



Botanical Biographies

Leave Nothing But Footprints? Ecological Thoughts about Human Ecologies

By David Galbraith

Every now and then, an idea comes along that makes just about everybody smack their forehead and think "Hey, why didn't I think of that?" Such was Thomas Huxley's response to reading Charles Darwin's theory of natural selection for the first time - it was so simple - why didn't I think of it? Just about everyone who is interested in ecology and the marvelous and frightening interactions between people and the natural environment have the same reaction when they first read a description of the concept of the ecological footprint.

We live in a society in which physical distance from resource to consumer has been largely obscured by an efficient global transportation network. It's perfectly commonplace to walk into a store on any street corner and buy fresh bananas or fresh oranges, staples of our daily diet that a century ago were relative luxuries. As individuals we think nothing of flying to Florida or Europe or even Australia for business or for pleasure. We drive immense distances in complex cars, burning fossil fuels and also making use of an immense network of paved and gravel roads.

Those of us who own property, mostly as our individual residential lots, tend to have a very good idea of how big the property is, who our neighbors are, and how we use the space within that property. Very few of us however, earn our subsistence from the land that we own. By purchasing goods and services that are dependent on land that is somewhere else, we fulfill our daily needs without an awareness of how

much land must be dedicated to fulfilling those needs.

How much land do you need? How much space does it really take to satisfy the consumers in all of us? After all, useable land it is a very finite commodity. Over the centuries, some societies have successfully increased their useable land through reclamation from wetlands, lakes or the sea, or by extending agriculture and settlement into areas that would be considered less than hospitable. For the most part however, useable land is finite. Coming to an understanding of the demands we place on that finite resource is an important component in understanding how we really interact with the rest of the world.

An ecological footprint is an estimate of how much terrestrial space an activity uses. The idea of an ecological footprint arose in the late 1980's through the research Mathis Wackernagel and William Rees in British Columbia. Their insight was that it is possible to estimate the amount of land that is needed to support an individual, or a community, in any society. By estimating the area of the land, or the "footprint" of the activities, and comparing that area among societies it is possible to understand the relative impact of consumption and lifestyle.

If the footprint is not an actual area of land, then how is it estimated? Wackernagel and Rees recognized that there are two ways in which the ecological footprint of a city, for example, could be calculated. One could either add up all of the physical area of the

city, and then add in the amount of land required to support agriculture, waste removal, construction, and all of the other services and materials that the city would use, or one could tally up all of the activities and consumption of an average individual and multiply that by the population of the city.

These two approaches are clearly related to each other. If one knows that the city has a population of a million, estimating the ecological footprint for the entire city and then dividing the footprint by 1,000,000 provides an estimate of the ecological footprint of an average individual in the city.

Wackernagel and Rees devised a detailed procedure for calculating ecological footprints in the early 1990s. The calculations themselves are complex because they must include many separate factors. In addition to the obvious use of land for dwellings, transportation, provision of forest products and other building materials, and arable land in agricultural production, several other types of land use must be included. Land that is dedicated to the production of fossil fuels for energy, land that is consumed by the disposal of waste, and even land that is necessary for the support of ecological services must be included in the calculation.

Ecological services are worth a special mention. These are all of the many factors upon which our society depends that actually come from natural ecological systems outside of the recognized human economy. Things like the recycling of carbon dioxide and oxygen by natural forests, and the provision of pollination by free-living insects, critical to our agricultural production, are all ecological services. Estimates of the value of ecological services to the whole human economy suggest that if we had to replace these services through some kind of technological means, the cost would exceed the total gross global value of the human economy by a factor of about three.

So, how big did Wackernagel and Rees estimate our ecological footprint to be? In 1995, the average Canadian was thought to have an ecological footprint of approximately 4.3 hectares. In part, that figure was based on annual carbon dioxide emissions of about 15.2 tonnes per year per person, an annual purchasing power in US dollars of \$19,320.00, an average of 46 vehicles per 100 persons, paper consumption of 247 kg of paper per year per person, and the consumption of 250 gigajoules of fossil energy use, and consumption of 1,688 m³ of fresh water per year.

In contrast, the world average ecological footprint in 1995 was estimated to be 1.8 hectares. Average global carbon dioxide emission was less than 30% of the Canadian emission, and average world purchasing power was \$3,800.00 US dollars in 1995. Globally, there are about ten vehicles for every 100 persons, average paper consumption is only 44 kilograms per year per person, and average energy use is approximately 20% or 50 gigajoules per year per person. Consumption of fresh water per person averaged 644 m³ of water per year, approximately 1/3 of the Canadian average.

At the other extreme, the ecological footprint of an average person in India was approximately 0.4 hectares per person in 1995. That figure is based on carbon dioxide emissions of 0.81 tonnes per year per person, an average purchasing power \$1,150 US dollars, an average of 0.2 vehicles per 100 persons, the consumption of two kilograms of paper per year, and five gigajoules of fossil fuel energy use. The average person in India consumes 612 m³ of fresh water per year.

The kinds of calculations that have gone into estimating ecological footprints can become quite detailed. For example researchers have estimated that on average we continuously need 0.16 hectares of land to produce the fiber that is necessary to support each Canadian's consumption of newsprint alone.

It should be noted that a hectare is a measure of the area of land within a square that is 100 m on each side. Thus, a hectare is 10,000 m², or 1/100 of a square kilometer. Each hectare is also about 2.7 acres. The typical quarter-acre house lot is about a thousand square meters, or a tenth of a hectare. This means that the consumption of newsprint by an average household in Canada requires the dedication of more than 1 1/2 times the land area of most people's property just to the production of the trees needed.

Of course, Canada is a big country. With a relatively small population, the consumption of a proportionately large ecological footprint is less worrying than if our population were much larger. The ecological footprint of individuals in the United States is similar, on a per person basis, to the ecological footprint of Canadians. In 1995, it was estimated that the ecological footprint of an average American was 5.1 hectares. If we assume an average ecological footprint of five hectares per person for people in Canada and the USA combined, we can rapidly come up with an estimate of total ecological footprint for the population

of northern North America. If the consuming population of Canada is 25,000,000 people, then the ecological footprint of all Canadians is approximately 1.25 million square kilometers. Using the same basic figure for consumption, the population of the United States has an ecological footprint of approximately 12.5 million square kilometers.

These numbers have two important implications. First, the consumption of resources and the use of space by the affluent population of northern North America represents an ecological footprint of close to 14 million km². As the actual area of Canada is 9.9 million km² and that of the USA is 9.1 million km², the combined ecological footprint of our societies is close to 75% of the total available domestic territory. In reality, of course, much of the territory of North America is not available to the uses implied in the ecological footprint, and some of the categories of consumption are based on the use of land elsewhere in the world. Our affluent societies are clearly having a strong impact on the land upon which they are based.

The second implication arises when the ecological footprint of our society is compared to that of other consumers around the world. If everyone on earth could have the same economic and material advantages that we enjoy in Canada, the ecological footprint of that consumption would require at least two entire extra planet earths to support it. Clearly, there are physical limits to the capacity of our planet to support an affluent lifestyle.

Another thoughtful analogy arose out of the description of the ecological footprint idea. If the available land on earth is finite, it is possible to estimate the share of the surface of the planet that each individual person would receive if all of the land were divided up person by person. The 6,000,000,000 people on earth each would have their share of the planet equal to a little less than 1.5 hectares, or a

square a little less than 120 m on a side. Of that 1.5 hectares, only about 0.25 hectares would be arable land. This theoretical portion of the surface of the earth per person is called an individual's earthshare.

As our global population continues to rise, we are faced with important challenges because of our use of space and the effects of our activities on such finite quantities as arable land. The valuable perspective that is afforded by considering ecological footprints is essentially the perspective of a society that is already providing for the material wants of its citizens at a level that is unprecedented in human history. In developing countries around the world, the aspirations of billions for a better life for themselves and their children depends upon increasing their consumption of resources and engaging in economic activity that accumulates wealth. Does the comfortable perspective of Canadians, repeatedly identified by the united nations as the beneficiaries of the most comfortable lifestyle on earth, have any positive message for ourselves or for others?

Having spent a great deal of the last 20 years wrestling with this issue, I am sure of only one thing: there are no simple answers. On the one hand, it is a certainty that if the billions of people around the world who aspire to a more comfortable life were suddenly granted access to resources that we as Canadians take for granted, we would face ecological ruin, followed shortly thereafter by economic ruin as the natural systems upon which our economy depends come grinding to a halt. On the other hand, it is perfectly possible to craft a lifestyle for oneself that does not depend on 5 or more hectares of ecological footprint, but which treads much more lightly on the earth. The experience of highly developed societies in Europe, and available technologies for energy efficiency and recycling, all indicate that it is possible to have a relatively small ecological footprint and a relatively high standard of living.

For further reading...

The figures presented in this article are from: Wackernagel, M. and Rees, W. 1996. *Our Ecological Footprint; Reducing Human Impact on the Earth*,. New Society Publishers, Gabriola Island, BC. 176 pages Illustrated. Canada Paperback ISBN 1-55092-251-3.

Several Internet Web sites allow visitors to calculate their own individual ecological footprints. Here are just a few:

- The City of Toronto has excellent resources on the Internet on energy efficiency and sustainability: <http://www.city.toronto.on.ca/energy/footprint.htm>

- World Wildlife Fund Canada: <http://www.wwfcanada.org>
- Redefining Progress, a non-governmental organization for ecology and society based in the USA: http://www.rprogress.org/progsum/nip/ef/ef_main.html

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