ENVIRONMENTAL ECONOMICS

AND NATURAL RESOURCE MANAGEMENT

SECOND EDITION

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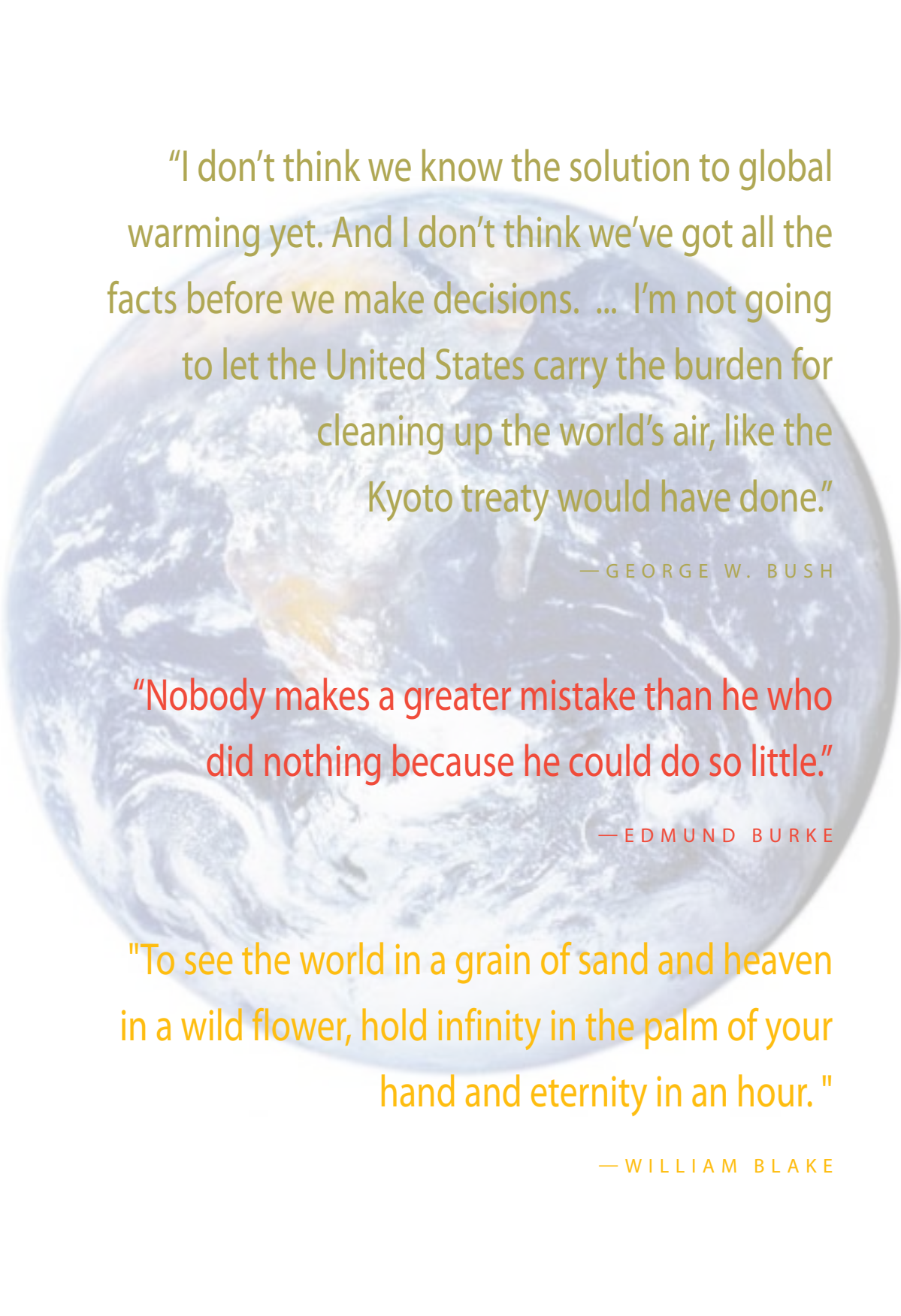


"I don't think we know the solution to global warming yet. And I don't think we've got all the facts before we make decisions. ... I'm not going to let the United States carry the burden for cleaning up the world's air, like the Kyoto treaty would have done."

—GEORGE W. BUSH

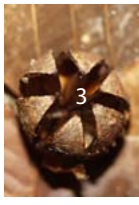
"Nobody makes a greater mistake than he who did nothing because he could do so little."

—EDMUND BURKE

"To see the world in a grain of sand and heaven in a wild flower, hold infinity in the palm of your hand and eternity in an hour. "

—WILLIAM BLAKE

1 The Big Picture



The motivation to study environmental economics is all around you and in your very breath. Out a window you might see pines and berries that require moderate temperatures and clean water to survive. Your body requires the same, as do the sources of the natural fibers in your clothing, the wood in your desk, the pages in this book, and your daily meals. Even some things you do not see, like the air you breathe, are dependent upon plants for rejuvenation. Our reliance on the environment is undeniable. One role of environmental economics is to assist with the necessary trade-offs between the environment that sustains us, and the manufactured products, electricity, homes, trips, and other goods and services that we enjoy to the detriment of the environment. Beyond the products our living assets provide, natural resources bestow the balance of goods as well. The synthetics in your clothing, your CDs and their jewel cases, your computer monitor, and your cell phone are made primarily of petroleum products. Petrochemicals, along with the minerals that make up your car, your frying pan, and your personal electronics, come from nonrenewable sources. They are available for extraction only once. To address the critical decisions about when and how to tap supplies of environmental assets is to partake in natural resource management.

Most economists espouse efficiency as their guiding light in decision making, meaning that they advocate actions that maximize the net benefits to society. Efficiency is not the rule in everyday life, particularly when the environment is concerned. The benefits of habitat preservation are often neglected in cost-benefit analyses of industrial development projects. The costs of pollution seldom enter into private decisions to drive another mile or build another factory. And as a matter of law, the costs of environmental regulations are not part of the equation

behind recommendations by the Environmental Protection Agency. The opportunities for improvement in current approaches and the relevance of the environment to our very existence make the study of environmental economics and natural resource management compelling and exciting. This first chapter highlights nine major issues within the field to whet your appetite for the topics that follow. This introduction is a relatively informal overview. The text will address all of these issues and more in worthy detail.

Market Failure: Can We Trust the Free Market?

In 1776, Scottish economist Adam Smith wrote that self-interested individuals operating in a free market could achieve economic efficiency as if guided by an invisible hand. Smith is one of the founding fathers of economics as we know it, and his ideas are well respected, so why would government or society want to meddle with the market? Unfortunately, and as Smith seems to have understood well enough himself, the assumptions required for free-market efficiency are seldom fully met. In the face of imperfect information, imperfect competition, externalities, or public goods, the market may need some visible hands to assist in the quest for efficiency.

What you don't know *can* hurt you. When producers know more about the risks associated with their products than consumers, consumers may over-consume products that are riskier than they think and under-consume products that are more beneficial than they think. This is why authorities sometimes step in to help teach us the virtues of consuming vegetables, and require producers to place hazard-warning labels on cigarettes and alcohol. For such products, consumption closer to the efficient levels may result from mandated warnings, training, and other forms of information sharing.

Competitive forces underpin the potential for market efficiency. When barriers to entry threaten competition, market intervention guided by antitrust legislation can lead to the lower prices, higher quality, and larger quantities enjoyed in competitive markets. The challenge is for the government to satisfy these goals while promoting innovation and permitting adequate incentives for entrepreneurs.

Externalities are effects felt beyond or "external to" those causing the effects. When individuals decide how many cigarettes to smoke or how many trees to plant in their yards, they may not consider the costs or benefits conveyed on others. Neglect of costs and benefits to others leads decision makers to over-consume goods that cause detrimental "negative" externalities and under-consume goods that generate "positive" externalities. The environment bears the perennial brunt of inefficiencies due to both positive and negative externalities. Fortunately, the economist holds tools, including taxes, subsidies, and property rights, that help consumers feel for themselves, or "internalize," the effects of their own behavior.

Public goods can be enjoyed by more than one person at a time, and those paying for the goods cannot prevent others from receiving the benefits. Streetlights, TV signals, and military protection are classic examples. Efforts to combat ozone depletion, preserve the giant panda, or remove toxins from global air supplies also fit the bill. The good news is that the giant panda can bring joy to people around the

world who simply relish its existence from afar. The bad news is that "free-riding" individuals try to benefit from the preservation efforts and monetary contributions of others rather than pitching in themselves. A virtue of government is its ability to tax beneficiaries of public goods in order to finance these goods at closer to their efficient levels. This text addresses public goods, externalities, and other threats to the ideal that markets should be "free" in the context of the environment, and discusses theories of whether, when, and how market intervention should take place.

Waste and Recycling: Where Can We Put It All?

We buy a lot of stuff. In a typical year, Americans spend $2.6 trillion on material goods, excluding gasoline and other energy goods that require no storage after use. Where are we to put the aftermath of, for example, our yearly $13.5 billion expenditure on athletic footwear or our $49 billion worth of nondurable toys? Our production of solid waste is increasing almost as rapidly as the number of viable landfills is decreasing. As the safest and most convenient dumpsites fill up, urban sprawl replaces prospective new sites with backyards and shopping centers. More distant dumpsites increase the direct and external costs of transporting and disposing of solid waste. The external costs go beyond transportation issues to include groundwater contamination from landfills and ash toxicity from solid waste incineration facilities.

Consumerism and costless disposal result in volumes of municipal solid waste and a scarcity of landfill space. Innovative programs require people to pay more as they throw away more.

Solutions to the problems with waste generation include innovative uses of waste, improved waste management systems, increases in recycling, advances that make dumpsites safer, and reductions in resource use. Economic theory foretells that the creation of private incentives for responsible behavior is one key to success. Heeding that advice, for example, over 5,000 communities have adopted "pay as you throw" programs that require households to pay by the bag for all waste sent to the dump. We will discuss the influence of these and other solutions to our mounting solid waste problem.

Sustainable Development: How Long Can This Last?

On the flip side of the waste/recycling question is the issue of where all of our material goods come from and how long we can continue to tap into those sources. We presently obtain most of our energy from nonrenewable oil and coal reserves. We expend our stocks of old growth forests, groundwater, and arable topsoil at unsustainable rates. And we send harmful emissions into the air and water at rates beyond the Earth's ability to dissipate them, meaning that they will only collect and increase in concentration until we reverse our actions (or they do us in). Given that our current modes of development are not sustainable, efforts are underway to discover which forms of development can continue into the indefinite future and to develop means of altering behavioral norms to coincide with sustainable activities. Notable progress has been made in the fields of forestry, mining and minerals, cement, mobility, and the electrical utility industries, and the increased pace of investigation into new areas of sustainability promises to bear more fruit.

Beyond issues of how to make resource use more sustainable are questions of how sustainable our behavior should be. What do we owe future generations? What value should we place on the welfare of others? Should we act, as political philosopher John Rawls suggests, as if we lived under a veil of ignorance regarding whether our time on the planet would come now or sometime in the future? Should our goal be to sustain the physical flow or the value of resources? Should our sustainability standard apply to physical capital or just natural resources? Should future generations be able to live as comfortably as we do? What it comes down to is that the fate of future generations is in our hands, and we must decide the toll we will take on their quality of life.

In part to justify conservation expenditures and prioritize environmental projects, economists face the challenge of placing values on species of wildlife.

Biological Diversity: What Is a Flamingo Worth?

Biological diversity, also known as **biodiversity**, refers to the variety of ecosystems, species, and genetic differences within a species. Biodiversity is in conflict with human civilization, in that urban development and industrialization come at the cost of lost habitat for living organisms. With colonization and increases in human population has come a dramatic increase in

the rate of extinctions, which are now estimated to occur at 100 to 1,000 times the natural or "background" rate of between 1 and 10 extinctions per year. This impels us to consider the broadly defined value of biological diversity, how that value compares with the value of industrial progress, and what is to be made of our conflicting interests.

Wildlife provides benefits to humans, including natural beauty, recreational opportunities, medicinal cures, and the very air we breathe. To use these human-centered benefits as the basis for decisions about environmental preservation is to take an **anthropocentric** view. An **ecocentric** perspective, on the other hand, would recognize that wildlife has value in and of itself. Proponents of this view argue that even in the absence of human life, plants and animals are worthy of preservation. Although economists understand both of these bases for decisions regarding the environment, they typically concentrate on the sufficiently challenging question of what biodiversity is worth to humans, rather than the more daunting task of assessing the value of biodiversity apart from human interests.

Economists have developed primarily anthropocentric techniques for estimating the value of wilderness areas and animal species from slugs to *Homo sapiens*. While more or less imperfect, these methods provide superior alternatives to throwing up our hands and saying we cannot determine the value of these environmental assets, the end result of which might be to disregard their values or treat them as infinite. This book will identify the virtues of biodiversity, review the preferred valuation techniques, and consider the appropriate applications of environmental asset valuation.

Environmental Degradation: Is Pollution a Real Problem?

Under a zero-pollution policy, we couldn't drive accident victims to the hospital, build homes, or produce most goods. In fact, to live is to pollute. Animals, including humans, emit hydrogen (H_2), methane (CH_4), hydrogen sulfide (H_2S), nitrogen (N_2),

Industrial exhaust systems send CO_2 and other emissions into the atmosphere, contributing to pollution and global warming. But controversy rages over what levels of pollution are acceptable and what will happen to jobs if tighter controls are instituted.

Despite the barriers of politics and inertia, the availability of clean-energy technology feeds optimism for increased implementation. Wind power is now the fastest growing sector of power generation with solar fuel cells not far behind. The pictured wind turbines collect energy outside of Lincoln, Nebraska.

and carbon dioxide (CO_2) in the processes of breathing, eating, and digesting. Even setting these essential emissions aside, the optimal level of pollution is positive because the benefits from the most important sources of pollution, such as hospitals and basic housing, outweigh the negligible effects of the first few puffs of smoke out of cars and smokestacks.

As we carry industrial development to new levels, the challenge from a societal standpoint is to distinguish areas where further development is appropriate from those where another tree should not fall and another widget should not roll off the assembly line. Is there evidence that we have gone too far? Should we conduct further research or take action against global warming and similar threats now? Despite apparent confusion among politicians, the answers to these questions are clearer than you might think. In brief, yes, and act now.

Alternative Energy Sources: Why Aren't They Here?

Since 1975, computers have swept the country, phones have become mobile, and microwave ovens and VCRs have alighted in every reasonably affluent home, and yet developments in alternative energy sources have been unimpressive. Why isn't there a hybrid car in every garage? Why aren't there solar panels on every rooftop or windmills on every mountaintop? Why did we develop the perfect fat substitute before the perfect fossil fuel substitute? There are a variety of economic principles associated with the contrasting growth rates in these products, including a few that are seldom discussed. The culprits include politics, inertia, a lack of critical mass, and the profit-maximizing strategies of firms that compete with clean energy sources. At

the same time, there is reason to be optimistic about the future. In the words of Karl R. Rabago, Managing Director of the Rocky Mountain Institute,

> *In spite of all the problems, the growth of clean energy options including generation, efficiency and energy management continues at a brisk if oft-overlooked pace. Wind is the fastest growing sector of the generation sector, with photovoltaics not far behind. Fuel cells for both stationary and mobile applications will become fully commercial before the end of the decade. Thousands of megawatts worth of efficiency have been put to work. The linkage between information technologies and the energy sector is strong and growing. In all, the ground floor for an exciting and clean energy revolution is solid.*[1]

Population and Economic Growth: Are We Doomed to Starvation?

Doomsayers have predicted our demise for centuries. In 1798, when Thomas Malthus heard that the population of the United States was doubling every 25 years and estimated that food supplies would increase by a constant amount each year, he "did the math" and proclaimed that this could not continue. Since then, advancements in technology and exploration have spoiled predictions of depletion with the production of unprecedented quantities of food, petroleum, coal, and other provisions. Beyond improvements in technology, we are assisted by the market mechanism, which increases prices for goods that become short in supply. Higher prices lead suppliers to work harder to find ways to produce more. High prices also lead consumers to desire less. Both of these behaviors act to ameliorate potential shortages. Of course, sooner or later we must confront the many binding resource constraints of the Earth, and this will force difficult questions on society. How can trends in consumption be reversed? If population control is part of the solution, should it be mandated or self-imposed? What is the ideal population? What role should more-developed countries play in the population-control strategies of less-developed countries? Economists have theories and opinions on each of these weighty questions, some of which might surprise you.

Natural Resource Management: When Should I Harvest My Elms?

Shakespeare said that the world is a stage and we are just players. In some other respects, the world is a farm and we are just farmers. As consumers, voters, or cultivators ourselves, we all influence decisions about whether and when to harvest our crop of wildlife and our stock of minerals. When farming our vast forests and oceans, we must also decide how many trees and fish to reap, how to bring them to market,

1 Written on January 15, 2001 for this textbook.

and how to reseed the land and waters. Indeed, these issues apply to water itself. In the United States only about 2.5 percent of extractable groundwater is available on a renewable basis. Decisions about these resources must be made in light of their repercussions for current and future generations. This is the task of natural resources management.

Beyond questions of whether, when, and how to harvest natural resources is the issue of how to manage access to resources that are not privately controlled. Harvests of fish from the world's oceans started to decline in the 1990s due to past overfishing, pollution, and inadequate regulation. The U.S. Department of the Interior manages more than 550 million acres of federal resource lands, 340 units of the national park system, and 442 wildlife refuges. When those with access to natural resources do not feel the effects of their decisions because they do not own the resources they are depleting, their actions may be inefficient and harmful to society. The challenge for society, then, is to find ways to provide incentives for everyone to use natural resources responsibly. This can mean limited access, policies of resource restoration, or punishment schemes that surmount the inherent difficulties of monitoring the remote areas where many of our most valued natural resources are. This text presents models of natural resource management and methods for encouraging responsible resource use among those with insufficient private incentives for compliance.

Environmental Ethics: Is the Question What Can We Do, What Must We Do, or What Should We Do?

Ethical dilemmas are intertwined into many of these issues. Some of the most difficult environmental decisions come when doing the "right thing" for society conflicts with personal gratification. While pollution control efforts tug on our purse strings, the act of polluting pulls on our moral fiber. Is it ethical for individuals to waste resources or pollute? How much municipal solid waste is it acceptable for each individual to generate? Do we have a moral responsibility to recycle? How much value should we place on sustainable development for the sake of future generations? What right do we have to destroy natural habitat areas and eliminate species of wildlife? And what ethical issues should we consider when planning our contributions to the planet's population?

Some ethical quandaries stem from uncertainty over the appropriate goal for society. Should the objective be utility maximization in the aggregate, equality of utility across individuals and/or time, or adherence to some sort of merit-based distribution of utility? Scholars have also suggested a number of approaches to individual ethical dilemmas, such as whether to purchase material goods that detract from the environment or whether to sell products that may cause harm to consumers. While reading Chapter 16 you will have the opportunity to consider these questions and others of your own, and to apply prescribed morality tests to the dilemmas you face.

Conclusions

In 2005 more than 70 dolphins beached themselves on the Florida Keys after a Navy submarine conducted sonar exercises nearby. Despite appearances, this type of incident is very much in the purview of economics, which provides tools to deal with trade-offs between, for example, the benefits of military training and the possibility of harm to marine wildlife. In this textbook you will read about how economists place values on wildlife, factor in elements of uncertainty, and seek efficient solutions to environmental and natural resource quandaries.

More broadly, the field of economics revolves around the allocation of scarce resources among competing ends. With most environmental assets falling into the scarce category, tension between developmental progress and the call of the wild resounds as a call for the application of economic tools. Humans have gained remarkable control over natural resources and the environment, and the associated decisions foment debate. In the realm of the environment, the stakes are high and mistakes can have profound repercussions.

Looking at environmental policy, some view the status quo as rosy and label as idealistic those suggestions that natural resources could be allocated much more efficiently. Others desire a relaxation of environmental standards, asserting that the problems are exaggerated and that financial resources could be better spent creating jobs or lowering taxes. Still others seek more social action. They note that sunlight delivers more energy to the Earth than power plants could ever muster by burning fossil fuels, and yet the burning continues for lack of responsible policy. Who is right? This text and this course can help you make your own informed decisions about the proper allocation of environmental resources.

This chapter introduced some of the intrigue and import of environmental and natural resource economics. As the text progresses, you will discover answers to many of the questions presented here, although these answers tend to spawn new questions: Given optimal pollution levels, how can factories be monitored to prevent excesses? How can improved techniques for natural resource management be implemented? How can we find the self-discipline required to do the right thing? Do not be afraid of new questions; be afraid of not knowing what the important questions are. Deliberate thought and debate will lead to new answers and still more questions, with each iteration of this process bringing greater levels of understanding and satisfaction.

Problems for Review

1. What solutions to the mounting municipal solid waste problem have been discussed or applied on your campus? Are there any solutions that you think would be more promising?
2. List five consumer goods that you have purchased recently. For each, note the source of the raw material that went into that good. For example, a compact disk is made from plastic by the petrochemical industry, which extracts its raw material (oil) from below the Earth's surface.
3. In your opinion, does society take an anthropocentric or an ecocentric view of natural resources when deciding on policies for preservation? Explain which view you think we *should* take and why.
4. What are four possible standards for sustainability?
5. What is the source of energy for the building you are in or closest to? What real barriers prevent more energy from being obtained from clean sources?
6. Is the optimal level of pollution zero? Why or why not?
7. What four broad categories of problems can prevent free markets from allocating resources efficiently?
8. What has prevented the starvation predicted by Thomas Malthus and others?
9. In what way are we all farmers?
10. Beyond the examples of ethical issues mentioned in this chapter, list two more environmental issues that you face on a regular basis.

websurfer's challenge

Find five Web sites devoted to the environment (not including those listed under Internet Resources). For each site write down

1. The name or URL
2. An environmental insight you learned from the site
3. A connection between the item in number 2 and environmental economics as discussed in this chapter

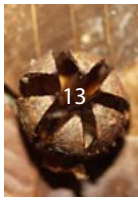
Internet Resources

The site for this textbook at Pensive Press:
http://www.EnviroText.com

The Environmental Protection Agency:
http://www.epa.gov

The Environmental Education Station:
http://web.centre.edu/econed

The Rocky Mountain Institute (source of the block quote above)
http://www.rmi.org



Further Reading

de Steiguer, J. E. *The Age of Environmentalism* New York: McGraw-Hill, 1997. A survey of the foundations of environmental economics, including important figures and incidents over the past century.

Smith, Adam. *The Wealth of Nations* New York: Prometheus Books 1991. One of the books that started it all—the study of economics, that is. It includes discussions of the efficiency of markets as discussed in this chapter.

Stavins, Robert N. *Economics of the Environment: Selected Readings* New York: Norton, 2000. A rich collection of papers on the issues introduced in this chapter as well as many other issues, written by contemporary stars of environmental economics.

Van Kooten, G. Cornelis. *The Economics of Nature: Managing Biological Assets* Malden Mass.: Blackwell, 2000. Provides a rigorous approach to environmental economics for those who want to see the calculus.