HOW WE KNOW WHAT WE SAY WE KNOW

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The World According to Pimm: A Scientist Audits the Earth. Stuart L. Pimm. McGraw Hill, New York, 2001. 285 pp., illus. $24.95 (ISBN 00713749060 cloth).

At its extremes, environmental opinion falls into one of two camps. Members of the first, sometimes disparagingly referred to by the second as Malthusians, hold that the world is rapidly going to hell in a handbasket and that there is ample factual evidence to prove it. The second group holds that things have never been better, thank you, and will continue to get better, and that

the evidence is all around us. In the face of two such vocal and self-assured sets of opinion, what's an informed citizen to believe?

Now comes Stuart Pimm with a primer on how we know what we say we know about the state of the ecological world. Using as an occasion for stock taking the fact that at the turn of the new millennium there are 6 billion *Homo sapiens*—a number that could double by midcentury—he gives us the raw data we need to appreciate what we do to Earth in order to make a living: how many square kilometers there are of all natural vegetation types and agricultural lands, the size of the seas, the amount of fresh water available for all uses, the number of species of plants and animals that may exist, and how quickly we are harvesting fishes, forests, and firewood. In each case he takes the reader through a series of calculations, ranging from back-of-the-envelope to the most precise that can be made through arduous field work and integration of satellite data. Usually he has at least two independently derived estimates for each such quantity, enabling him to establish a narrow range and, most important, showing us that the estimates converge and that the trends are not reassuring.

The first section introduces the difficulties in classifying Earth's terrestrial ecosystems to provide a global accounting of terrestrial net primary productivity—the annual production of green stuff—and arrives at a figure of about 130 billion tons. Of this we consume about a billion tons directly as food and another 2 billion as timber and firewood, while our livestock consume an additional 2 billion. But to provide this, we must also produce 25 billion tons of inedible plant parts and lose 3 billion tons in potential production because the land is claimed by cities and roads.

We learn that most cropland is derived from areas that once had sufficient heat and moisture to support forests before they were cleared, with only about one-quarter from converted grasslands or irrigated drylands. We also discover how rapidly boreal forests are being harvested and burned (0.75 billion tons per year), how much additional plantation growth is needed to meet all of our timber requirements (3 billion tons per year), and that tropical forests are shrinking at the rate of about 160,000 km^2 per year.

A bracing interlude on the history of Easter Island, dense with lush subtropical forest when its Polynesian colonizers arrived and now a treeless waste, prompts the observation that "land does not guarantee the means for existence." A sobering list of abandoned lands—at Anasazi sites in the US Southwest, Uxmal, and Angkor Wat—follows.

Next comes an extensive disquisition on drylands—why they are so vulnerable, and why so poorly managed. These lands, which produce 30 percent of humanity's global harvest, are being lost at the rate of 1 percent per year, mainly because of salinization and soil erosion. Land that is either too dry for rain-fed cropping or lacks a source of water for irrigation is used for livestock production, which tends to degrade it further. The replacement of Arizona's lush grasslands with a gullied, mesquite-strewn landscape following the cattle population explosion of the late 1800s is especially dispiriting.

Not quite halfway into the book, Pimm arrives at the bottom line of our impact on the land: Of the approximately 130 billion tons of terrestrial primary productivity per year, we use 26 billion for crop production, 14 billion from forests, 17 billion for grazing, and we sacrifice 3 billion for urban areas, for a total of 60 billion. In sum, humanity uses a whopping two-fifths of Earth's terrestrial primary productivity

Of this, the biggest piece, 26 billion tons, represents crop production. It is staggering that although the human population nearly doubled in the last three decades, the total area of cropland increased only 7 percent, from roughly 14 million to 15 million km^2. Yet this productivity is clearly not sustainable using current technology. Crop yields per acre are peaking, more and more cropland is being marginalized and turned over to less efficient livestock production, tropical forests are shrinking, and per capita consumption of primary productivity is rising as the peoples of developing countries aspire to the developed world's standard of living—"grain-fed beef and the rest of it."

Is our current rate of use of terrestrial productivity sustainable? In one of the many metaphorical gems in the book, Pimm hints at the answer:

> Gaia, our hostess at the global cocktail party, is not happy. There are always people who high-grade the cashews from bowls of mixed nuts. Not for them the lowly sunflower seeds, still in their husks. Now this is all that remains. Those who did not get the cashews are asking for them. The high-graders who did get them are now demanding the even more expensive Macadamia nuts. The doorbell is ringing, announcing the arrival of more guests. Dr. Pangloss is telling her in one ear that everything will be OK. In her other ear Cassandra is assuring her that everything is not OK. What Gaia knows for certain is that in cracking the sunflower seeds, the guests will make one hell of a mess, drop bunches of them on the carpet, and spoil the party for everyone. (p. 107)

One of Pimm's grimmest chapters covers available freshwater. Humanity uses or borrows—usually returning it in much degraded condition—60 percent of all accessible freshwater runoff. In capturing it we have fragmented rivers, with disastrous consequences for fish and mollusc diversity; caused the mouths of rivers to recede from sea coasts (the Colorado); produced dead zones where some do enter the sea (the Mississippi); and caused giant seas to dry up (the Aral).

Part II of the book, "Blue Ocean, Green Sea," explains why most of the ocean—the 90 percent of it that is deep and blue—is so unproductive, with most of our harvest coming from the shallower green part, mostly over the continental shelves. As he did for the land, Pimm meticulously explains how we get the numbers for net primary productivity across Earth's oceans and for fisheries production. All told, the annual marine net productivity is on the order of

105–120 billion tons, of which we take about 35 percent.

Next he explains why the seas' great fisheries are exhaustible and, in too many cases—Atlantic gray whales, fin whales, Alaskan king crabs, Atlantic cod, hakes, haddocks, and other species—*have* been nearly exhausted. This has to do with the trophic position of most of what we harvest—mainly predators, as compared to plants and herbivores in agricultural production, and the inexorable economics of harvesting. Here we learn about the pernicious effects of general economic phenomena—the tragedy of the commons and perverse subsidies, for example—as well as those peculiar to this industry, such as the enormous "bycatch" of unwanted fish (also mammals, turtles, birds, and invertebrates) deriving from long-line fishing, seining mishaps, and horrendous wholesale dredging of the seafloor.

We get a brief respite in the final section, "The Variety of Life," a stimulating foray into the arcana of estimating how many species there are, why we think the average duration of a species has been around a million years, and how we know that, for a depressingly broad array of plant and animal taxa, the extinction rate has increased 10- to 100-fold because of our activities on the planet. This section, like the others, features vivid cameo appearances of ecologists and evolutionists of Pimm's acquaintance. Unlike the others, it ends on an optimistic note, explaining how, with a little effort and a reasonable amount of cash, we could protect sufficient habitat to preserve perhaps half of the remaining diversity of life.

Throughout the volume, Pimm maintains a joyful enthusiasm for the natural world, and by and large avoids scolding his readers about their profligate use of gasoline, their swordfish-eating habits, and so on. The gloves come off in the epilogue, however, where he barely contains his contempt for colleagues who stay above the fray in order to maintain the purity of their science, refusing to expend time and prestige capital on applied research and advocacy. No serious-minded biologist can maintain such an attitude after reading this marvelous book. All of us—students, teachers, researchers, and policymakers—should ask ourselves: If not us, who? If not now, when?

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