92–93, 107
  green investment, 85–86, 140–43, 174
  law enforcement, 81–85
  multilateral environmental agreements, 151–52
  policy, 118–37, 144–62
  policy funding, 133, 152–56
  preservation, 156–60
  social awareness, 85–86
  sustainable development, 28–33, 69, 155
  taxes, 104
  treaties, 144–52
  see also climate change; conservation; ecosystems; ozone depletion; pollution; water
Environmental Protection Agency (U.S.), 75, 83, 99, 102, 143
Epstein, Paul, 46–47
European Union
  beef hormone ban, 111–14
  carbon emissions, 96–97
  chlorofluorocarbon use, 90, 100–01
  farm subsidies, 64–65, 125
  food safety laws, 111–16
  genetically modified organisms, 114–16, 168
  see also specific countries
exclusive economic zones, 58
exotic organisms, *see* bioinvasion; bioprospecting
Export-Import Bank (U.S.), 136
exports, *see* world trade
extinction, *see* biodiversity; endangered species
Exxon, 98, 135

farmland, *see* agriculture; cropland productivity
fisheries
  aquaculture, 59–60
  biodiversity, 36–37, 107
  coral reef destruction, 107
  dolphin protection, 116–19
  exclusive economic zones, 58
  global trade, 56–61
  invasive species, 36–37
  overfishing, 57–59
  Pelly Amendment, 151
  persistent organic pollutant effects, 76–77
  pollution effects, 76–77, 107
  sea turtle mortality, 121–23
  subsidies, 124
  sustainable management, 37, 58, 69, 146–47, 167
  tuna embargo, 116–20
Focus on the Global South, 65
food
  crop diversity, 61–62
  cropland productivity, 31, 61–64
  global safety standards, 112–16

food *(continued)*
livestock, 51, 56, 111–14
malnutrition, 50
organic farming, 67–68
security, 64–65
see also agriculture; fisheries; grain
Food and Agriculture Organization (U.N.)
crop diversity, 61
farmers' rights, 63–64
food deficit projections, 50
forest products study, 20, 29
pesticide evaluation, 80
spending, 158
sustainable agriculture projects, 161
foreign investment
commercial bank loans, 136, 138–39, 142
globalization effects, 5–6, 127–43
green investment, 85–86, 140–43, 174
natural resource investment, 16–19, 28–33, 130
private investment, 6, 134–37, 140
stocks, 138–43
see also subsidies; World Bank; *specific companies*
Forest Peoples Fund, 32
forest products trade, 19–25, 28–29
forests
bioinvasion, 38
carbon storing, 32
certified, 28–29
deforestation, 19–21, 24–25, 55, 131
ecological value, 20
fires, 55
globalization effects, 19–25
illegal logging, 21–22, 24
subsidies, 125
sustainable forest management, 28–29, 155
Forest Stewardship Council, 28, 175
Formosa Plastics Corporation, 75
fossil fuels, 104, 136–37
see also carbon emissions; renewable energy
Foundation for Advancements in Science and Education, 79
Framework Convention on Climate Change, 32–33, 89, 94–99, 147
France, 81, 112
freshwater ecosystems, 25, 137–39, 166
see also water; wetlands
Friends of the Earth, 136, 164

Garrett, Laurie, 43
General Agreement on Tariffs and Trade, 116–20, 123
genetically modified organisms, 61–64, 114–16, 168
Gentry, Bradford, 138
Global Climate Coalition, 106
Global Climate Information Project, 98
Global Environment Emerging Markets Fund, 140
Global Environment Facility, 152–56, 158, 169
Global Environment Fund, 140
Global Legislators Organization for a Balanced Environment, 171–72
Global Policy Forum, 172
global warming, 8, 92–93, 107

see also carbon emissions; climate change
Global Water Policy Project, 53
Goudsmit, Jaap, 43
grain
biotechnology, 31, 61–64
feedgrain use, 51
genetic uniformity, 61–64
international trade, 49–54, 66–70
subsidies, 64–65
water dependence, 53–54
see also agriculture
Green Alliance (U.K.), 139
Green Century Balanced Fund, 140
greenhouse gases, *see* carbon emissions; climate change; global warming
green investment, 85–86, 140–43, 174
Greenpeace, 73–74, 120, 164, 168
Green Revolution, 61–63

Hahn, Beatrice, 44
hazardous waste, 72–75, 80–85
Hazarika, Sanjoy, 71
health
AIDS, 43–45
cancer, 88
cholera, 45–47
dengue fever, 46–47
globalization effects, 41–47
lead poisoning, 82
malaria, 94
persistent organic pollutant effects, 76–77
smallpox, 41, 47
toxic waste effects, 73–75, 82
see also World Health Organization
Home Depot, 142
hunger, *see* food

ICF Kaiser, 140
imports, *see* world trade
India
Bhopal accident, 71–72
chlorofluorocarbon use, 101–02
wind energy, 104
indigenous people, 31–32, 124, 135
Indonesia
deforestation, 19, 21, 24, 55, 132
economic crisis, 128, 131–32
exports, 19, 21, 25
foreign investment, 24
forest fires, 55
industry, 85–86, 140–43, 174
see also economy; technology
infectious disease
AIDS, 43–45
cholera, 45–47
dengue fever, 46–47
globalization effects, 41–47
malaria, 94
smallpox, 41, 47
information technologies, 6–7, 163
Institute for Policy Studies (U.S.), 136
Instituto Nacional de Biodiversidad (Costa Rica), 31–32
Inter-American Tropical Tuna Commission, 119
Interim Multilateral Fund, 102
International Atomic Energy Agency, 158
International Conference on Population and Development (Cairo), 161

International Council for Local Environmental Initiatives, 161
International Dolphin Conservation Program, 120
International Federation of Organic Agriculture Movements, 166, 175
International Finance Corporation, 134, 155, 173
International Labour Organisation, 158–60
International Monetary Fund, 55, 128–33, 158, 173
International NGO Network on Desertification and Drought, 167
International Organization for Standardization, 175
International Plant Protection Convention, 37
International POPs Elimination Network, 167
International Rivers Network, 166
International Whaling Commission, 146, 148
Internet, 7, 163
Investor Responsibility Research Center, 140, 142

Japan, 125, 151
jobs, 106, 158–60

Kenya, 40, 103
Kyoto Protocol, *see* Framework Convention on Climate Change

labor, *see* jobs
land, *see* cropland productivity
Law of the Sea, 37, 58, 146–47
Lehman Brothers, 138
Levy, Barry, 79
livestock
  aquaculture, 59–60
  beef hormone dispute, 111–14
  feedgrain use, 51
  grazing practices, 56
logging, *see* forest products; forests

MacMillan Bloedel, 168
malaria, 94
Malaysia, 19, 21, 24–25
malnutrition, 50
Mann, Jonathan, 42, 44
manufacturing, *see* industry; technology
Marine Mammal Protection Act (U.S.), 116–17
Marine Stewardship Council, 69
Marrakesh accord, 65
Max Havelaar Foundation (Netherlands), 66, 68–69
meat consumption, 51, 59–60, 111–14
Merck and Company, 31
Mexico
  Chiapas conflict, 48
  crop monocultures, 61
  energy efficiency, 104
  environment laws, 84
  fair trade agreements, 66–67
  forest products, 24–25
  free trade zones, 84
  organic farming, 67–68
  tuna embargo, 116–20
mining, 25–28, 98
Missouri Botanical Gardens, 32
Monsanto, 63, 168

Montreal Protocol on Substances That Deplete the Ozone Layer, 88–90, 92, 145–46
Morgan Stanley, 138
Multilateral Agreement on Investments, 165
Multilateral Investment Guarantee Agency, 134

Nana, Sunday, 73
National Audubon Society (U.S.), 67
National Food Alliance (U.K.), 53
National Mining Association, 98
natural resources
  ecological footprint, 9, 11, 130
  economic value, 18–19, 28–33
  fossil fuels, 104, 136–37
  globalization effects, 15–33, 130–31
  investments, 16–19, 28–33, 130
  mining, 25–28, 98
  renewable energy, 104, 106
  sustainable use, 28–33
  water, 53–54
  see also biodiversity; endangered species; fisheries; forests; renewable energy; water
Natural Resources Defense Council, 99
nongovernmental organizations
  Agenda 21 goals, 170
  corporate sustainability reporting, 142
  Earth Negotiations Bulletin, 171
  Eco, 171
  export finance policy, 137
  global governance role, 149, 153–55, 164–74
  globalization effects, 7
  grants, 153
  protected lands, 131
North American Free Trade Agreement, 24, 48, 54, 84, 120
Novartis, 63
nutrition, *see* food

oceans
  conservation, 69, 116–23
  coral reef destruction, 107
  marine ecosystems, 107
  persistent organic pollutant effects, 76–77
  sea level rise, 93
  see also fisheries
Overseas Private Investment Corporation (U.S.), 136–37, 140
ozone depletion, 87–92, 100–05, 145–46

PCBs, 76–77
Pearce, Fred, 76
persistent organic pollutants, 76–81, 167
pesticides, 56, 77–80, 111–14, 166
Philippines, 83, 85, 103
Pimentel, David, 42
plastics, 75, 98
policy
  ecological globalization, 133, 152–56
  energy reform, 104
  fisheries management, 37, 58, 69, 146–47, 167
  food safety, 111–16
  forest management, 28–29, 155
  global food management, 53, 112–16
  persistent organic pollutants, 76–81, 100, 167

policy *(continued)*
sustainable development, 160–61, 169–71
water management, 53–54
see also climate change; economy; environment; nongovernmental organizations; United Nations; World Trade Organization
pollution
air, 99–100, 145
asbestos, 80–82
Bhopal accident, 71–72
Clean Air Act (U.S.), 99–100
environmental policy, 118–37, 144–62, 175
environmental taxes, 104
fisheries, 76–77, 107
global effects, 7, 71–86
hazardous waste, 72–75, 80–85
heavy metals, 75, 82
manufacturing, 82–83
methyl isocyanate gas, 71–72
mining, 26
persistent organic pollutants, 76–81, 167
species extinction, 6–7, 107
toxic waste, 72–75
see also carbon emissions; pesticides
population growth, 8, 158, 161
Portas, Pierre, 74
Postel, Sandra, 53
private investment, 6, 134–37, 140
see also foreign investment
Public Citizen (U.S.), 114

Rainforest Alliance, 68–69
Raymond, Lee R., 98–99
refugees, 6–7
Reinicke, Wolfgang, 175–76
renewable energy, 104, 106
Repetto, Robert, 64
river systems, 25, 137–39, 166
see also water; wetlands
Rodrik, Dani, 12
Rotterdam Convention, 147
Royal Dutch Shell, 106, 135
Russia, 95–97, 128, 131

SAM Sustainability Group, 141
Sanitary and Phytosanitary Measures agreement, 112
Seattle meeting, *see* World Trade Organization
Securities and Exchange Commission (U.S.), 142–43
Shapiro, Robert, 168
Shell Oil Company, 136, 168
Shiva, Vandana, 125
smallpox, 41, 47
soil, *see* cropland productivity; desertification
solar energy, 106
Solomon Smith Barney, 138
Standard & Poors index, 140–41
Stock Exchange of Thailand, 143
Storebrand Scudder Environmental Value Fund, 140
subsidies
agriculture, 64–65, 125
carbon emissions, 104, 136–37
exports, 64–65, 125, 136–37
fisheries, 124
forest use, 125
reform, 124–25
Suharto, 132
Sun Belt Inc., 54
sustainable development
agriculture, 66–70, 161
biodiversity, 28–29, 155
fisheries, 37, 58, 69, 146–47, 167

forests, 28–29, 155
natural resources, 28–33
reporting, 142
U.N. role, 160–62, 169–71
world commitment, 169–76
Sustainable Group Index, 141
Sustainable Performance Group, 140

Taiwan, 75, 151
taxes, 104
technology
biotechnology, 31, 61–64
computers, 6
energy use, 104, 106
Internet, 7, 163
telephones, 7
Terra Capital Fund, 155
Thailand, 60–61, 127, 143
The Body Shop, 29
Third World, *see* developing countries
Three Gorges Dam (China), 137–39
Töpfer, Klaus, 159
tourism, 6, 29–31
toxic waste, 72–75, 80–85
trade, *see* economy; world trade
TransFair, 66
transnational corporations, 5–6, 66, 82–84
see also specific companies
transportation, 6, 29, 34
tropical storms, 94

ultraviolet radiation, 88
unemployment, *see* jobs
Union Carbide, 71
United Nations
Basel Convention, 73–74, 146, 151
Children's Fund, 158
Commission on Sustainable Development, 161–62, 169–71
Conference on Environment and Development (Rio), 18, 94, 112, 160–62, 170
Conference on the Human Environment, 156
Convention on Biological Diversity, 18, 31, 37, 63, 147, 149
Convention on International Trade in Endangered Species of Wild Flora and Fauna, 39–40, 145–51
Convention on the Law of the Sea, 37, 58, 146–47
Development Programme, 158
Education, Scientific and Cultural Organization, 158
Environment Programme, 73–74, 139, 142, 150, 153, 156–60
Framework Convention on Climate Change, 32–33, 89, 94–99, 147
General Assembly, 172
Industrial Development Organization, 158
Intergovernmental Panel on Climate Change, 92–93, 160
Population Fund, 158, 161
public hearings, 170
Security Council, 172
sustainable development policy, 160–61, 169–71
World Meteorological Organization, 158, 160
see also Food and Agriculture Organization

United States
beef hormone dispute, 111–14
bioinvasion, 35–38
biosafety, 115–16
carbon emissions, 95–97
Clean Air Act, 99–100
Court of International Trade, 122–23
crop diversity, 61–62
endangered species, 35
Endangered Species Act, 122–23
environmental activism, 171
Environmental Protection Agency, 75, 83, 99, 102, 143
Export-Import Bank, 136
export subsidies, 64–65, 125, 136–37
Food and Drug Administration, 56
foreign direct investment, 82
forest management, 28
genetically modified organisms, 114–16
grain exports, 50
green investment, 140–43
hazardous waste, 72–73
infectious disease, 45
Marine Mammal Protection Act, 116–17
mining, 27
National Toxics Campaign, 84
organic farming, 67
Overseas Private Investment Corporation, 136–37, 140
ozone policy, 98–100
Pelly Amendment, 151
pesticide exports, 78–79
pesticide use, 55–56
sea turtle protection, 121–23
Securities and Exchange Commission, 142–43
toxic waste dumps, 75
tuna embargo, 116–20
wildlife trade, 40–41

Venezuela, 30, 134

Wackernagel, Mathis, 9, 11
waste management, 72–75, 80–85
water
aquaculture, 59–60
Clean Water Act (U.S.), 99–100
floods, 25
freshwater ecosystems, 25, 137–39, 166
grain trade effects, 53–54
see also oceans; pollution; wetlands
weather, *see* climate change
wetlands
bioinvasion, 37
destruction, 60–61
environmental value, 60
global warming effects, 8, 92–93
see also freshwater ecosystems
wildlife trade, 29, 38–41, 129
wind energy, 104, 106
Women's Environment and Development Organization, 164, 167
work force, *see* jobs
World Bank
certified forests, 29
development assistance, 135
environmental lending, 133, 153
environmental policies, 134–36
international financial architecture, 129–33
policy reforms, 173

Pollution Prevention and Abatement Handbook, 134–35
private-sector loans, 134–37
World Court, 170
World Environment Organization, 159
World Forum of Fish Workers & Fish Harvesters, 164, 167
World Health Organization
beef-hormone ban, 111–13
environmental rules, 112–17, 121–26, 161
infectious disease study, 42–43, 45, 47
pesticide toxicity effects, 77–79
spending, 158
World Meteorological Organization, 158, 160
World Resources Institute, 20, 56
World Tourism Organization, 29
world trade
agriculture, 49–54, 66–70
asbestos, 80–82
chlorofluorocarbons, 102
Court of International Trade, 122–23
fair trade movement, 66–67
fisheries, 56–61
forest products, 19–25, 28–29
globalization effects, 5–6, 8, 127–43
trade wars, 38, 69, 112–26
transnational corporations, 5–6, 66, 82–84
water, 54
wildlife, 29, 38–41, 129
World Trade Organization
asbestos trade, 81
chlorofluorocarbons trade, 102
closed sessions, 125, 173
Committee on Trade and Environment, 151
food safety standards, 112–16
food security, 64–65
forest products trade agreement, 24–25
future reforms, 123–26
Marrakesh accord, 65
multilateral environmental agreements, 151–52
Seattle meeting, 3, 10, 65, 69, 126, 163, 173
sea turtle protection, 121–23
spending, 158
trade barriers, 38, 69
water trade, 54
World Wide Fund for Nature, 69, 164
World Wildlife Fund, 29
Wuppertal Institute (Germany), 53

Yonghai, Shi, 86

Zapatista National Liberation Army (Mexico), 48
Zimbabwe, 30, 40

ABOUT THE AUTHOR

HILARY FRENCH is Vice President for Research at the Worldwatch Institute, a nonprofit policy research organization in Washington, DC, devoted to the analysis of global environment and development issues. Her research and writing focuses on the role of international institutions in environmental protection and sustainable development and on the integration of environmental concerns into international economic policymaking.

During her 12 years at the Institute, Ms. French has written six Worldwatch Papers, including *Investing in the Future: Harnessing Private Capital Flows for Environmentally Sustainable Development, Partnership for the Planet: An Environmental Agenda for the United Nations,* and *Costly Tradeoffs: Reconciling Trade and the Environment*. She has also been a coauthor of nine of the Institute's annual *State of the World* reports, and Associate Project Director for four editions. She contributes to the Institute's other annual publication, *Vital Signs*, and is a member of the Editorial Board of *World Watch*, the Institute's bimonthly magazine, where her articles appear regularly. She has written articles for numerous other publications, and lectured widely at conferences and universities in the United States and abroad.

Prior to joining the Institute, Ms. French interned with the U.N. Development Programme in Côte d'Ivoire and with the United Nations Institute for Disarmament Research in Geneva. She holds degrees from Dartmouth College and from the Fletcher School of Law and Diplomacy.