



From Big to Bigger How Mass Immigration and Population Growth Have Exacerbated America's Ecological Footprint

By Leon Kolankiewicz

Executive Summary

Mass immigration is increasing America's Ecological Footprint (EF), pushing our country deeper into ecological deficit. Approaching 310 million, U.S. population currently exceeds the carrying capacity of our land and resource base. Nevertheless, high immigration levels exacerbate these trends by pushing our population to ever more precarious heights, preventing U.S. population stabilization, forcing annual growth rates to more than three million net new residents, and driving our numbers to a projected 440 million by 2050. If these projections hold true, by 2050 America's population will grow faster than it is today, and the United States will be on a trajectory toward a billion or more by 2100. EF analysis provides additional scientific evidence that indeed, "numbers count," and that today's America, to say nothing of tomorrow's, is vastly overpopulated as well as over-consuming.

The Ecological Footprint is a measure of aggregate human demands, or the human load, imposed on the biosphere, or "ecosphere." When all is said and done, the human economy, all production and consumption of goods and services, depends entirely on the Earth's natural capital – on arable soils, forests, croplands, pasturelands, fishing grounds, clean waters and air, the atmosphere, ozone layer, climate, fossil fuels, and minerals – to perform the ecological services and provide the materials and energy "sources" and waste "sinks" that sustain civilization.

Drawing on natural capital beyond its regenerative capacity leads to drawdown, or depletion of the capital stock, just as drawing down the principal of a savings account or inheritance will eventually exhaust it. When humankind began to exploit fossil fuels at the onset of the Industrial Revolution in the 19th century,

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drawdown began to accelerate. This drawdown expanded exponentially in the 20th century and continues today virtually unabated.

EF compares the demands of the human economy, or subsets of it, with Earth's (or a given country's) ecological capacity for regeneration and renewal, thus its "biocapacity." EF represents the amount of biologically productive land and sea area needed to regenerate the resources a given human population consumes and to absorb and render harmless, or assimilate the corresponding waste or residuals it generates.

In the two decades since EF analysis emerged at the University of British Columbia on Canada's west coast, it has evolved and matured. Today the Global Footprint Network, with more than 100 partner organizations around the world, continues to improve the scientific rigor and transparency of EF methodology.

Among the three most important findings of EF analysis are that:

1. Some countries and regions have an EF that exceeds their biocapacity, while other countries have an EF that is less than their available biocapacity. The first set of countries are said to have a deficit, while the second are understood to have a surplus or reserve of biocapacity.
2. Since the late 1970s, humanity as a whole has not been living within the ecological means of the planet; that is, we are already in overshoot, an unstable, and unsustainable condition.
3. Even as humanity's aggregate EF continues to increase, the Earth's biocapacity is decreasing simultaneously; biocapacity is being degraded. The global EF now exceeds global biocapacity, which, as just noted, is not sustainable.

In 2006, the most recent year for which data are available, the Global Footprint Network reported the United States had an Ecological Footprint of 22.3 global acres (nine global hectares) per person (per capita). This level was the third highest per capita EF in the world, exceeded only by two small oil-producing Middle-Eastern countries: the United Arab Emirates and Qatar. In 2006, the total biocapacity of the United States was 10.9 global acres (4.4 global hectares) per capita. The difference between the country's EF and biocapacity was its ecological deficit — 11.3 global acres (4.6 global hectares) per capita. At that time the United States had the sixth highest ecological deficit in the world.

Rapid population growth, driven primarily by a persistently high immigration rate, is aggravating this country's ecological deficit. Over-consuming and overpopulated America is living beyond its ecological means. If environmentalists are serious about living up to their name and facing the challenge of environmental sustainability, they must address the threat of unsustainable U.S. population growth. Although changing technologies and challenging over-consumption and waste are crucial in our pursuit of sustainability, so is the need for population stabilization, nationally and globally. And nationally, population stabilization cannot happen without immigration reduction. As the Population and Consumption Task Force of President Clinton's Council on Sustainable Development concluded in 1996: "reducing current immigration levels is a necessary part of working toward sustainability in the United States."¹

Introduction – Evolution of the Ecological Footprint: Insights Emerge from Ecotopia and Bigfoot's Homeland

In 1975, Ernest Callenbach published the utopian novel *Ecotopia*, about a fictional, ecologically enlightened country in the Pacific Northwest that broke away from the United States in 1980. Joel Garreau's 1981 best-seller *The Nine Nations of North America*, gave a nod to Callenbach by naming one of his socioeconomic/cultural "nations" Ecotopia. Garreau said Ecotopia encompassed northern California, Oregon and Washington west of the Cascades, coastal British Columbia, and southeast Alaska, the fjord-riven, island-clustered Alaska panhandle.

As one who has lived among the tree-worshipping druids in the rainforests of western Washington, coastal British Columbia, and southeast Alaska, I'd say Callenbach and Garreau were onto something. I earned my Master of Science degree at one of Ecotopia's foremost universities.

From 1977-1981, I had the good fortune to pursue graduate studies on a college campus blessed with arguably the most spectacular natural setting and views of any in North America, the University of British Columbia in Vancouver, Canada. From the stately fragrant rose garden, one gazed north across the shimmering waters of the North Pacific toward snowcapped crests in the rugged, wild B.C. Coast Range, a crumpled mass of mountains, glaciers, forests, and fjords stretching hundreds of miles along the fabled Inside Passage to Alaska. The legendary Sasquatch or Bigfoot reputedly stalks the deep, dripping forests of Douglas fir, western red cedar, salal, and impenetrable devil's club thickets along these fjords and fastnesses. Blue-tongued glaciers, not yet emasculated by a warming climate, hug many a mountain slope; frozen and seemingly inert, in fact they gouge out valleys and transfigure the landscape, dynamic symbols of restless geology in action and the ever-changing face of Mother Earth.

This setting seemed fitting for one majoring, as I was, in environmental planning and natural resources management. Whenever I needed inspiration from the drudgery of drafting my master's thesis on pollution control in the Fraser, one of Western Canada's most important salmon rivers, all I had to do was stroll over to the rose garden, sniff the flowers, and savor the view. My thesis advisor, Dr. William E. Rees or Bill to us grad students, also enjoyed this view from his office on the fourth floor of UBC's School of Community and Regional Planning. Perhaps this vision and others of "Ecotopia" inspired him as well, because with this view as a backdrop, he and one of his Ph.D. students, Swiss-born Mathis Wackernagel, created the concept of Ecological Footprint (EF), one of the more important ecological insights and analytical tools of recent decades.

While the evocative term Ecological Footprint was not coined until after I had already graduated and left UBC for untamed Alaska, I remember that Bill was moving toward the notion of the EF in his lectures and research even back while I was taking coursework from him. I recall him lecturing that in terms of materials and energy stocks and flows, all cities and human settlements were not self-sufficient unto themselves, but rather in an important sense were dependent, or even parasitic on resources furnished by the surrounding landscape or hinterland. Bill argued that cities imported or took in low-entropy resources and exported or expelled high-entropy wastes over a much wider area than the relatively small, built-up space occupied by buildings and pavement.

In his popular column “On Language” published in *The New York Times*, the late writer William Safire described how Professor Rees hit upon the term “ecological footprint”:

Computers, which usually don't have any feet, take up room on a desk; they used to lie flat, leaving little room for a telephone, a spouse's picture, souvenir coasters and other desktop doodads. But a generation ago, spaced-in designers thought of turning the machine on its side, making a “mini-tower.” When the University of British Columbia issued one of these space savers in 1992 to William Rees, that regional planning professor — working on a paper about “regional capsules” — recalls telling a doctoral student that he especially liked its “smaller footprint” on his desk. Then the idea hit him: “It took just a few seconds to replace every reference to ‘regional capsule’ in the paper with ‘ecological footprint.’”²

Bill Rees published his first scholarly article on EF — “Ecological footprints and appropriated carrying capacity” in 1992 in the journal *Environment and Urbanization*. In this paper, he used the concepts of human carrying capacity and natural capital to argue that, “prevailing economic assumptions regarding urbanization and the sustainability of cities must be revised in light of global ecological change.”³

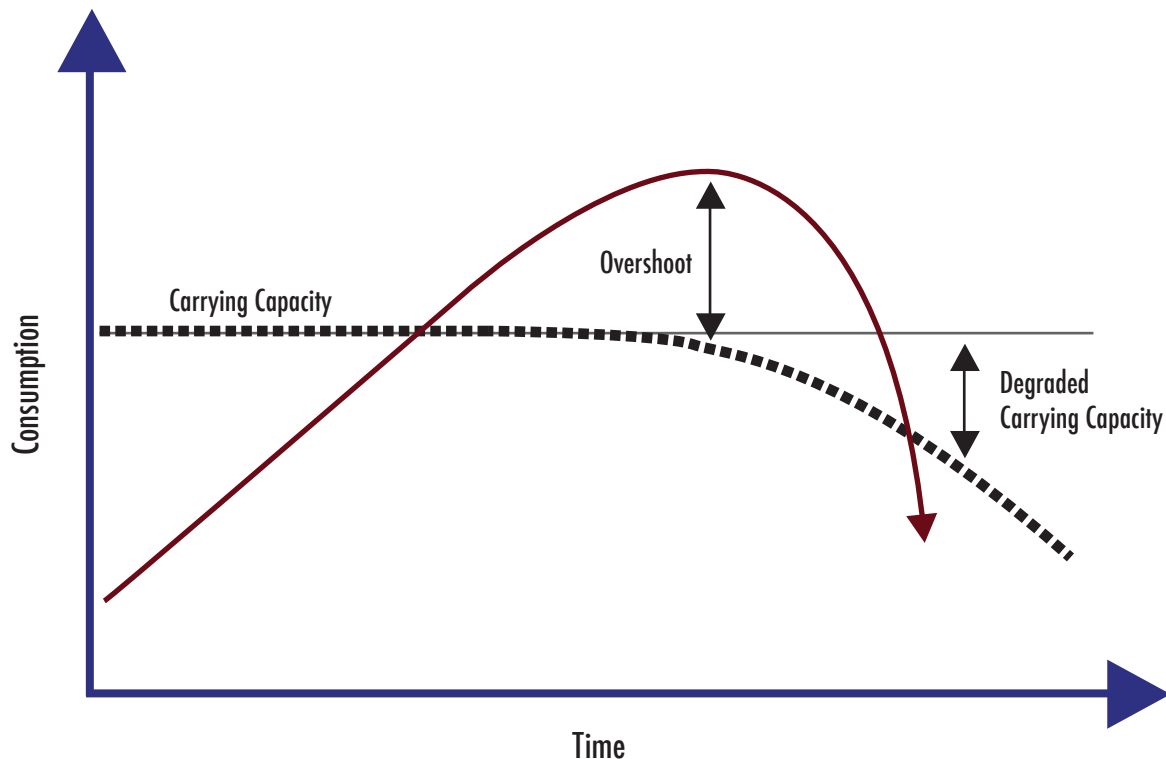
While we are used to thinking of cities as geographically discrete places, most of the land “occupied” by their residents lies far beyond their borders. The total area of land required to sustain an urban region (its “ecological footprint”) is typically at least an order of magnitude greater than that contained within municipal boundaries or the associated built-up area. In effect, through trade and natural flows of ecological goods and services, all urban regions appropriate the carrying capacity of distant “elsewheres,” creating dependencies that may not be ecologically or geopolitically stable or secure.⁴

In 1996 Wackernagel and Rees published *Our Ecological Footprint: Reducing Human Impact on the Earth* (Gabriola Island, BC: New Society Publishers).⁵ Filled with clever illustrations and succinct explanations, this small and engaging book described their insights and the rationale and methodology behind calculating EF. It began the process of popularizing the EF concept.

One of the people fascinated by EF and its potential to graphically quantify humanity's aggregate demands on Mother Earth was the distinguished entomologist, conservation biologist, and Pulitzer Prize-winning author E.O. Wilson.⁶ Professor Wilson put in a good word for EF to America's most elite scientific body, the National Academy of Sciences, and in 2002, he edited a paper on EF by Wackernagel and co-authors entitled “Tracking the ecological overshoot of the human economy” for publication in the Academy's prestigious *Proceedings of the National Academy of Sciences*.⁷ In less than a decade, EF had emerged from ecotopian obscurity to being embraced by America's scientific establishment, and later the world's. At the same time, EF, and a derivative, the Carbon Footprint, began to achieve popular acceptance by environmental advocacy groups, national governments, the U.N., the news media, and the public at large.

Today, Rees continues his work at the University of British Columbia. In 2003, Wackernagel established the Global Footprint Network, based in Oakland, California. Since its founding more than 15 years ago, EF has matured and continued to evolve. With growing recognition of its utility in measuring human demands on nature, and nature's capacity to meet these demands, this metric has increasingly been adopted by world governments, businesses, and environmental/conservation organizations. The Global Footprint Network, with more than 100 partner organizations around the world, works to improve the scientific rigor and transparency of EF methodology. At the heart of their efforts are the National Footprint Accounts, which furnish a detailed accounting of ecological resource demand and supply for all countries with populations above one million. This international NGO also supports the movement for sustainability by working to

Figure 1. Ecological Overshoot



make ecological limits central to economic and environmental decision-making. The ultimate goal is to assure human well being by reversing “ecological overshoot” and reducing pressure on critical ecosystems so they remain robust, even as they continue to provide humanity with essential ecological services.⁸

As shown graphically in Figure 1, ecological overshoot refers to the phenomenon by which the population of a species, whether *Homo sapiens* or some other organism, may temporarily exceed the carrying capacity of its environment.⁹ When overshoot occurs, the organism in question degrades the quality of its habitat, reducing carrying capacity and thus the ability of the environment to support a given population in the future. Many environmental scientists fear that human beings, now over 300 million strong in the United States and nearly seven billion strong on Earth, are already in overshoot mode, and that population reduction in this century is all but inevitable.¹⁰ Yet this notion of an inevitable decline is exceedingly “politically incorrect,” as well as counter-intuitive, since the United States and global populations continue to grow annually by some three million and 80 million, respectively. Most of the scientists and population activists who believe demographic decline is unavoidable also believe that enlightened population policies can still make a tremendous difference. How? By cushioning the fall and making it more palatable and humane than if nature were allowed to run its course and the Four Horsemen of the Apocalypse ran roughshod over civilized mores.

How did we human beings, with all our vaunted intelligence and technology, fall into the overshoot trap? Wasn't this trap laid for witless brutes like the reindeer on St. Matthew Island in the Bering Sea,¹¹ rather than the precocious ape with opposable thumbs, that after leaving behind the limited horizons of quadrupeds, began walking toward vast new horizons so many eons ago? Didn't the execrable Malthus, rebuked by everyone from Jonathan Swift and Charles Dickens to Karl Marx and Friedrich Engels, opine mistakenly two centuries back that our population would be controlled by misery and vice? Since our numbers have

grown eight-fold since his erroneous and callous calculations, hasn't the reviled Malthus been utterly discredited?

Well, in the words of another “discredited” writer, biologist and Stanford professor Paul Ehrlich, humanity discovered a one-time “treasure trove” of finite, non-renewable resources, chief among them the fossil fuels: coal, oil, and natural gas. It is no coincidence that the human population explosion began in earnest alongside the industrial revolution, powered by fuels that are destined to disappear. Escalating human influence over the ecosphere has now become so profound and pervasive that some leading scientists have wondered in print whether humans are now “overwhelming the Great Forces of Nature.”¹² One prominent scientist has even proposed the naming of a new geologic epoch to describe the age we're not only in, but have wrought ourselves: the Anthropocene, or the Age of Man.¹³

Yet our dilemma is not just that human population may have been boosted to unsustainable heights by the fossil fuel boon. We have also used up or degraded other natural capital, both renewable and non-renewable natural resources including forests, soils, fisheries, wildlife, minerals, water, wetlands, mangroves, marshes, coral reefs, estuaries, airsheds, and we have spread toxic contaminants far and wide over, under and across the Earth. Moreover, the climate change we are inadvertently and apparently causing may be toward a state that effectively reduces the human carrying capacity of the Earth both by disrupting agricultural output (soil moisture and crop stress) and reducing habitable land area from coastal flooding.¹⁴

The Methodology of Ecological Footprint: How Humans Diminish the Earth's Natural Capital

In essence, the Ecological Footprint is a measure of aggregate human demands, or the human load imposed on the biosphere in this Anthropocene Age. When all is said and done, the human economy, which entails the production and consumption of all goods and services, depends entirely on Earth's natural capital, which provides all the ecological services and natural resources that sustain civilization. Consuming natural capital at a rate that exceeds nature's ability to regenerate it will draw down and eventually exhaust the capital stock,¹⁵ just as siphoning funds from the principal of a savings account faster than the interest rate builds those funds will eventually drain it dry. In the 19th century, when humanity began extracting and combusting first coal, then oil, and finally natural gas, drawdown began in earnest. This drawdown accelerated exponentially in the 20th century and in the 21st century continues apace.

EF analysis explicitly compares and contrasts the resource consumption of the human economy with the biosphere's capacity for renewal and regeneration of those same natural resources. EF is a measure of the amount of biologically productive land and sea area needed to regenerate the resources a given human population consumes and to



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absorb and render harmless, or assimilate, the corresponding waste or residuals it generates. Resources are obtained from environmental “sources” and wastes are discarded or discharged into environmental “sinks.” Environmental sources and sinks that begin to run dry and overflow are signals the system is overloaded.

EF and other measures of humanity’s impacts on natural resources and ecological processes are predicated on the following assumptions:

- It is possible to keep track of most of the resources humanity consumes and the wastes humanity generates.
- Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain these flows (those resource and waste flows that cannot be excluded from the assessment).
- By weighting each area in proportion to its usable biomass productivity (its potential production of biomass that is of economic interest to people), the different areas can be expressed in standardized hectares (a metric unit of area equal to approximately 2.5 acres). These standardized hectares, called “global hectares,” represent hectares with biomass productivity equal to the world average productivity that year.
- Because these areas stand for mutually exclusive uses, and each global hectare represents the same amount of usable biomass production for a given year, they can be added up to a total representing the aggregate human demand.
- Nature’s supply of ecological services can also be expressed in global hectares of biologically productive space.
- Area demand can exceed area supply. For example, a forest harvested at twice its regeneration rate appears in EF accounts at twice its area, a phenomenon that is an example of the “ecological overshoot” described above.¹⁶

EF accounts include six human activities that require ecologically productive spaces. All of these activities take place in the United States and are crucial to Americans both economically and ecologically. They include all of agriculture (both crop cultivation and livestock production), fisheries, and forestry that supply Americans with all of our domestically-produced food and much of our fiber, water, and energy. Conventional profiles of advanced, affluent, “post-industrial” and “information-based” economies like that of America’s tend to minimize the role of these activities as a percentage of the economy, both in terms of the number of jobs they represent and their contribution to our GDP. This famously misled Robert Solow, the Nobel Prize-winning economist to declare that “the world can, in effect, get along without natural resources.”

Yet these resources and the productive economic activities that make them available for our consumption are the underpinnings of the vast, complex economic enterprise we have so painstakingly built up over the last century or two. Without food, water, and a stable climate, the economic engines of Silicon Valley, Main Street, Wall Street, the Pentagon, Madison Avenue, and the Federal Government would collapse, just as surely as our bodies would collapse were we denied the steady breaths of fresh air that we take for granted. Below I briefly discuss the six human activities that require ecologically productive spaces as characterized by developers of the EF.¹⁷

1. **Growing crops for human food, animal feed, fiber, oil, and rubber.** The Cropland Footprint is a measure of the land area necessary to grow all crops consumed by humans and livestock. It includes land used for agricultural products, market animal feed, and grasses cropped and fed to livestock.¹⁸ This category requires the most bioproductive land of all. It includes approximately 1.6 billion hectares of cropland worldwide, consisting of both cultivated crops and unharvested land that supports temporary pastures and fallow land, failed plantings, as well as shoulders, shelterbelts, and other uncultivated patches.

One shortcoming of Cropland Footprint calculations is that they do not account for the extent to which farming techniques or unsustainable agricultural practices cause long-term degradation of soil.¹⁹ As the research of Cornell University's David Pimentel and numerous agencies and other agricultural scientists has documented over many years, losses due to erosion, water-logging, salinization, and degraded fertility are substantial,²⁰ though highly variable from site to site. In 2000, the Natural Resources Conservation Service (NRCS) estimated that 108 million acres of cropland in the United States have excessive soil erosion (an area equal to California, our third-largest state), with 1.3 billion tons of soil eroded annually.²¹ In any case, while necessary to simplify EF analysis, the assumption of no soil degradation is highly optimistic and unrealistic.

2. **Grazing animals for meat, hides, wool, and milk.** Animal grazing to raise livestock for meat, dairy, hide, and wool products requires pastureland.²² Currently, there are about 3.4 billion hectares of pasture worldwide, defined by the Food and Agricultural Organization (FAO) as "land used permanently (five years or more) for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land)."
3. **Harvesting timber for wood, fiber, and fuel.** Timber harvest depends on managed or unmanaged forests or plantations.²³ According to the FAO, there are about 3.9 billion hectares of such forests worldwide, although many areas, especially tropical rain and dry forests, are in the process of being deforested. Timber productivity estimates are based on the UN Economic Commission for Europe and FAO's "Temperate and Boreal Forest Resource Assessment," and "Global Fiber Supply Model," and the Intergovernmental Panel on Climate Change, and provide a world average yield of 1.81 m³ of harvestable underbark (wood) per hectare per year. These sources also furnish information on plantation type, coverage, timber yield, and areas of protected and economically inaccessible forest.²⁴
4. **Marine and freshwater fishing.** Out of the entire vast ocean area, only a small fraction concentrated largely along the world's coasts — the continental shelves — provides more than 95 percent of the marine catch. The Fishing Grounds Footprint is calculated using estimates of the maximum sustainable catch for 1,439 different marine species and more than 268 freshwater species of fish. These sustainable catch estimates are converted into an estimate of the primary production requirement, calculated from the average trophic level of the species in question. Fish that feed higher on the food chain (at higher trophic levels) require more primary production input and as such are associated with a higher Footprint of consumption. In turn, this is then divided among the world's continental shelf areas. Globally, there were 2.4 billion hectares of continental shelf and 433 million hectares of inland water areas in 2006.²⁵
5. **Accommodating infrastructure for housing, transportation, industrial production, and hydro-electric power.** These artificial structures constitute built-up land that largely eliminates biologically productive habitat through the process of "development." Built-up land occupied 167 million hectares of land worldwide in 2006, and presumably occupies what would previously have been cropland. This assumption is based on the fact that human settlements are generally situated in highly fertile, flat areas.²⁶

- 6. Forests for carbon dioxide uptake from the burning of fossil fuels.** Burning fossil fuel injects carbon dioxide (CO_2) into the atmosphere, destabilizing the Earth's climate. EF calculates the area requirement by estimating the biologically productive area needed to sequester (take up and assimilate into plant matter) enough carbon emissions to avoid an increase in atmospheric CO_2 . Because the world's oceans absorb about one-third of the CO_2 emissions from fossil fuel combustion, EF accounts only for the remaining two-thirds, based on each year's capacity of world-average forests to sequester carbon. Eventually, mature forests become saturated, so that the net rate of CO_2 uptake goes to zero.

An alternative to the sequestration approach is to estimate the area requirement for a fossil fuel substitute from biomass — such as ethanol or methanol — using current technology. This leads to similar or even larger area demands. The equivalent energy from fuelwood grown on forest land with world average productivity would produce roughly the same area as the sequestration approach, whereas replacing liquid fossil fuel with the same amount of unrefined biomass energy would require an area 56 percent larger.²⁷

The EF is measured in units called “global hectares.” EF analysis weights or scales different land and water categories to account for variations in their productivities. These “equivalence factors” and “yield factors” convert actual areas of different land use types (measured in hectares) into their global hectare equivalents. Equivalence and yield factors are applied both to EF and “biocapacity” calculations. Yield factors account for differences in the productivity of a given land-use type between a given country and the global average.

Equivalence factors translate a specific type of land use (e.g., world average cropland, forest) into a universal unit of biologically productive area — the aforementioned global hectare. In 2006, for example, grazing land had an equivalence factor of 0.51 (Table 1, p. 10), indicating that, on average, the productivity of the world's grazing land was approximately half the average productivity for all land (and water) categories combined. The equivalence factor for built-up land is assumed equal to that for cropland because so much developed land is on or near fertile cropland areas.²⁸

EF measures the summed area of biologically productive lands and waters needed to produce all the resources an individual, population (city, region, state, country, continent, etc.), or activity consumes, and to absorb the carbon dioxide waste it generates, given prevailing technology and resource management practices. This area can then be compared with the biological capacity (“biocapacity”) of the same city, state, region, or country; that is, the amount of biologically productive area available to generate the resources consumed — and to sequester the CO_2 emitted by that city's, state's, region's or country's population. If a land or water area provides more than one of these services it is only counted once, so as not to exaggerate the amount of productive area actually available.

Biocapacity Assessment

A national biocapacity calculation begins with the total amount of ecologically productive (“bioproductive”) land available. “Bioproductive” refers to those lands and waters supporting plant populations dense or large enough to carry out significant photosynthetic activity and accumulation of biomass, or what ecologists call “net primary production.” Using energy supplied by the sun, photosynthesis taking place inside the chloroplasts of green plants converts water (H_2O) and carbon dioxide (CO_2) in the air into the organic compound glucose ($\text{C}_6\text{H}_{12}\text{O}_6$, a simple sugar) and eventually more complex organic substances.

Barren areas, such as deserts, glaciers, ice fields, rocky mountains, and alpine tundra of low or dispersed productivity are ignored in biocapacity assessments, because they are relatively unproductive biologically. This is not intended to minimize their ecological and aesthetic importance or their important diversity,

Table 1. Equivalence Factors from 2006

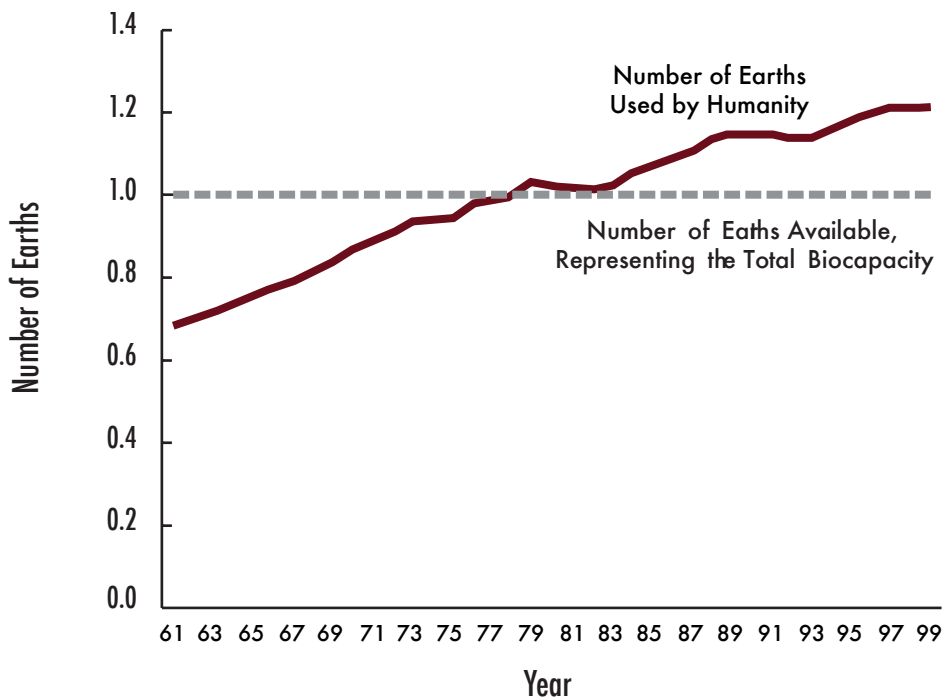
Area Type	Equivalence Factor (global hectares per hectare)
Primary Cropland	2.39
Forest	1.24
Grazing Land	0.51
Marine	0.41
Inland Water	0.41
Built-Up Land	2.39

Source: Global Footprint Network; see End Note 7.

but merely to recognize that their biological productivity and biomass accumulation are negligible. As the Global Footprint Network emphasizes, areas such as the Sahara Desert, Antarctica, or Alpine mountaintops do indeed support wildlife — both plant and animal life, but their production is simply too scant and/or too dispersed to be directly and economically harvestable by humans on any significant scale.²⁹

Biocapacity is an aggregate measure of the area of available land, weighted by the productivity of that land. It signifies the capacity of the biosphere to provide crops, livestock (pasture), timber products (forest), and fish, as well as to take up CO₂ in forests. It also accounts for how much of this regenerative capacity is occupied by built-up or developed land, both infrastructure such as streets, roads, and parking lots, and other structures such as houses, office buildings, schools, and factories. In essence, in EF analysis, biocapacity is a measure of the ability of available terrestrial and aquatic areas to provide ecological services.³⁰

Figure 2. Ecological Overshoot on a Global Scale - Number of Earths Used by Humanity Exceeds Number of Earths Available (1.0), and “Good Planets Are Hard to Find”



Source: Wackernagel, et al.; see End Note 7.

Note: In this graph the numbers of Earths (total biocapacity) available is held at a constant 1.00 for the sake of the illustration, when in fact biocapacity is falling, as Figure 4 shows.

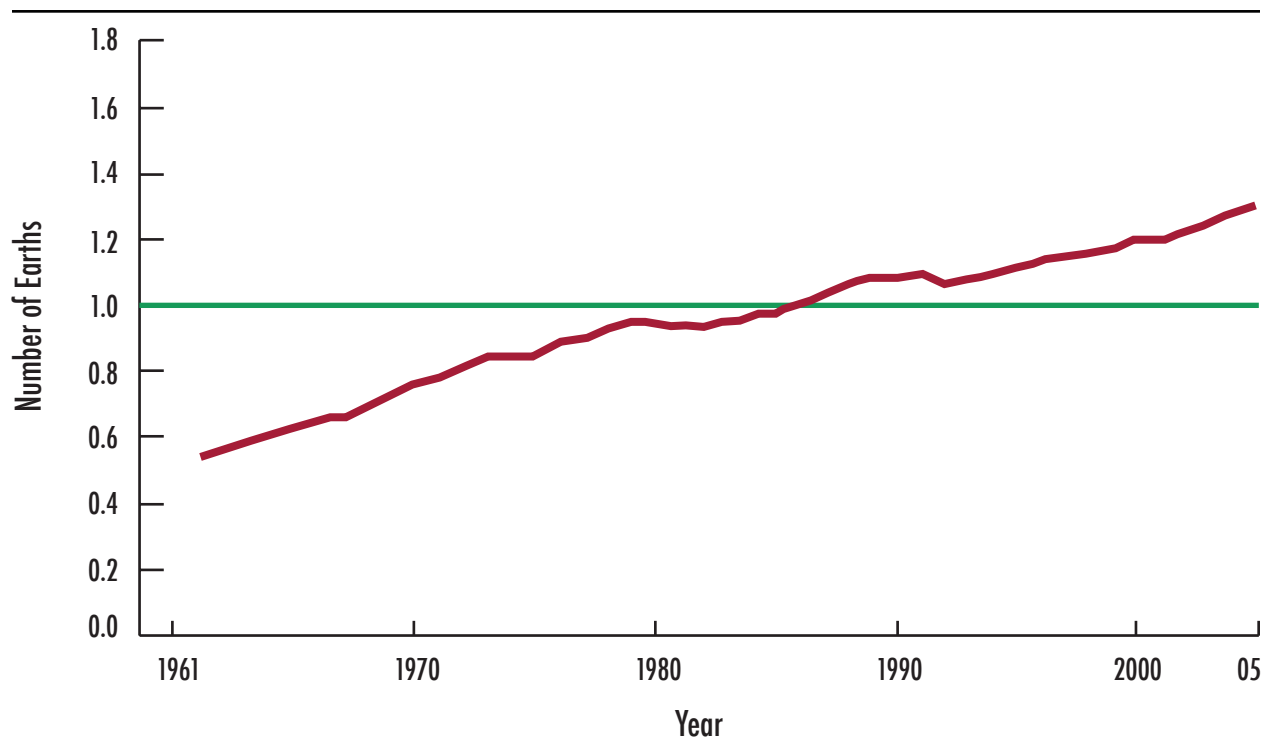
National Footprint Accounts: The Global Context

Perhaps the three most important conclusions to be drawn from Ecological Footprint analysis over the years are that:

1. Some countries and regions have an EF that exceeds their biocapacity, while other countries have an EF that is less than their available biocapacity. The first set of countries are said to have a deficit and the second set a surplus or reserve of biocapacity.
2. Since about the 1970s or 1980s, humanity as a whole *has not been living within the ecological means of the planet*; that is, we are already in overshoot, an unstable and unsustainable condition.³¹ See Figures 2-5.
3. Even as humanity's aggregate EF continues to increase, the Earth's biocapacity is decreasing simultaneously; biocapacity is being degraded. The *global EF now exceeds global biocapacity*, which, as just noted, is not sustainable (Figure 4, p. 12).

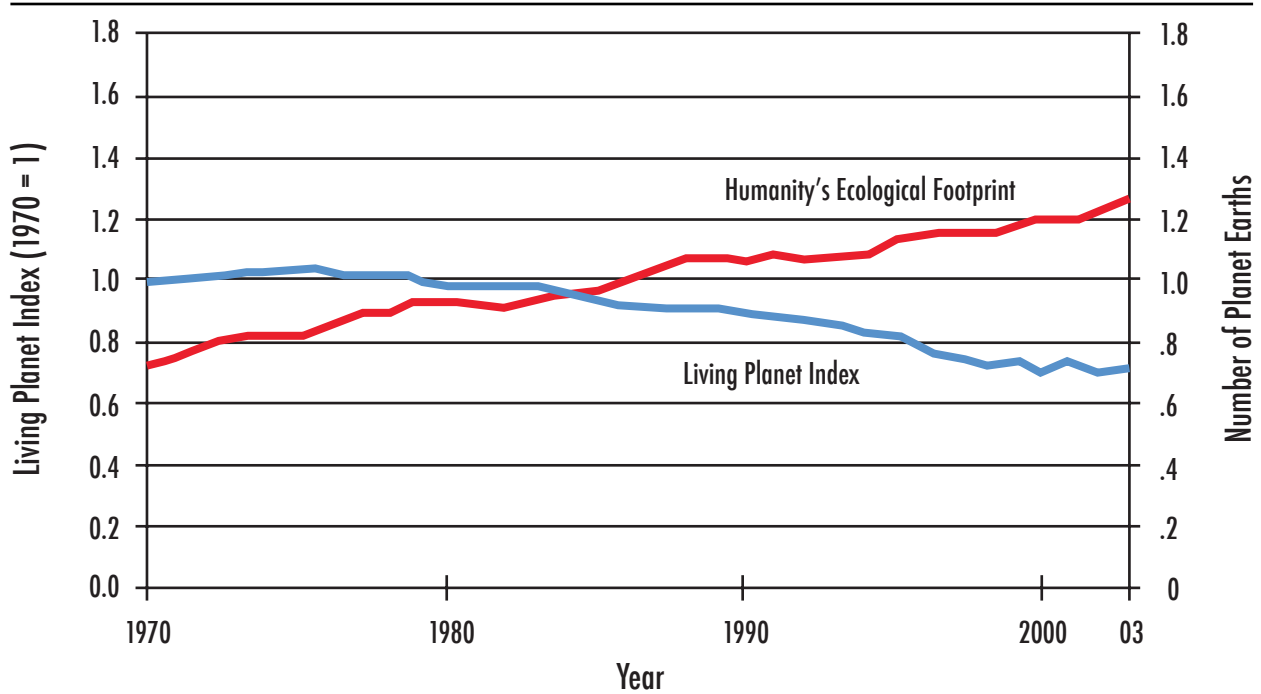
In 2006, the most recent year for which data are available, the total worldwide EF was 17.1 billion global hectares (gha). With a world population then at 6.6 billion people (now 6.8 billion and continuing to climb in 2010), the average person's (or per capita) EF was 2.6 gha. Notwithstanding these data, in that year there were only 11.9 billion gha of biocapacity available, or 1.8 gha per capita. This overshoot of nearly 40

Figure 3. - Ecological Footprint and World Biocapacity, 1961-2005, Holding World Biocapacity Constant at 1.0 (Number of Planet Earths)



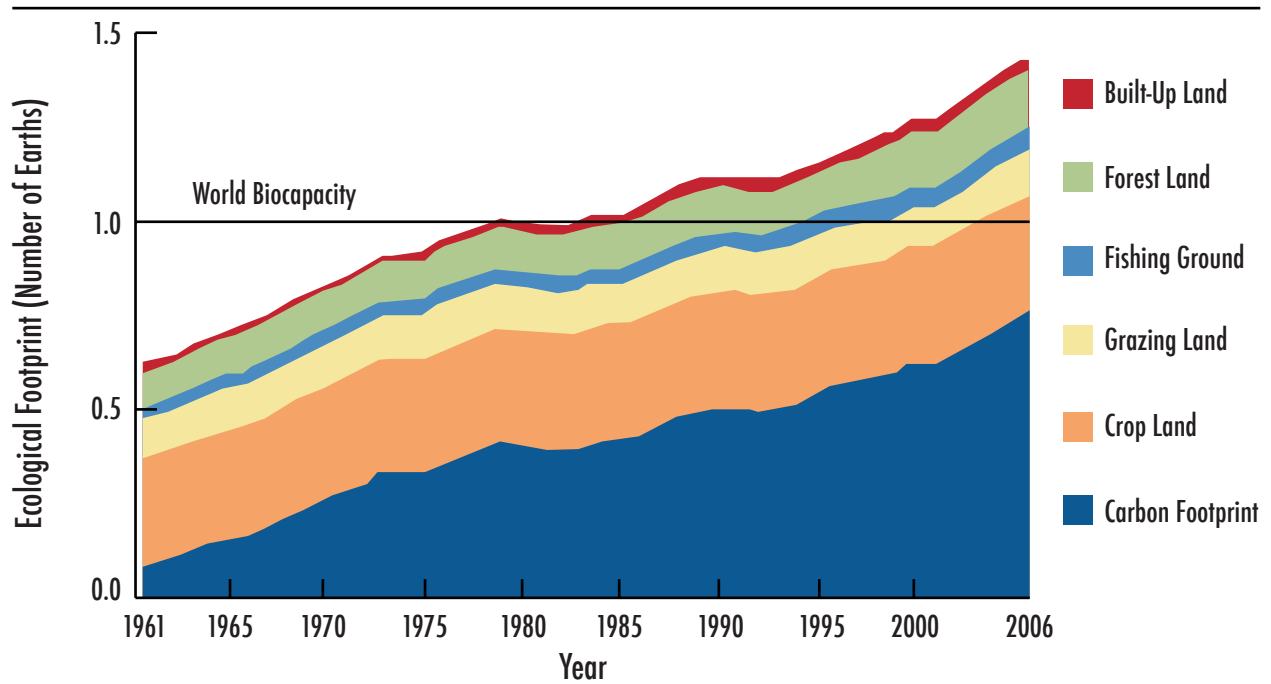
Source: Global Footprint Network; see End Note 8.

Figure 4. Humanity's Increasing Ecological Footprint and Decreasing Biocapacity (Living Planet Index)



Source: World Wildlife Fund for Nature (WWF).

Figure 5. Breakdown of Ecological Footprint into Land and Water Categories, 1961-2006



Source: Global Footprint Network; see End Note 8.

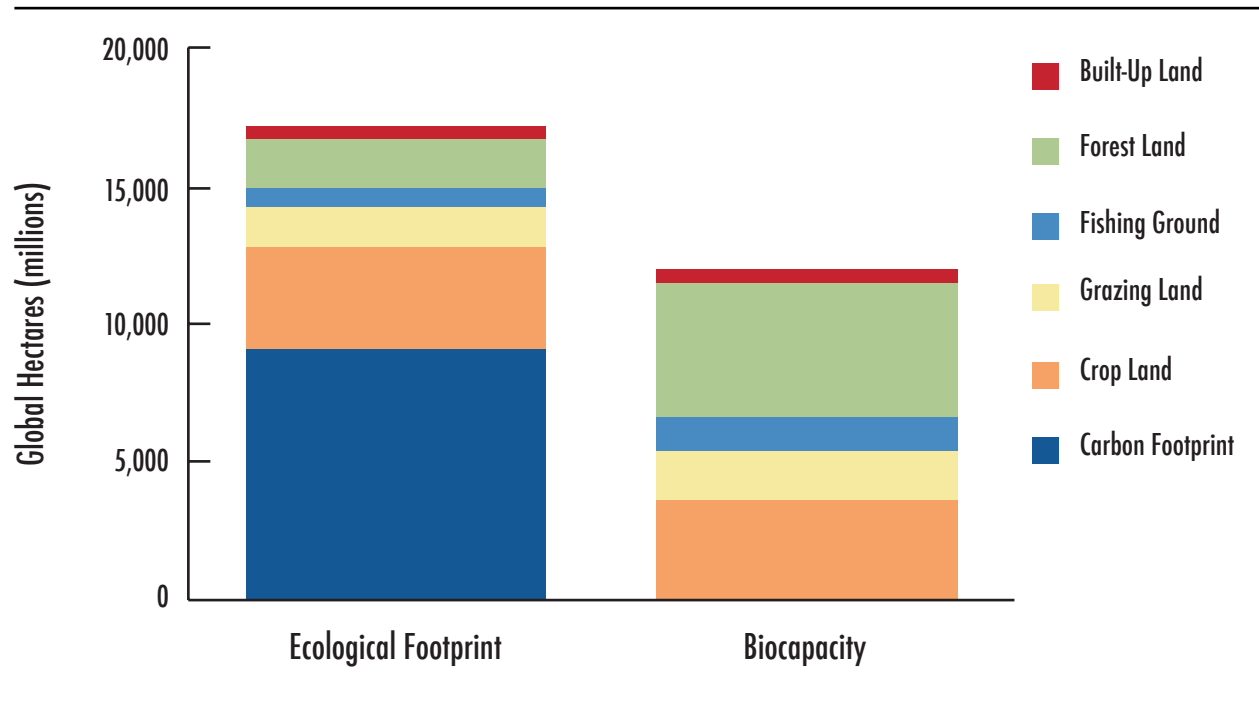
percent means that in 2006, humanity used the equivalent of 1.4 Earths to support its consumption. As the Global Footprint Network says, “it took the Earth approximately a year and four months to regenerate the resources used by humanity in that year.”³²

Figures 3-5 are graphs showing the global situation from several different perspectives.

Figure 6 compares the total global EF with the total global biocapacity in 2006, disaggregating each by land/water type. One particularly striking feature of this graph is the world's enormous carbon footprint, which comprises about half the overall EF. Again, the Carbon Footprint refers to the amount of forestland needed to absorb or sequester anthropogenic emissions of carbon dioxide (to prevent its accumulation in the atmosphere and enhanced uptake by the ocean). If this were ignored in the EF vs. biocapacity comparison, the entire world would still be operating at an ecological surplus rather than at a deficit, but humanity continues to ignore these emissions and mounting CO₂ levels in the atmosphere, at its— and the ecosphere's peril.

Table 2 (p. 14) compares the EF's and biocapacities of selected regions, income groupings, and countries of the world. Of the more than 100 major countries surveyed in the most recent Global Footprint Network analyses, based on 2006 statistics and data, the United States had the third highest per capita EF, exceeded only by two small oil-producing Middle-Eastern countries, the United Arab Emirates and Qatar. What really counts, however, is the deficit between the per capita EF and the per capita biocapacity. Table 3 (p. 18) ranks the top 21 countries by the size of their per capita ecological deficit. The U.S. ranks sixth on this list. That means we have the sixth greatest gap between what our ecosystems produce and what our nation consumes. The difference is made up by a combination of imports (appropriated carrying capacity) and, in the case of CO₂ emissions, imposing our climate-forcing pollutants on the rest of the world and the ecosphere as a whole.

Figure 6. Total Ecological Footprint and Biocapacity by Land and Water Categories, 2006



Source: Global Footprint Network; see End Note 8.

Table 2. Ecological Footprints and Biocapacities of Selected Countries and Regions, 2006

Country or Region	Population (millions)	Total EF*	Ecological Footprint (global acres per capita)					Built-Up Land
			Cropland Footprint	Grazing Footprint	Forest Footprint	Fishing Footprint	Carbon Footprint	
World	6,592.9	6.4	1.40	0.53	0.68	0.24	3.40	0.15
High-Income Countries	1,022.1	15.0	2.30	0.46	1.73	0.69	9.52	0.28
Middle-Income Countries	4,281.1	4.4	1.15	0.41	0.46	0.19	2.03	0.15
Low-Income Countries	1,277.0	2.5	0.90	0.26	0.58	0.05	0.63	0.12
Africa (average)	942.5	3.5	1.19	0.50	0.72	0.11	0.86	0.13
Chad	10.5	4.3	1.51	1.91	0.71	0.00	0.03	0.18
Congo	3.7	2.4	0.74	0.08	1.02	0.19	0.22	0.13
Congo, Dem.Republic	60.6	1.8	0.40	0.03	1.21	0.03	0.03	0.12
Nigeria	144.7	4.0	1.56	0.15	0.52	0.11	1.51	0.13
South Africa	48.3	6.8	1.94	0.52	0.73	0.23	3.20	0.15
Tanzania	39.5	2.5	0.76	0.77	0.62	0.00	0.27	0.11
Asia (average)	3,983.9	3.7	0.93	0.16	0.35	0.19	1.98	0.14
China	1,328.5	4.6	0.89	0.31	0.36	0.16	2.67	0.17
India	1,151.8	1.9	0.69	0.02	0.30	0.03	0.78	0.09
Iran	70.3	6.6	1.62	0.41	0.12	0.31	3.89	0.22
Iraq	28.5	3.3	1.05	0.07	0.02	0.03	2.06	0.06
Israel	6.8	13.3	2.54	0.22	0.88	0.37	9.11	0.17
Japan	128.0	10.2	1.43	0.08	0.70	1.17	6.61	0.17
Korea (South)	48.1	9.2	1.71	0.10	0.60	1.51	5.17	0.14
Pakistan	160.9	1.8	0.73	0.02	0.20	0.03	0.75	0.11
Qatar	0.8	23.9	3.39	0.50	0.66	1.06	17.86	0.45
Saudi Arabia	24.2	8.6	3.18	0.27	0.36	0.35	3.99	0.45
Thailand	63.4	4.3	1.33	0.03	0.43	0.52	1.80	0.15
Turkey	73.9	7.0	2.50	0.20	0.63	0.10	3.37	0.20
Turkmenistan	4.9	9.5	1.84	1.20	0.01	0.01	6.08	0.30
United Arab Emirates	4.2	25.4	4.88	0.48	1.21	0.94	17.76	0.15
Europe (average)	731.3	11.1	2.61	0.31	1.22	0.55	6.16	0.29
Czech Repub.	10.2	13.1	2.54	0.29	2.44	0.16	7.29	0.40
Denmark	5.4	17.8	2.71	0.53	3.06	1.49	9.31	0.68
Estonia	1.3	15.9	1.09	0.36	5.94	0.35	7.78	0.33
Finland	5.3	13.6	3.14	0.09	2.53	0.93	6.59	0.35
France	61.3	11.4	2.00	0.40	1.57	0.74	6.14	0.52
Germany	82.6	10.0	2.29	0.18	1.25	0.34	5.46	0.44
Greece	11.1	14.2	2.30	0.63	1.05	0.30	9.74	0.20
Hungary	10.1	8.0	2.87	0.16	1.01	0.06	3.44	0.43
Ireland	4.2	20.2	2.63	1.79	1.58	0.80	12.82	0.61
Italy	58.8	12.2	2.53	0.50	1.24	0.59	7.12	0.21
Netherlands	16.4	11.4	3.01	0.52	1.02	0.45	6.03	0.34
Norway	4.7	10.4	2.93	0.10	1.47	0.44	5.06	0.38
Poland	38.1	9.6	1.61	0.03	1.64	0.28	5.87	0.17
Russian Fed.	143.2	11.0	3.74	0.13	1.06	0.38	5.52	0.15
Spain	43.9	13.9	2.87	0.43	1.15	1.31	8.02	0.12

Country or Region	Total BioCapacity	Biocapacity (global acres per capita)					Ecological (Deficit) or Reserve
		Cropland	Grazing Land	Forest	Fishing Ground	Built-Up Land	
World	4.5	1.39	0.65	1.83	0.44	0.15	(1.9)
High-Income Countries	8.3	2.86	0.80	2.92	1.42	0.28	(6.7)
Middle-Income Countries	4.2	1.17	0.60	1.88	0.35	0.15	(0.2)
Low-Income Countries	2.5	0.86	0.55	0.71	0.21	0.12	(0.1)
Africa (average)	3.7	1.05	1.12	1.13	0.31	0.13	0.2
Chad	8.3	1.48	3.80	2.64	0.24	0.18	4.0
Congo	32.6	0.57	10.01	20.62	1.27	0.13	30.2
Congo, Dem.Republic	6.6	0.36	0.31	5.66	0.13	0.12	4.8
Nigeria	2.2	1.48	0.49	0.06	0.06	0.13	(1.8)
South Africa	4.2	1.68	1.74	0.05	0.62	0.15	(2.5)
Tanzania	2.2	0.76	0.77	0.36	0.16	0.11	(0.4)
Asia (average)	1.8	0.82	0.20	0.37	0.24	0.14	(2.0)
China	2.1	0.87	0.31	0.55	0.19	0.17	(2.5)
India	0.9	0.68	0.01	0.06	0.09	0.09	(1.0)
Iran	2.4	1.35	0.53	0.17	0.17	0.22	(4.1)
Iraq	0.6	0.34	0.06	0.13	0.02	0.06	(2.7)
Israel	0.8	0.50	0.02	0.09	0.04	0.17	(12.5)
Japan	1.5	0.32	0.00	0.83	0.20	0.17	(8.6)
Korea (South)	0.7	0.35	0.00	0.23	0.01	0.14	(8.5)
Pakistan	0.9	0.67	0.01	0.03	0.10	0.11	(0.9)
Qatar	9.7	0.28	0.00	0.00	8.93	0.45	(14.2)
Saudi Arabia	3.2	1.24	0.39	0.51	0.62	0.45	(5.4)
Thailand	2.6	1.59	0.03	0.44	0.42	0.15	(1.6)
Turkey	3.6	2.21	0.33	0.76	0.12	0.20	(3.4)
Turkmenistan	8.4	2.12	5.55	0.04	0.38	0.30	(1.1)
United Arab Emirates	3.4	0.34	0.01	0.33	2.55	0.15	(22.0)
Europe (average)	7.5	2.50	0.46	3.54	0.68	0.29	(3.7)
Czech Repub.	6.5	2.75	0.34	3.01	0.01	0.40	(6.6)
Denmark	12.8	6.16	0.10	0.71	5.16	0.68	(5.0)
Estonia	22.2	1.64	0.97	7.93	11.34	0.33	6.4
Finland	32.1	3.40	0.01	21.38	6.95	0.35	18.5
France	7.0	3.17	0.68	2.19	0.44	0.52	(4.4)
Germany	4.6	2.14	0.25	1.57	0.21	0.44	(5.4)
Greece	3.4	1.95	0.25	0.35	0.62	0.20	(10.9)
Hungary	6.4	4.24	0.27	1.41	0.02	0.43	(1.6)
Ireland	10.5	2.41	2.24	0.61	4.65	0.61	(9.7)
Italy	2.6	1.31	0.21	0.66	0.16	0.21	(9.6)
Netherlands	2.6	0.67	0.16	0.19	1.23	0.34	(8.8)
Norway	15.1	1.71	0.07	7.98	4.96	0.38	4.7
Poland	4.5	2.01	0.33	1.74	0.29	0.17	(5.1)
Russian Fed.	15.6	3.83	0.81	10.33	0.51	0.15	4.7
Spain	3.3	2.07	0.32	0.59	0.16	0.12	(10.6)

Table 2. Ecological Footprints and Biocapacities of Selected Countries and Regions, 2006 (continued)

Country or Region	Population (millions)	Total EF*	Ecological Footprint (global acres per capita)					Built-Up Land
			Cropland Footprint	Grazing Footprint	Forest Footprint	Fishing Footprint	Carbon Footprint	
Sweden	9.1	7.0	2.78	0.27	0.83	0.46	2.25	0.41
Switzerland	7.5	13.8	1.79	0.49	1.07	0.35	9.82	0.28
Ukraine	46.6	6.6	2.15	0.03	0.41	0.27	3.57	0.16
United Kingdom	60.7	15.1	2.29	0.49	1.43	0.57	9.88	0.45
Latin America (average)	564.7	6.0	1.43	1.74	0.89	0.28	1.49	0.19
Argentina	39.1	7.4	1.06	3.35	0.51	0.50	1.77	0.23
Bolivia	9.4	5.9	1.17	3.02	0.39	0.03	1.16	0.18
Chile	16.5	7.6	1.65	0.78	2.34	1.36	1.22	0.31
Colombia	45.6	4.6	0.77	1.93	0.32	0.11	1.28	0.20
Costa Rica	4.4	6.7	1.09	0.63	1.81	0.12	2.78	0.23
Cuba	11.3	5.7	2.38	0.27	0.28	0.09	2.60	0.12
Haiti	9.4	1.2	0.61	0.10	0.26	0.04	0.12	0.06
Honduras	7.0	5.5	1.14	0.84	1.47	0.08	1.81	0.18
Mexico	105.3	8.0	2.48	0.45	0.79	0.24	3.90	0.18
Paraguay	6.0	8.3	0.79	4.16	2.15	0.02	1.01	0.17
Peru	27.6	4.4	1.32	0.59	0.45	1.11	0.73	0.24
Venezuela	27.2	5.8	1.26	0.88	0.33	0.47	2.65	0.17
North America (average)	335.5	21.5	2.63	0.20	2.87	0.42	15.14	0.22
Canada	32.6	14.2	1.34	0.64	2.59	0.57	8.88	0.19
USA	302.8	22.3	2.77	0.16	2.90	0.40	15.82	0.23
Oceania (average)	33.8	14.3	0.64	5.76	2.18	1.30	4.32	0.15
Fiji	0.8	9.1	1.35	0.44	1.19	1.02	4.92	0.17
New Zealand	4.1	18.7	1.08	6.06	2.77	3.00	5.45	0.35
Papua New Guinea	6.2	4.2	0.51	0.04	0.73	2.15	0.51	0.27

*Total Ecological Footprint from consumption, that is, production plus imports minus exports

Source: Global Footprint Network; see End Note 8.

Country or Region	Total BioCapacity	Biocapacity (global acres per capita)					Ecological (Deficit) or Reserve
		Cropland	Grazing Land	Forest	Fishing Ground	Built-Up Land	
Sweden	25.8	2.82	0.11	15.83	6.67	0.41	18.8
Switzerland	3.2	0.63	0.42	1.81	0.02	0.28	(10.6)
Ukraine	5.5	3.62	0.34	1.00	0.37	0.16	(1.1)
United Kingdom	3.9	1.52	0.27	0.26	1.39	0.45	(11.2)
Latin America (average)	13.4	1.78	2.22	8.40	0.82	0.19	7.4
Argentina	17.4	5.73	4.80	1.93	4.73	0.23	10.0
Bolivia	47.8	1.66	6.79	38.96	0.17	0.18	41.8
Chile	10.1	1.11	1.31	5.33	2.05	0.31	2.5
Colombia	9.5	0.54	3.26	5.41	0.10	0.20	4.9
Costa Rica	4.5	0.88	1.61	1.47	0.28	0.23	(2.2)
Cuba	2.7	1.45	0.22	0.50	0.36	0.12	(3.1)
Haiti	0.6	0.37	0.10	0.02	0.04	0.06	(0.6)
Honduras	4.9	1.07	0.81	2.18	0.65	0.18	(0.6)
Mexico	4.2	1.61	0.76	1.23	0.41	0.18	(3.8)
Paraguay	26.7	3.21	6.63	16.48	0.16	0.17	18.4
Peru	10.1	1.01	1.41	6.74	0.67	0.24	5.6
Venezuela	6.5	0.71	0.83	4.73	0.11	0.17	0.8
North America (average)	14.0	5.35	0.71	5.47	2.21	0.22	(7.5)
Canada	42.2	10.61	0.65	20.72	10.01	0.19	28.0
USA	10.9	4.79	0.72	3.84	1.37	0.23	(11.3)
Oceania (average)	31.7	4.70	12.23	6.96	7.64	0.15	17.3
Fiji	6.1	1.19	0.26	3.25	1.22	0.17	(3.0)
New Zealand	29.8	2.57	8.57	12.43	5.83	0.35	11.0
Papua New Guinea	9.2	0.73	0.12	6.40	1.72	0.27	5.0

Immigration, Population Growth, and America's Enormous Ecological Footprint

As of early 2010, the United States has a rapidly growing population of 308 million.³³ In the 1990s, U.S. population expanded by nearly 33 million, the largest single decade of growth in American history since the decennial national censuses began in 1790. The 1990s exceeded even the peak decade of the Baby Boom, the 1950s by nearly five million (Figure 7). The 2001-2010 decade now drawing to a close will approach this record increment. Far from coasting to a stop or cessation in growth, U.S. population remains stubbornly and persistently high, and is literally growing with no end in sight. At current growth rates, every year more than three million net new residents are added to the U.S. population.³⁴

The U.S. Census Bureau projects that by 2050, the population of the United States will have grown to 439 million. This is an increase of 131 million, or 43 percent, over our current population of 308 million. In 2050, if the Census Bureau's current projections come to pass, the U.S. population would still be adding 3.45 million residents a year (more than today, though the annual growth rate will have declined somewhat), and there would be 5.7 million births compared to 4.3 million annual births today.³⁵

Yet it is misleading to imply that increased births would be the dominant force behind this massive population growth. That is because many of those births would not occur, or at least would not occur in the United States, were it not for the persistently high levels of net immigration that are assumed by the Census Bureau in these projections. In 2050, the Bureau's projections assume "net international migration" (immigration minus emigration) of 2.05 million, an increase from 1.34 million in 2010. This assumption reflects the Bureau's professional judgment that domestic and international pressures to further increase already high immigration rates will only intensify. If the factors behind demographic change are divided between "net natural increase" (births minus deaths) and "net migration" (immigration minus emigration), then in 2050, 41 percent of the annual increment of 3.45 million would be attributable to net natural increase, and 59 percent would be due to net migration.

However, even this breakdown understates the decisive influence that the level of immigration has in determining America's demographic future. The full impact of immigration on demographic trends only becomes apparent when the U.S.-born descendants of immigrants are accounted for because, after all, these U.S. births would not have occurred but for the prior acts of migration by eventual parents that made them possible. When births to immigrants are accounted for, demographers at the Pew Research Center calculated recently that:

Table 3. Top 21 Countries with the Greatest Per Capita Ecological Deficits, 2006

Country	Per Capita Ecological Deficit(acres)
United Arab Emirates	22.0
Kuwait	18.2
Qatar	14.2
Israel	12.5
Belgium	11.4
United States	11.3
United Kingdom	11.2
Singapore	11.0
Greece	10.9
Spain	10.6
Switzerland	10.6
Ireland	9.7
Italy	9.6
Netherlands	8.8
Japan	8.6
Korea (South)	8.5
Portugal	7.9
Czech Republic	6.6
Slovakia	5.6
Saudi Arabia	5.4
Germany	5.4

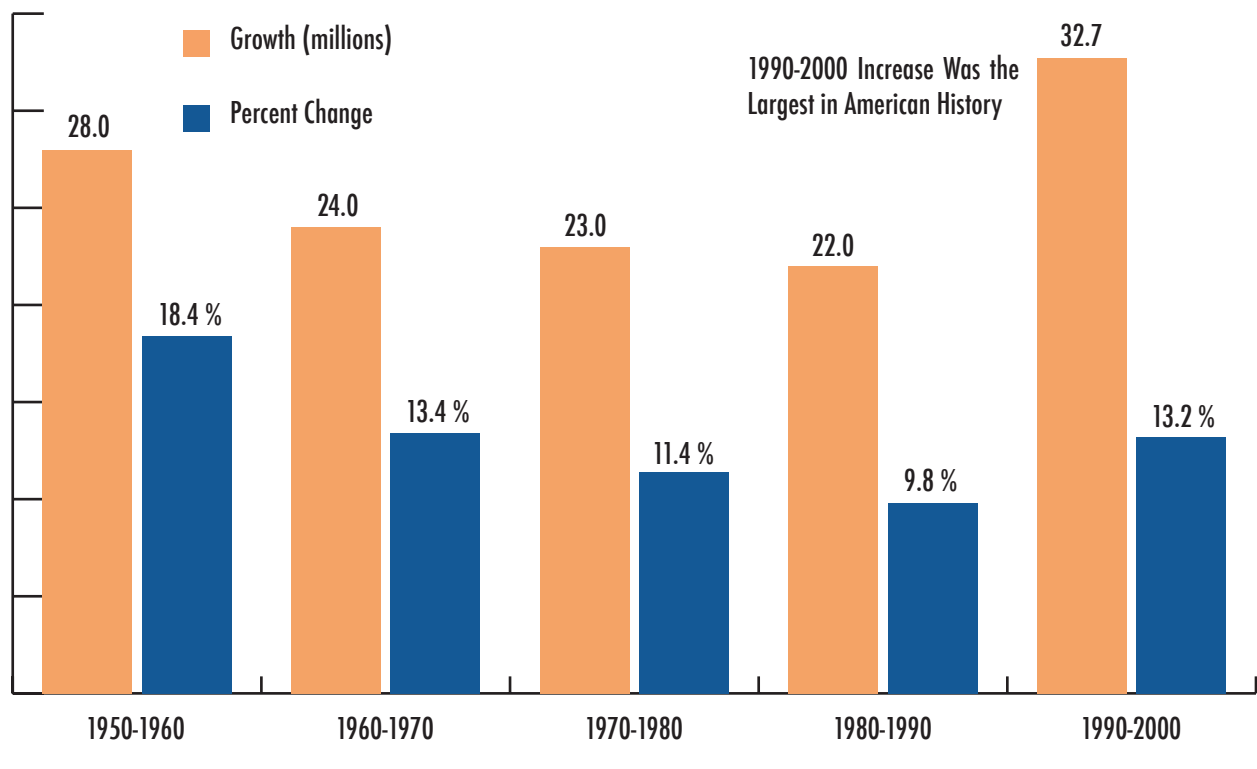
Source: Global Footprint Network; see End Note 8.

*If current trends continue, the population of the United States will rise to 438 million in 2050, from 296 million in 2005, and **82 percent of the increase** will be due to immigrants arriving from 2005 to 2050 and their U.S.-born descendants.³⁶ [emphasis added]*

Figures 8-10 graphically illustrate the powerful role of immigration policy in shaping current and future U.S. demographic trends. Figure 8 (p. 20) shows U.S. population growth from 1790 to 1970; the steepening curve, one characterized by larger and larger increments over time is a shape characteristic of all phenomena experiencing exponential growth. If, however, the 1970 levels of demographic components (net immigration, fertility or birth rates, and mortality rates) had been maintained over the decades that followed, the growth trajectory would have appeared more like that of the curve in Figure 9 (p. 20), rather than the much steeper curve in Figure 8.

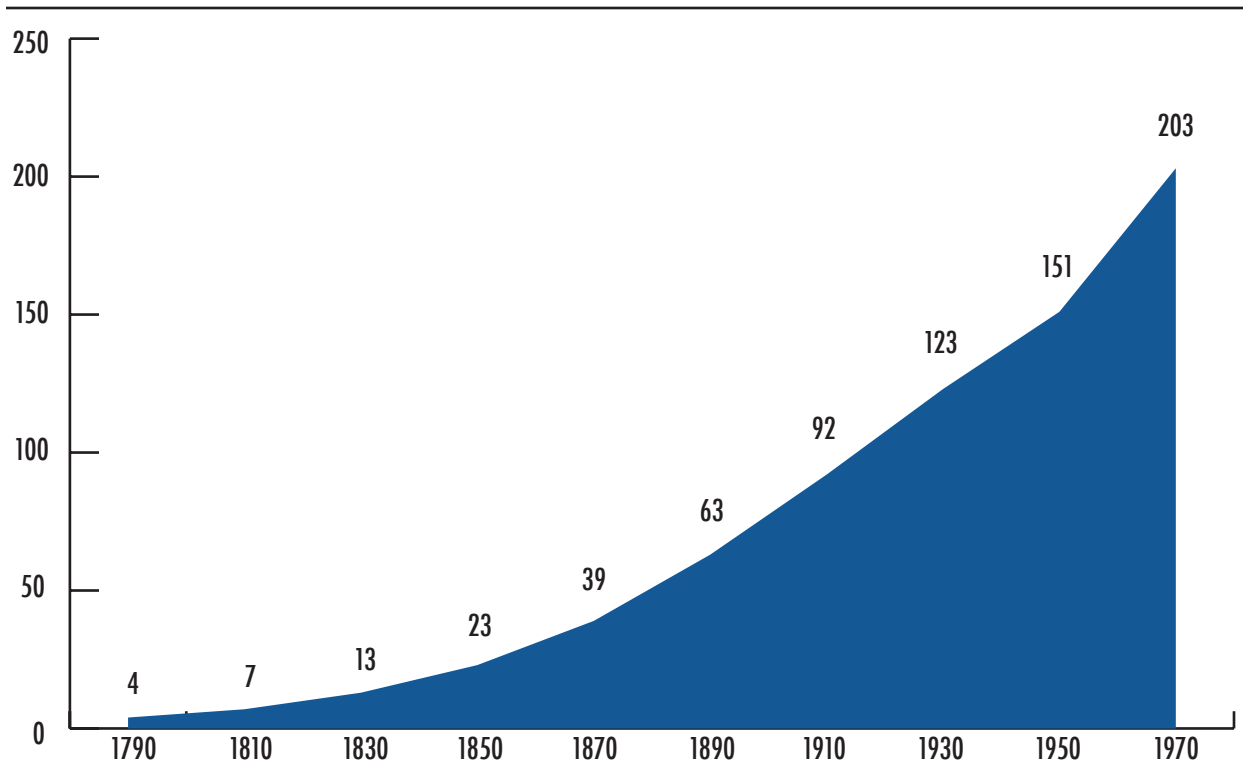
At the time of the first celebration of Earth Day in 1970, young environmentalists who had just finished reading Paul Ehrlich's best-selling 1968 book, *The Population Bomb* and listening to one of Earth Day Founder Senator Gaylord Nelson's moving speeches believed whole-heartedly in the cause and necessity of U.S. and global population stabilization. They endorsed the view of popular cartoonist Walt Kelly's character Pogo that, "We have met the enemy and he is us" (a play on words of the famous line by Commodore Perry: "We have met the enemy, and they are ours"). In other words, the more of "us" there are, the more "enemies," or at least environmental burdens Mother Earth faces. If this generation had been able to realize its vision of slowing and then stopping U.S. population growth and reining in the environmental degradation it caused, the trajectory might have looked something like that of the curve in Figure 9. Growth would have tapered off and America's population would never have hit 300 million. Instead, because of the rapidly rising wave of immigration

Figure 7. U.S. Population Growth by Decade, 1950-2000



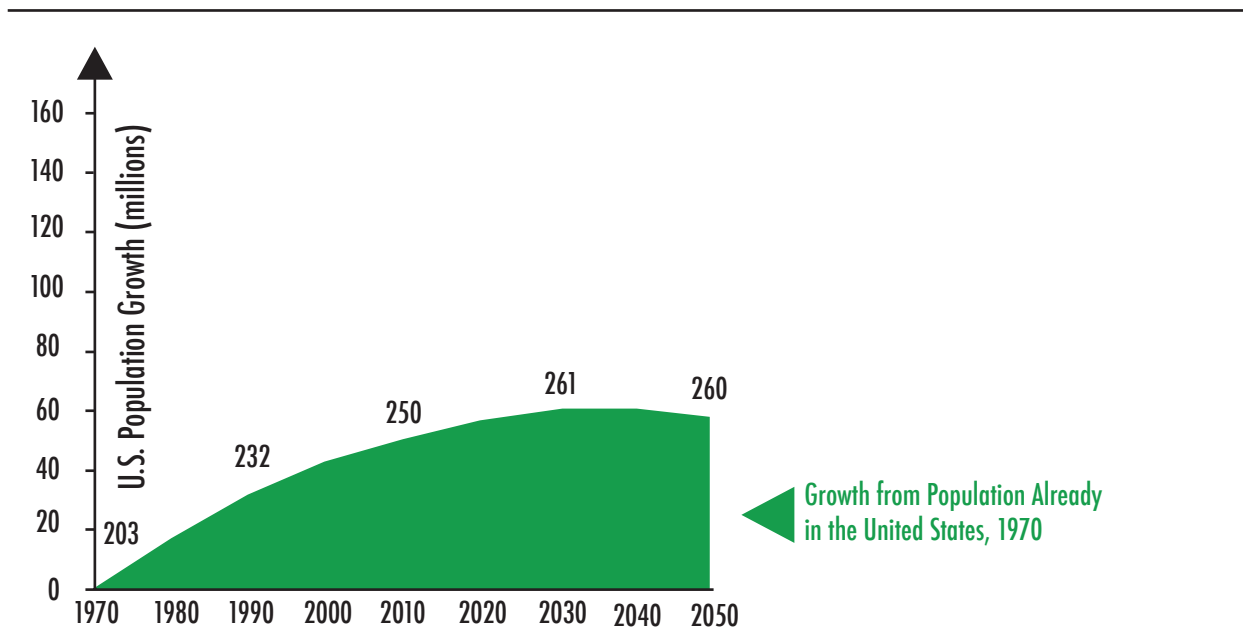
Source: Population Institute.

Figure 8. U.S. Population Growth from 1790 to 1990 (millions)



Source: NumbersUSA.

Figure 9. Class of 1970's Earth Day Vision



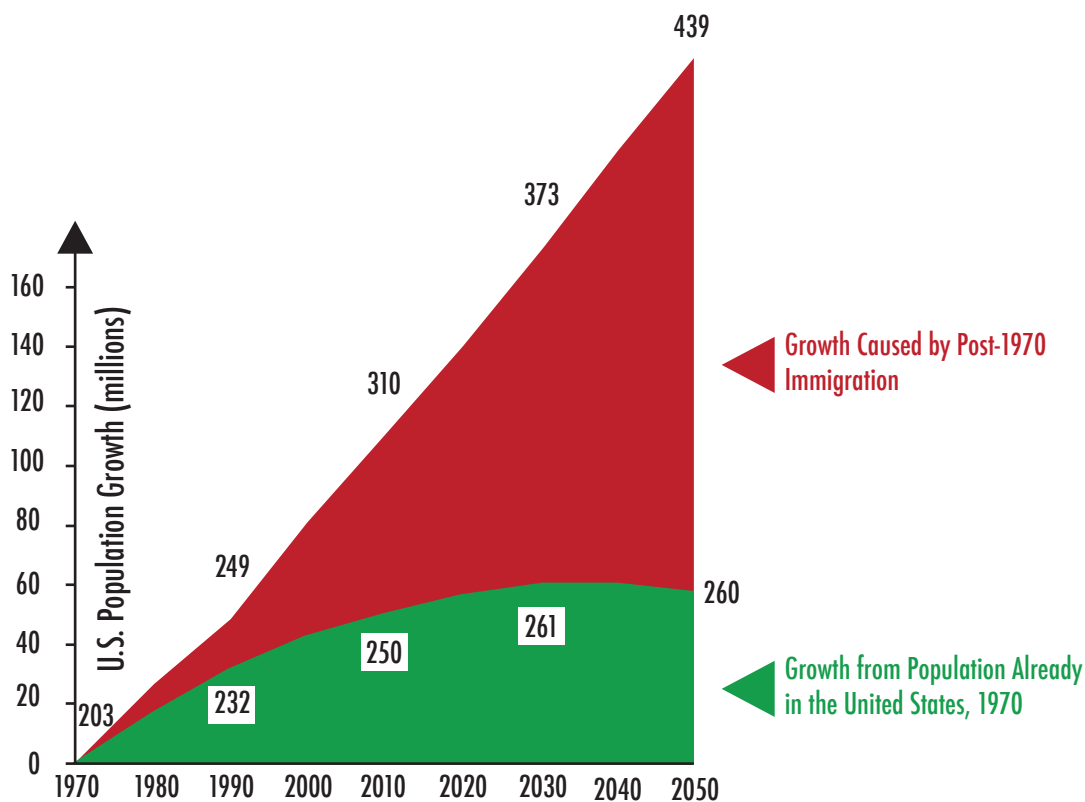
Source: U.S. Census Bureau. Courtesy of NumbersUSA.

unleashed by the Immigration and Nationality Act of 1965, Americans and their environment are facing the grim, and utterly unsustainable, future of ever-greater demographic pressures represented by Figure 10.

What bearing do these “inconvenient truths” have on America’s Ecological Footprint? In a nutshell — everything. *Current immigration levels are enlarging the already enormous U.S. Ecological Footprint and ecological deficit.* With the U.S. population booming by more than 10 percent a decade, the only way to maintain — much less reduce the current, unacceptable size of our EF is to reduce our per capita consumption every decade by more than 10 percent — not just for one or five decades, but indefinitely, for as long as population growth continues. One doesn’t have to be a physicist or a political scientist to recognize that an achievement of this magnitude would be technically and politically unrealistic, if not impossible. America is *already* in ecological overshoot, and massive population growth driven by high immigration rates only serves to exacerbate the situation.

Figure 11 (p. 22) shows current trends with respect to the Ecological Footprint and Biocapacity of the United States from 1961 through 2006.³⁷ As is evident from the crossing lines in this graph, America’s EF first surpassed its biocapacity in the late 1960s, just prior to the first Earth Day. Since then the gap or ecological deficit has only continued to widen. While the addition of each new American does not necessarily increase our *per capita* or per person (as opposed to our aggregate) EF — only increased per capita resource consumption and CO₂ generation does that, it does directly decrease our per capita biocapacity, and thus increases our ecological deficit.

Figure 10. Current Demographic Vision Due to Mass Immigration

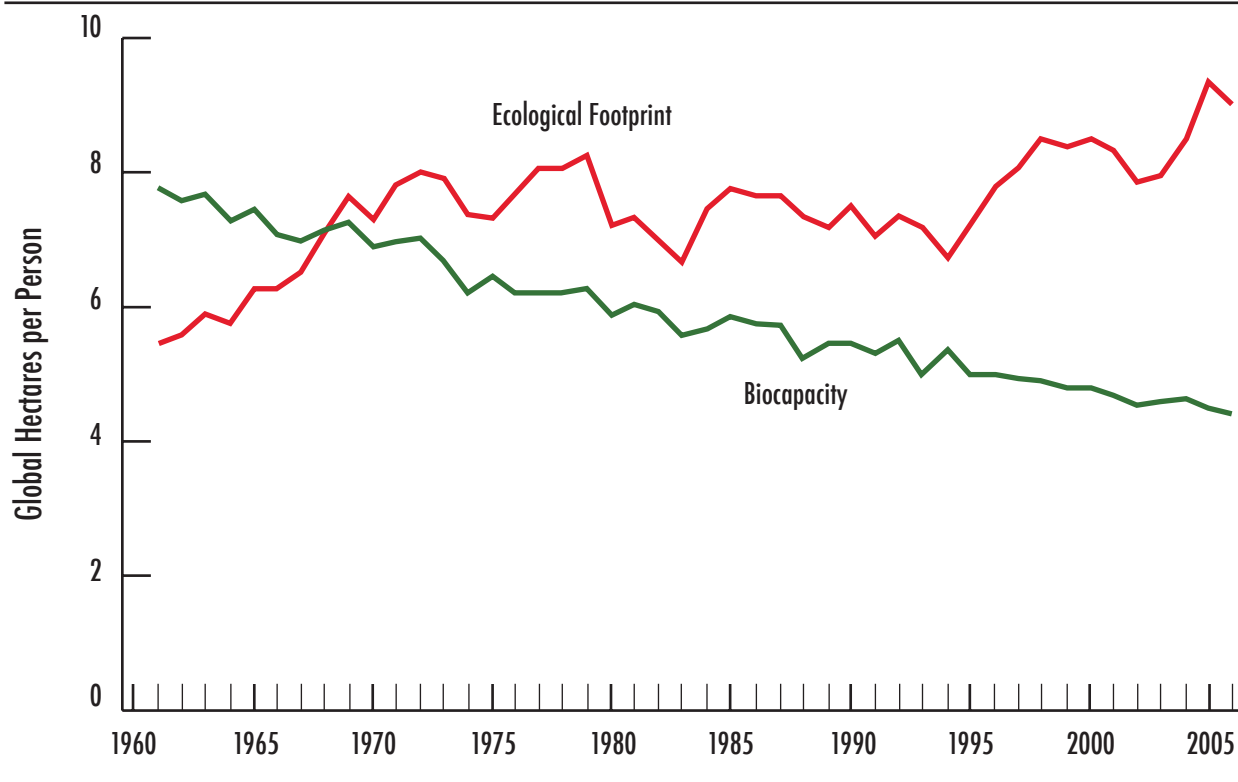


Source: U.S. Census Bureau. Courtesy of NumbersUSA.

Population growth does this in two ways. First, given a fixed biocapacity — that is, a land base that is demonstrably finite and constant, with fixed maximum acreages of potential cropland, grazing land, forestland, and fishing grounds — it is a simple mathematical reality that adding more people who depend on this ecologically productive land base reduces per capita biocapacity. Second, the more than three million new Americans added every year require space and area in which to live, work, play, shop, and attend school. As open space is converted into the “built-up land” category, some combination of forestland, cropland, and grazing land is inevitably developed. (In the 1950s, Orange County, California, home to Disneyland, was touted by developers as “Smog Free Orange County,” but by the 1990s, after four decades of relentless sprawl development to accommodate Southern California’s multiplying millions, it became known as “Orange Free Smog County”). In this way, our country’s biocapacity is steadily and inexorably diminished by a growing population.

The USDA Natural Resources Conservation Service’s (NRCS’s) *National Resources Inventory* (NRI) estimated that the United States lost 44 million acres of cropland, 12 million acres of pastureland, and 11 million acres of rangeland from 1982 to 1997, for a total loss to our agricultural land base of 67 million acres over this 15-year period.³⁸ (One explanation of the much higher acreage of lost cropland than pastureland and rangeland was that a larger fraction of the cropland acreage was not “lost” per se, but deliberately “retired” from active production into the so-called Conservation Reserve Program or CRP, a program administered by the U.S. Department of Agriculture’s Farm Service Agency. These were lands of marginal quality and high erodibility, lands on which modern, intensive agriculture is unsustainable). All 49 states inventoried lost cropland. Overall cropland losses continued in the next NRI published in 2007.³⁹

Figure 11. U.S. Ecological Footprint vs. Biocapacity, 1961-2006



Source: Global Footprint Network, see End Note 37.

The impacts of the loss of this land extend beyond agriculture. The USDA has estimated that each person added to the U.S. population requires slightly more than one acre of land for urbanization and highways.⁴⁰ Clearly, more land is required as more people are added to our population.

A comparison of NRI acreage — 25 million acres of newly developed land over the 1982-1997 period and 67 million acres of agricultural land lost shows that development per se is not responsible for all or even half of agricultural land loss. Arable land is also subject to other natural and manmade phenomena such as soil erosion (from both water and wind), salinization, and waterlogging that can rob its fertility, degrade its productivity and eventually force its retirement or increase its dependency on ever greater quantities of costly inputs like (fossil-fuel derived) nitrogen fertilizers. Arguably, however, much of these losses are due to over-exploitation by intensive agricultural practices needed to constantly raise agricultural productivity (yield per acre) in order to provide ever more food for America's and the world's growing populations and meat-rich diets.

Thus, the potent combination of relentless development and land degradation from soil erosion and other factors is reducing America's productive agricultural land base even as the demands on that same land base from a growing population are increasing. If the rates of agricultural land loss that have prevailed in recent years were to continue to 2050, the nation will have lost 53 million of its remaining 377 million acres of cropland, or 14 percent, even as the U.S. population grows by 43 percent from 308 million to 440 million.⁴¹

Continuing on to 2100, the discrepancy between booming population numbers and declining cropland acreage widens even further (Figure 12). The Census "Bureau's middle series" projection (made in the year 2000) is 571 million, more than a doubling of U.S. population in 2000.⁴² (The "highest serious" projection was 1.2 billion, and actual growth since these projections were made has been between the middle and highest series). If the same rate of cropland loss were to continue, the United States would lose approximately 106 million acres of its remaining 377 million acres of cropland, or nearly 30 percent. Cropland per capita, that is, the acreage of land to grow grains and other crops for each resident, would decline from 1.4 acres in 1997 to 0.47 acres in 2100, a 66 percent reduction. If this occurs, biotechnology will need to work miracles to raise yields per acre in order to maintain the sort of diet Americans have come to expect.

Figure 12. Opposing Trends in U.S. Population Size (Growing Man) and Cropland Area (Shrinking Corn Stalk), 2000-2100



These ominous, divergent trends — an increasing population and declining arable land, have actually led some scientists to think the unthinkable: that one day America may no longer be able to feed itself, let alone boast a food surplus for export to the world. In the 1990s, Cornell University agricultural and food scientists David and Marcia Pimentel and Mario Giampietro of the Istituto Nazionale della Nutrizione in Rome, Italy, argued that by approximately 2025, the United States would most likely cease to be a food exporter, and that food grown in this country would be needed for domestic consumption. These findings suggest that by 2050, the amount of arable land per capita may have dropped to the point that, “the diet of the average American will, of necessity, include more grains, legumes, tubers, fruits and vegetables, and significantly less animal products.”⁴³ While this might, in fact, constitute a healthier diet both for terrestrial and aquatic ecosystems and for many calorically and cholesterol-challenged Americans, it would also represent a significant loss of dietary choice. As nations get wealthier, they tend to “move up the food chain” in the phrase of the Earth Policy Institute’s Lester Brown, that is they consume higher trophic level, more ecologically demanding and damaging meat and dairy products, but were these predictions to hold true, Americans, for better or worse, would be moving in the opposite direction.

From 2005 to 2006, the U.S. per capita ecological deficit widened from 10.9 to 11.3 acres, continuing the long-term trend depicted in Figure 11. Assuming the Census Bureau’s official population projections for 2050 actually do happen, the U.S. population would be 43 percent larger than at present. Even if there were no further increase in the U.S. per capita EF, which is, as can be seen from the 45-year trend in Figure 11, a rather generous assumption, a 43 percent increase in the U.S. population would correspond to a further 43 percent reduction in biocapacity per capita, *even without the types of continuing land and resource degradation just discussed above for cropland*. The 2006 U.S. biocapacity was 10.9 global acres (ga) per capita. By 2050, if current U.S. demographic trends and projections hold, this will have been reduced to 6.2 ga per capita. If the per capita American EF of consumption were to remain at the 2006 value of 22.3 ga, the ecological deficit in 2050 would increase to 16.1 ga per capita.

In essence, if we American “Bigfeet” do not opt for a different demographic path than the one we are treading now, Ecological Footprint analysis indicates unequivocally that we will continue plodding ever deeper into the forbidden zone of Ecological Overshoot, trampling our prospects for a sustainable future. Incidentally, we would also be trampling the survival prospects for many hundreds of endangered species with which we share our country. These birds, mammals, fish, amphibians, reptiles, butterflies, mussels, and other taxa are menaced with extinction by our aggressive exploitation of nearly every ecological niche, nook, and cranny.

In nature, no organism in overshoot remains there for long. Sooner or later, ecosystem and/or population collapse ensues. Are we humans, because of our unique scientific acumen, immune from the laws of nature that dictate the implacable terms of existence to all other species on the planet? Our political, economic, and cultural elites seem to think so, and *en masse*, we certainly act so. Yet ironically, many scientists themselves believe otherwise: that all-too-human hubris, unless checked by collective wisdom and self-restraint, will prove to be our undoing, and that civilization as we know it may unravel.⁴⁴

The Upshot

EF was never intended by its creators as the final word on ecological overshoot and environmental degradation. It does not explicitly address any number of critical issues that also have a bearing on the nation's and the Earth's carrying capacity and sustainability, including the over-exploitation, pollution, and worsening shortages of water resources, peak oil (and depletion of other fossil fuels and non-renewable mineral resources), or the widespread contamination of ecosystems by innumerable, persistent toxic chemicals, the human assault on biodiversity, or environmental justice. Some of its assumptions, for example that harvest of a given renewable resource is being conducted sustainably, may be overly optimistic. Yet EF analysis has evolved, matured, and improved over the nearly two decades since its initial conception on the lovely campus of the University of British Columbia, sheltered and sequestered from the rest of Vancouver by the verdant evergreen forests of the Endowment Lands and Pacific Spirit Regional Park.

EF analysis has emerged as a useful, interactive tool for exploring, illustrating, and quantifying the collective, aggregate, growing demands that human beings are placing on nature, and in turn, the diminishing ability of nature to supply apparently insatiable human needs, appetites, and whims.

For Americans concerned about the natural environment and resources in the one portion of the planet over which we have the particular obligation and ability to be good stewards, EF analysis reaches the stark conclusion that our country is already well into ecological overshoot, having long ago exceeded our biocapacity or carrying capacity. Immigration-driven population growth exacerbates an already untenable, unsustainable situation. If American environmentalists truly care about the environmental sustainability of their own country, and the world of which it is a part (and over which America exercises disproportionate influence), it behooves them to admit overpopulation and act accordingly. And what would acting accordingly consist of? Actively supporting U.S. population stabilization and reduced immigration levels to the U.S. as an urgent national imperative, on a par with ongoing and emerging efforts promoting energy and resource conservation and efficiency, green technologies, vegetarianism, recycling/reuse, preventing pollution, reducing waste, and protecting species, habitats, and ecosystems.

We need to put the “P” back into the IPAT equation (Impact = Population x Affluence x Technology) first proposed back in 1972 by biologist Paul Ehrlich and physicist (and now Obama science advisor) John Holdren.⁴⁵ It was there in the early part of the modern environmental movement, as the leaders of this movement can attest.⁴⁶ For a variety of reasons, the Environmental Establishment dropped its advocacy and retreated into uncomfortable silence and abject denial on U.S. population.⁴⁷

A popular saying among populists is that, in democracies, “if the people lead, the leaders will follow.” Yet in the case of population stabilization, in some notable instances, the leaders have led, but the people have neglected to follow. This occurred most recently with President Clinton's Council on Sustainable Development, developed in the heady days after the Rio “Earth Summit” in 1992. The Council's Population and Consumption Task Force, chaired by former U.S. Senator (now head of the United Nations Foundation) Tim Wirth (D-CO), declared in 1996 that: “We believe that reducing current immigration levels is a necessary part of working toward sustainability in the United States.”⁴⁸

Ecological Footprint analysis only confirms this conviction. Now it is up to environmentalists to acknowledge it as well.

End Notes

¹ President's Council on Sustainable Development. 1996. *Population and Consumption Task Force Report*. 1996.

² William Safire. 2008. "On Language." Footprint. *The New York Times Magazine*. Published February 17.

³ William E. Rees. 1992. "Ecological footprints and appropriated carrying capacity: What urban economics leaves out." *Environment and Urbanization*. 4 (2): 121-130. Available online at <http://eau.sagepub.com/cgi/content/abstract/4/2/121>.

⁴ *Ibid.*

⁵ Mathis Wackernagel and William Rees. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island, BC and Philadelphia, PA: New Society Publishers, The New Catalyst Bioregional Series.

⁶ Dr. Edward O. Wilson. 2002. Personal communication with the author at the National Press Club, Washington, DC.

⁷ Mathis Wackernagel, Niels B. Schulz, Diana Deumling, Alejandro Callejas Linares, Martin Jenkins, Valerie Kapos, Chad Monfreda, Jonathan Loh, Norman Myers, Richard Norgaard, and Jørgen Randers. 2002. "Tracking the ecological overshoot of the human economy." *Proceedings of the National Academy of Sciences*. 99(14): 9266-9271. July 9.

⁸ Ewing B., S. Goldfinger, A. Oursler, A. Reed, D. Moore, and M. Wackernagel. 2009. *The Ecological Footprint Atlas 2009*. Oakland: Global Footprint Network.

⁹ William R. Catton, *Overshoot: The Ecological Basis of Revolutionary Change*. Urbana: University of Illinois Press, 1980.

¹⁰ By way of example, in a 1992 effort spearheaded by the late physicist Henry Kendall, Nobel Laureate in Physics, MIT professor, and co-founder of the Union of Concerned Scientists, some 1,700 of the world's leading scientists, including a majority of the Nobel laureates in the sciences (more than 100 of them), issued the "World Scientists' Warning to Humanity." Concerning population, the Warning stated: "The Earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite. Its ability to provide for growing numbers of people is finite. And we are fast approaching many of the Earth's limits Pressures resulting from unrestrained population growth put demands on the natural world that can overwhelm any efforts to achieve a sustainable future If we are to halt the destruction of our environment, we must accept limits to that growth No more than one or a few decades remain before the chance to avert the threats we now confront will be lost and the prospects for humanity immeasurably diminished." This was written at a time when the Earth's population was 1.5 billion less than it is now.

¹¹ In one of the best documented cases of population overshoot and collapse in the scientific literature, wildlife biologist David Klein of the Alaska Cooperative Wildlife Research Unit described how an introduced population of reindeer (*Rangifer tarandus*) on this remote, uninhabited island in the Bering Sea skyrocketed exponentially from 29 animals in 1944 to 6,000 in 1963, before a massive die-off that claimed virtually the entire population during the harsh winter of 1963-64. The population boom of the reindeer, a function of a high birth rate and low mortality, was a natural response to the high quality and quantity of the untouched forage (lichens) blanketing St. Matthew Island and a complete absence of predators. The population collapse or crash occurred after the reindeer had eliminated the lush mats of slow-growing lichen that once carpeted the island, and thus reduced its carrying capacity for years to come.

¹² Will Steffen, Paul J. Crutzen, and John R. McNeill. 2007. *Ambio*. 36(8):614-621., Royal Swedish Academy of Sciences. Steffen is Director of the Fenner School of Environment and Society at the Australian National University. Crutzen is former Director of the Atmospheric Chemistry Division of the Max Planck Institute for Chemistry in Mainz, Germany and is Professor (part-time) at the Scripps Institute of Oceanography, University of California, La Jolla. In 1995 he was awarded the Nobel Prize in Chemistry for his work on the chemical processes leading to the destruction of stratospheric ozone. John R. McNeill is Professor of History and University Professor at Georgetown University.

¹³ Paul J. Crutzen. 2002. Geology of mankind. *Nature*. 415, 23 (3 January 2002). Environmental writer Bill McKibben's book, *The End of Nature*, published in 1989, posited that human-induced climate change, by altering every ecosystem on the planet, would virtually end "nature" as we know it — as a distinct, overarching entity above and beyond the ability of humans to manipulate or undermine in any fundamental way.

¹⁴ George Monbiot. 2009. "Requiem for a Crowded Planet: This is what the failure of the climate talks means." *The Guardian* (UK). Accessed December 22, 2009, at <http://www.monbiot.com/archives/2009/12/21/requiem-for-a-crowded-planet/?utm>.

¹⁵ Supra, note 7.

¹⁶ Supra, note 7.

¹⁷ Supra, note 7.

¹⁸ Kitzes, J., A. Galli, S.M. Rizk, A. Reed and M. Wackernagel. 2008. *Guidebook to the National Footprint Accounts: 2008 Edition*. Oakland: Global Footprint Network.

¹⁹ Supra, note 8.

²⁰ David Pimentel, C. Harvey, P. Resosudarmo, K. Sinclair, D. Kurz, M. McNair, S. Crist, L. Shpritz, L. Fitton, R. Saffouri, and R. Blair. 1995. "Environmental and Economic Costs of Soil Erosion and Conservation Benefits." *Science* 24 February 1995: Vol. 267. no. 5201, pp. 1117–1123. Abstract: Soil erosion is a major environmental threat to the sustainability and productive capacity of agriculture. During the last 40 years, nearly one-third of the world's arable land has been lost by erosion and continues to be lost at a rate of more than 10 million hectares per year. With the addition of a quarter of a million people each day, the world population's food demand is increasing at a time when per capita food productivity is beginning to decline. David Pimentel. 1993. *World Soil Erosion and Conservation*. London: Cambridge University Press.

²¹ Natural Resources Conservation Service. 2000. Excessive Erosion on Cropland 1997 [map]. Available online at: <http://www.nrcs.usda.gov/technical/NRI/maps/mappdfs/m5083.pdf>.

²² Supra, note 8.

²³ Supra, note 7.

²⁴ Supra, note 8.

²⁵ Supra, note 8.

²⁶ Supra, note 8.

²⁷ Supra, note 7.

²⁸ Supra, note 8.

²⁹ Supra, note 8.

³⁰ Supra, note 8.

³¹ Supra, note 8.

³² Supra, note 8.

³³ U.S. Census Bureau. Population Clock. Accessed December 29, 2009, at <http://www.census.gov/>.

³⁴ U.S. Census Bureau. 2008. Projections of the Population and Components of Change for the United States: 2010 to 2050. Accessed December 29, 2009, at <http://www.census.gov/population/www/projections/summarytables.html>.

³⁵ *Ibid.*

³⁶ Passel, J. S. and D. Cohn. 2008. U.S. Population Projections: 2005 - 2050. Pew Research Center – Social & Demographic Trends. Available online at: <http://pewhispanic.org/files/reports/85.pdf>.

³⁷ Global Footprint Network. 2009. Accessed 12/28/09 on the World Wide Web at: <http://www.footprintnetwork.org/en/index.php/GFN/page/trends/us/>.

³⁸ U.S. Department of Agriculture, Natural Resources Conservation Service. 2000. *Summary Report – 1997 National Resources Inventory (revised December 2000)*. 84 pp. Released January 2001. See Table 1, “Surface area of nonfederal and federal land and water areas, by state and year,” p. 11.

³⁹ Natural Resources Conservation Service. 2007. National Resources Inventory – 2003 Annual NRI, State Report. February.

⁴⁰ Vesterby, M. & Krupa, S. 2001. “Major Uses of Land in the United States, 1997.” Resource Economics Division, Economic Research Service, USDA, Statistical Bulletin No. 973. October 18, 2001. www.ers.usda.gov/publications/sb973.

⁴¹ U.S. Census Bureau, Midyear Population Estimates and Average Annual Period Growth Rates: 1950 to 2050, International Data Base, October 2002 version.

⁴² Frederick W. Hollmann, Tammany J. Mulder, and Jeffrey E. Kallan. 2000. “Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100”: U.S. Census Bureau, Population Division Working Paper No. 38. Issued January 13, 2000. Available at <http://www.census.gov/population/www/projections/natproj.html>; Leon Kolankiewicz. 2000. “Immigration, Population and the New Census Bureau Projections.” Center for Immigration Studies *Backgrounder*. Available online at: <http://www.cis.org/articles/2000/back600.html>.

⁴³ David Pimentel and Mario Giampietro. 1994. “Food, Land, Population and the U.S. Economy.” Washington, D.C.: Carrying Capacity Network; David Pimentel and Marcia Pimentel. 1997. “U.S. Food Production Threatened by Rapid Population Growth.” Washington, D.C.: Carrying Capacity Network.

⁴⁴ Debora Mackenzie. 2008. “Why the demise of civilization may be inevitable.” *New Scientist*. Issue No. 2650. Available online at: <http://www.newscientist.com/article/mg19826501.500-why-the-demise-of-civilisation-may-be-inevitable.html>.

⁴⁵ Paul R. Ehrlich and John P. Holdren. 1971. Impact of Population Growth. *Science*, 171, 1212-1217.

⁴⁶ Gaylord Nelson. 1998. Personal communication with the author. The late former U.S. Senator and Wisconsin Governor Nelson is widely credited as the “Father of Earth Day”.

⁴⁷ Roy Beck and Leon Kolankiewicz. 2000. “The Environmental Movement’s Retreat from Advocating U.S. Population Stabilization (1970-1998): A First Draft of History.” *Journal of Policy History*, Vol. 12, No. 1. Pennsylvania State University Press. Available online at: <http://www.numbersusa.com/content/resources/publications/issues/environment/environmental-movements-retreat-advocati.html>. Leon Kolankiewicz and Roy Beck. 2001. *Forsaking Fundamentals: The Environmental Establishment Abandons U.S. Population Stabilization*. Washington, DC: Center for Immigration Studies. ISBN 1-881290-00-X. Available online at: <http://www.cis.org/articles/2001/forsaking/toc.html>.

⁴⁸ President’s Council on Sustainable Development. 1996. Population and Consumption Task Force Report. 1996.

Progressives for Immigration Reform is a non-profit organization seeking to educate the public on the unintended consequences of mass migration.

PFIR concurs with the U.S. Commission on Immigration Reform that “it is both a right and a responsibility of a democratic society to manage immigration so that it serves the national interest.”

It is the position of PFIR that immigration policy should consider the effects of policy on population size, population growth, skill composition of the labor force, the working conditions and wages of both immigrants and native born workers, domestic water and energy supplies, open space and preservation of biodiversity, and the emission of greenhouse gases from the United States.

PFIR favors policies toward developing countries to lessen the “push” factors of poverty and unemployment that drive emigration.

<http://www.pfirdc.org>