IS HUMANITY FATALLY SUCCESSFUL?

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A framing premise of this paper is that the sustainability dilemma is not merely an ecological or technical or economic crisis as is usually assumed, but rather it is a crisis rooted in fundamental human nature. More specifically, it is a crisis of human evolutionary success – indeed, we have reached the point where our success is killing us!

This interpretation is not part of the conventional sustainability debate for a very simple reason. We human beings – for all that we suppose ourselves to be evidence of intelligent life on earth – really fail to understand who we are. We have a very limited understanding of what motivates us, why it is we do certain things that we do. Little wonder that human nature is hardly on the sustainability radar.

At the heart of this problem is the fact that people today rarely think of themselves as biological beings. It comes to mind from time to time if one has heart palpitations or some other illness but, on the whole, we moderns don't like to think of ourselves as biological entities. But indeed we are – we are products of evolution, and our behaviour both as individuals and as society represents a delicate dialectic between self-conscious reasoning and deeper and sometimes darker unconscious urges and predispositions.

The fact is that we humans have a long evolutionary history and many of the traits that we've acquired along the way, traits that were adaptive 50,000 years ago, are with us still. But now some of these once-desirable qualities may threaten humanity's future prospects. That is, some characteristic human qualities and behaviours may well now be maladaptive. I will try to make the case that these ancient traits are such that techno-industrial society *in particular* is inherently unsustainable. The world is ecologically full – but evolution has not provided us with inhibitions against extinguishing other species, against eliminating competing human groups or, indeed, against destroying our earthly habitat(s).

In these circumstances, prospects for building civil society, and maintaining the conditions necessary for civilized existence on Earth depend mainly on our capacity to devise mutually beneficial cultural constraints on social behaviour that has become maladaptive on a crowded planet. Of course, if we're going to "fix" ourselves in this way, we need to know more about ourselves.

The notion that we are not sufficiently conscious of our own nature has been a persistent theme in the literature of many countries. Listen to Anton Chekhov: "Man will become better only when you make him see what he is like." Or perhaps you prefer W.H . Auden: "We are lived by forces we can scarcely understand." I believe that coming to understand these forces will give us a chance to take a great evolutionary step forward to the point where sound intelligence incorporated into our cultural "programming" holds sway over more well-tested, biologically-determined, but increasingly dangerous behavioural patterns.

My second major premise should already be obvious, namely that if humans are the product of evolution, we are also the product of Darwinian natural selection. Uniquely, however, human evolution is as much determined by socio-cultural as by biological factors. This means, of course, that both cultural and biological "mutations" are subject to natural selection. Everyone recognizes that maladaptive physical mutations will be "selected out" in an environment for which they are unsuitable. It is less well appreciated that, like biological mutations, ill-suited socio-cultural patterns can also be selected out. To reiterate this central idea, culture now as much determines the human future as biology but, like disadvantageous physical characteristics, unfit cultural traits will be eliminated by evolutionary forces.

We can find support for this assertion in both ancient and more recent history. One of the most interesting cases – one that even makes the popular press from time to time – is the story of Easter Island, a small button of land of about 165 square kilometres (65 square miles) in the South Pacific 2,250 kilometres (1400 miles) from the nearest land mass, another smallish Island, Pitcairn. Easter was a verdant subtropical island, heavily forested with at least two very important tree species and many plant and animal species useful to

humans. It was first inhabited only around the year 450 or 500 A.D when probably no more than two or three canoe-loads of Polynesian explorer-sailors landed on its shores. The new colony took hold and grew over the next 10 centuries into a kind of microcosmic culture. Over that period, the Easter Islanders developed class structure, division of labour, a priesthood and religion, agriculture, science and art , including some of the finest stonework – both fitted stones for buildings and platforms, and carvings - known to preindustrial times. In short, Easter Island society had most of the basic manifestations and characteristics of the much grander and earlier human cultures of Europe, Africa, Asia and even the Americas (Incas and Aztecs), with which most people are more familiar.

The population flourished, growing to around 10,000 (perhaps as few or as 7000 or many as 20,000) people by A.D. 1400-1500. But then something rather mystifying happened. Easter Islanders cut down the last palm tree growing on their isolated rock. Easter Island was a culture entirely dependent on the forest for their buildings, for log rollers to move their massive carvings, and, most important, for the dugout canoes by which they obtained most of their animal protein. Easter Islanders ate porpoises and fish that could be obtained only by active pursuit in boats.

How could this have happened? Whatever were they thinking? Easter Island's population was small enough that everyone must have at least recognized just about everyone else. One could walk around the island in about two days, so presumably everyone was aware that the forest was disappearing and that a crisis was upon them. There was probably much discussion of what might happen if the forest disappeared and maybe even heated political debates about what to do. And yet, for whatever reason, any effort to change the established pattern of resource exploitation, any move toward a conservation plan, clearly failed – in the end the last tree was felled.

When Europeans (the Dutch explorer Roggeveen) discovered Easter Island in A.D 1722, the population had fallen to something like 2,000 sorry souls. These people were living in rude reed huts and caves —houses had been destroyed, and art and science abandoned. The human dregs of the Easter Island culture that had been thriving

just 200 years earlier now survived, in part, on cannibalistic raids on each others' encampments.

The secret of Easter Island's implosion has slowly been revealed by mud core samples taken from the swamps in the interior of the island. Paleobotanists have examined the pollen profile laid down through the island's entire 1500-year post-discovery history. What they learned is that, one by one, the important species of resource plants disappeared. The pollen record suggests that the last specimens of the critical palm tree came down around 1400. Meanwhile, Easter Island's midden heaps tell a similar story. Here we can trace the dietary history of Easter Island society, including the disappearance, one after another, of valuable food species. Most critically, around 1500, fish bones and porpoise bones disappear from the record to be replaced a few years or decades later by human bones.

What could possibly be going on if virtually every member of a society is aware of their society's dependence on limited local resources, of their utter isolation from any other sources of supply, and yet the people do nothing to prevent the destruction of their own prospects. Many articles have been written about Easter Island. British public servant and historian Clive Ponting (1990) was mystified that the Easter Islanders seemed "…unable to devise a system that would allow them to find the right balance with their environment." Most relevant to the present discussion, Jared Diamond's (1995) asks "Are we about to follow their lead?" Think about it. Virtually everyone on Earth is aware that we have an ecological crisis and a population problem, and now there is fear of increasing geopolitical strife. We are utterly dependent on the resources of a tiny planet isolated in space with no hope of finding alternative supplies, and, yet, we too seem unable to devise a system that will allow us to find the right balance with our environment.

Ominously, Easter Island is no exception. Joseph Tainter (author of "The Collapse of Complex Societies," 1988) has observed that "what is perhaps most intriguing in the evolution of human societies is the regularity with which the pattern of increasing complexity is interrupted by collapse…" (Tainter 1995). Perhaps, then, ignominious collapse is the *norm* for complex societies.

But, surely, you protest, modern society is different. We know better. Our technological prowess and mastery over nature distinguish us from more primitive cultures. We can avoid crises by reading the warnings, by responding positively to data and analysis. Well, this sounds good – certainly one of our most cherished contemporary beliefs is that is that we are a science-based culture. But what's the *de facto* modern record? In a controversial paper reviewing the recent record of human exploitation of natural resources, some of my UBC colleagues (Ludwig *et al.* 1993) concluded that: "Although there is a considerable variation in detail, there is remarkable consistency in the history of resource exploitation. Resources are invariably or inevitably overexploited, often to the point of collapse or extinction."

Another UBC colleague, Daniel Pauly, has conducted path-breaking research on the current state of the world's fisheries. Something like 75% of the world's fish stocks have been overexploited by humans. Pauly has demonstrated that although the FAO-measured fish catches each year remain relatively constant, it's not because we're managing well, but rather because we eliminate one species or one stock and simply move on to another. We are literally "fishing down the food web," sweeping up the ocean's bounty as we go (Pauly et al. 1998, Pauly and MacLean 2003). More recently, Myers and Worm (2003) and Christensen et al. (2003) report that only 10 percent of the original biomass of predatory fish remain in the world's oceans after just 50 years of industrial fishing and that remaining specimens are a fraction of the size of their forebears a few decades ago.

The list goes on. A recent article in the *Globe & Mail* described the threat to certain orchids because of human over-harvesting. In some African countries, orchid tubers are a favoured food, and easier trade has opened up wider markets for these tubers. This situation is fairly typical. When any valuable species – particularly rare ones like these orchids – is exposed to a globalizing marketplace, there will always be people willing to pay top dollar to have it, down to the last remaining specimen. And so we see growing international trade in rare and endangered plants and animals (or their parts). Globalization is a major threat to their survival because humans have little inhibition against destroying non-human species if they profit in the

short term from doing so.

To summarize, there is evidence enough in both the historical record and present trends to support the assertion that *H. sapiens* is inherently biased against sustainability *by nature*. This socio-behavioural bias has led to frequent societal collapses in the past and modern society is far from being invulnerable. Modern society is far from being invulnerable. Indeed, I would argue that unsustainability is an *inevitable* emergent property of the interaction of growth-bound, techno-industrial society and the ecosphere. By this I mean that it doesn't much matter how one reconfigures the system at the margins, it won't make much difference. Industrial society is being propelled to the precipice by certain deep-seated (genetically-based) behavioural tendencies that are actually being reinforced by contemporary values and beliefs.

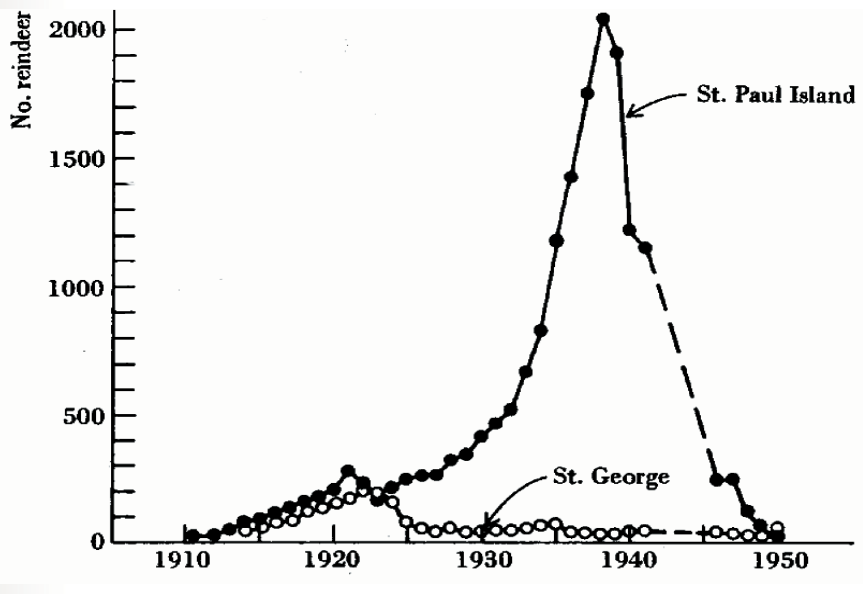
What can we do about our situation? As I stated at the outset, we should begin by coming to know ourselves better. So, with that in mind, let's look at the bio-behavioural factor first.

On one level, our dilemma is by no means unique to humans. All species have an inherent capacity to expand into all the ecological space available to them. Unless there are other constraints on that expansion – negative feedback of one kind or another – all populations grow to the point that they destroy some critical resource and then they collapse. (This was Reverend Malthus' great insight about humans.)

Figure 1 illustrates a famous ecological example involving reindeer. A few of these animals were introduced to islands in the Pribilof chain which had previously not had reindeer populations. The islands were therefore free of reindeer parasites and predators and, in each case (although with rather different temporal profiles), the reindeer populations rose exponentially to a peak which was followed by a more rapid collapse. If we relabelled the "y" axis "Human Population" and extended the "x" axis out a thousand years or so, the graph would effectively trace replicate the history of Easter Island's population. The rise and subsequent collapse of the deer populations is fundamentally no different from the rise and fall of the human populations of Easter Island. Even the "experimental"

circumstances are similar: the invader species (reindeer or human) occupies a new, rich environment with no natural or cultural checks on population growth. In each case, the introduced organism inevitably overwhelms its new habitat, destroying its food sources. Subsequent starvation and disease (and a little cannibalism in the human case) leads to population collapse. The main point is that on a very basic level – having an innate propensity to expand into new habitat – humans are no different from any other species.

FIGURE 1: The Rise and fall of reindeer populations on the Pribilof Islands



On another level, humans differ greatly from other species. One key to understanding this difference was brought to light in the early part of the last century by Ludwig Boltzman, a physicist and one of the fathers of thermodynamic theory. Familiar with Darwinian natural selection, Boltzman recognized the central role played by energy as an evolutionary driver. Boltzman argued that the struggle for life is really a struggle for free energy available to do work. All

species have evolved in competition – and cooperation – with each other in ways that tend to maximize their appropriations of the energy and material resources they need survive and reproduce.[1] By the 1920s, Alfred Lotka, one of the great ecologists of the 20th century, recognized that successful species (and whole systems) are those that maximize their appropriations of energy from their environment and then secondarily maximize the efficiency with which they convert that energy into offspring. In the case of humans, we use the energy/matter we appropriate from our ecosystems not only to maintain and reproduce ourselves, but also to create and sustain all our so-called economic capital. Humans have both a biological and an industrial metabolism.

The title of this paper asks whether humans are fatally successful. There can be little question about the "successful" part and if one accepts that we're engaged in a competitive struggle for energy, it's not hard to derive from the literature a lengthy list of those things about human beings that give us an advantage in acquiring energy. I've boiled these down to four that make particular sense to me.

The first is access to food – don't forget our first source of energy is the basic bio-energy we need to grow and reproduce. Here the advantage is straight-forward – humans have uniquely broad or catholic feeding habits. We can eat just about anything. We're omnivorous in the extreme, and this enables us to tap into more sources of bio-energy than virtually any other large mammal of comparable size. Moreover, if we cannot eat something, we'll domesticate an animal that can, and then we will eat the animal or its products such as milk or blood.

This takes us to the second point: Humans are uniquely adaptive, and this enables us to exploit virtually all ecosystems and habitats on the planet. We can live in the Arctic or the desert. We may not be able to eat desert plants, but goats will, so we'll take goats with us into the dry-lands. There is no habitat type on Planet Earth that is not now occupied to some degree (or at least heavily exploited in the case of the sea) by human beings. Since we exploit all major ecosystem types, we have access to the multiple food classes we can digest wherever on Earth they occur. Even in pre-agricultural times,

this gave humans an advantage far beyond the capacities of any other vertebrate species.

It is interesting that in modern times, many people who are mesmerized by our economic and technological progress see humans as becoming increasingly independent of nature, as moving ever further away from our biological roots. Yet if you look at food sourcing from an ecological perspective, it becomes clear that we have become *increasingly* embedded in the ecosystems that sustain us over time. For example, what is the most ecologically significant marine mammal? The answer is *H. sapiens.* As the dominant macro-consumer species in the marine food-web, humans appropriate a larger share of the final products of photosynthesis from the world's oceans than any other marine mammal, probably more than all the others combined. We don't tend to think of ourselves as marine mammals because we don't live *in* the sea like whales or even seals.[2] But in trophic (food-web) terms, abetted by increasingly sophisticated fishing technology, we are by far the dominant marine carnivore (see the findings of Myers and Worm, 2003, and Christensen et al., 2003).

The same argument can be made about humanity's place in terrestrial ecosystems. Humans are by far the most ecologically significant herbivore on the plains and grasslands of the world. We are the major exploiter of the productivity of the world's forests. Again, because of our unique capacity to exploit multiple environments and tap into all available sources of energy/matter, no other species comes close to dominating the planet and its eco-processes as do human beings.

However, more important to human success than any of the above is the evolution of intelligence and our acquisition of language, particularly written language. This great leap forward – our third unique quality – made possible the fourth advantage of humans over the competition, the fact that *human knowledge is cumulative*. Not only do we have unique capacities to exploit every nook and cranny of the planet but, because of our ability to communicate within and between generations, we get better and better at doing it. Technological advance piles on technological advance.

Again, it is worth emphasizing that the main ecological effect of technology has not been to disconnect humankind from nature, but

rather to extend the scope and the intensity with which we exploit the ecosphere. This is how we have become the dominant consumer organism. The common belief that because of urbanization and technology we have effectively become independent of nature, is one of the great perceptual disconnects of modern times. (As we shall see, it is a fine example of a modern myth.) In reality, we are more *in* nature and as dependent *on* nature as ever we have been.

So far I have emphasized the role of energy in evolutionary success and the special capacities that humans have evolved to acquire it. I want now to underscore the importance of energy by reference to two particularly significant energy-related advances in the human dominance of the earth. The first is the (possibly forced) adoption of agriculture. The estimated average rate of population growth in the 10,000 years since the agricultural revolution has been about 13 times greater than during the previous of 10,000 year period. Agriculture involves a shift from simple hunting-gathering, which had major effects on ecosystems but didn't destroy them, to processes that modify entire landscapes in order to redirect the bio-energy flows from photosynthesis to a single species, namely ourselves. Little wonder there was a 13-fold leap in population growth.

The second great surge in energy availability began only a century and a half ago with the explosive increase in the use of fossil fuels. The significance of this to human "success" is readily apparent from a look at the human population growth curve over past last two millennia [Figure 2]. Here we can see a parallel explosion, the fourfold increase in human numbers from about 1.5 billion in 1850 to the present population of over 6 billion, over the same century and a half.

Let's consider the relationship to fossil energy more closely. Figure 3 illustrates the displacement of human and animal labour by fossil energy in the last century and a half. What it shows is that we are now utterly dependent for most of the work done in our society on a single source of energy. It has truly been said that no resource has changed the structure of our economies, the nature of technology, or the balance of geopolitics more than fossil energy. Indeed, the average citizen today in the wealthy industrial countries has between 100 to 200 energy slaves working for him or her. In this sense, each of us is the equivalent of 100 to 200 pre-industrial humans.

FIGURE 2: Human population growth over the past two millennia (Cohen 1995)

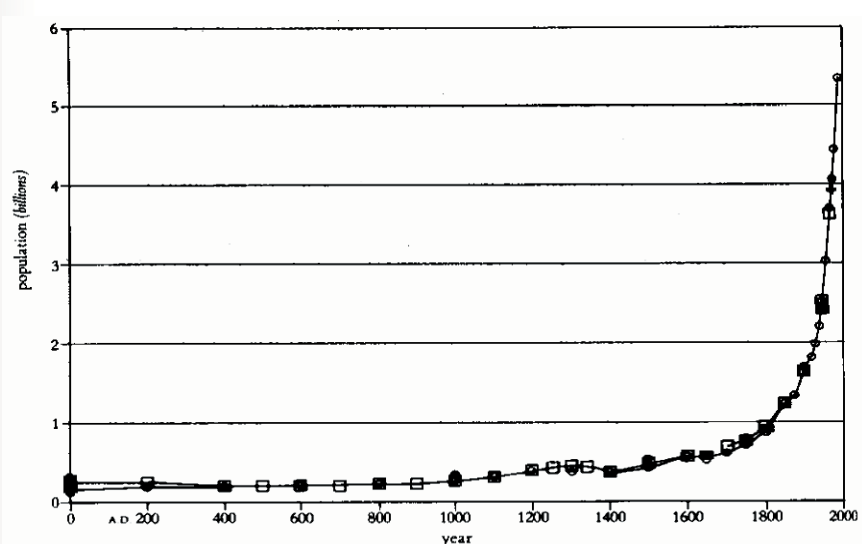
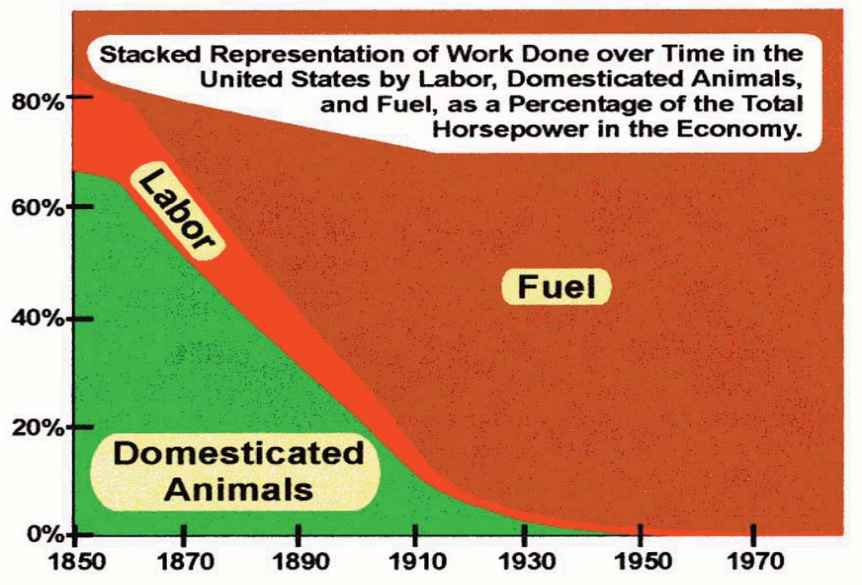


FIGURE 3: The Fossil Fuel Subsidy (Gever et al., 1991, p. 79)



Keep in mind that a major human use of energy is to increase our rate of exploitation of everything else. We could not have fished down the seas or deforested the planet without the huge extra-somatic energy "subsidy" from fossil fuels. It follows that from the perspective of sustainability, human success imposes enormous costs on the rest of the system. The human enterprise is an open, growing sub-system expanding within a materially closed, non-growing ecosphere (Daly 1992, Rees 1995). Thus, the extent to which human beings appropriate energy and material from the total flows through ecosystems reduces the quantity of resources available for other consumer species. In short, the growth and maintenance of the human enterprise is necessarily at the expense of biodiversity.

Humans use three main strategies to appropriate the bio-energy that would otherwise be available to other species. The first is simply to displace other species from their natural ecological niches. For example, up to sixty million bison used to migrate annually North and South through the great plains of North America. But humans ploughed under the native prairie and replanted it to wheat, oats, barely, rye, etc., which we now consume directly or feed to cattle. If one performs an energy accounting of the former bison habitat and adjusts for the increased production due to artificial fertilizer, irrigation, etc., the biomass of human beings and domestic livestock currently supported by prairie agriculture is the energetic equivalent of the biomass of the bison and other species (pronghorns, grizzlies, etc.) that once occupied this formerly native grassland. Humans have largely taken over the vertebrate herbivore and carnivore niches of the great plains.

Secondly, we are inclined to eliminate any residual non-human competition. Right now in British Columbia we're debating whether we ought declare open season on wolves – again! Why are we interested in killing wolves? Because they eat *our* deer, moose and caribou (and possibly domestic stock from time to time). We blame wolves for declining wild ungulate numbers in seeming denial that we are often the main predators on these species. If we really want to increase moose populations, we might decide to cut back on hunting licences, but we'd rather blame and eliminate competitors

such as wolves. It's also legal for salmon "farmers" to shoot seals and sea-lions that might steal from their floating salmon net-pens. Finally, humans are unique in that we poison our own food supply with massive applications of pesticides to eliminate insects that would otherwise claim some of our food crops.

The third way in which humans grow at the expense of nature is through sheer over-exploitation – we deplete the earth's finites stocks of both self-producing (i.e., renewable) and non-renewable resources. Overfishing, deforestation, falling water-tables, erosion and other forms of soil degradation, etc., are the symptoms of this malaise. The growth of the human enterprise is very much a thermodynamic process by which we convert non-human biomass and other resources into human biomass and the material infrastructure of our industrial economy at a great increase in global entropy (pollution and disorder). In the process, we destroy other species populations (e.g., the North Atlantic cod), deforest the landscape, draw down ancient aquifers, deplete our oil and gas reserves, and so on. It bears repeating that this pattern is an unavoidable consequence of our being a growing component of a finite non-growing system. We are but one species out of 10 to 30 million – we don't really know how many species there are – and not only is our population growing by 80 million per year but, because of our fossil energy subsidy, our per capita impact is also increasing (in effect, we are getting bigger as well as more numerous). The consequences for the long-term stability of the ecosphere are increasingly ominous.

Resource over-exploitation by humans is an ancient story. We now have a fairly good record of the consequences of the spread of human beings over the planet from Africa through Europe, Asia, and ultimately Australasia, North America and South America. In every area where the picture is coming into focus, we see that the dispersal of humans over the earth in the last 50,000 years has led to mass extinctions. Large flightless birds, relatively slow-moving, easily-hunted mammals, and other so-called "low hanging fruit" often disappear completely in the decades or centuries following human invasion of their ecosystems. For example, New Zealand was populated by several endemic species of Moa, large meaty flightless

birds that had had no exposure to predators before humans arrived. All were extirpated within a few decades by the ancestors of today's Maori. In short, even in pre-agricultural times, when humans inserted themselves into new habitats and ecosystems, there was a massive shift in the energy and material flows through those systems and in the subsequent distribution of biomass among species, resulting in the extinction of the most vulnerable.

Human displacement of competing species is a variation of what ecologists call the Competitive Exclusion Principle. If there is a limited supply of some critical resource required by two or more species, then species "a" might abolish species "b" from the habitat altogether if "a" is competitively superior. Humans are clearly superior competitors and bio-energy appropriated by humans from the global total is irreversibly unavailable to competing species – what we get, they don't. Population growth and the massive fossil-energy subsidy has greatly increased the rate of human resource use and expropriation of wildlife habitats and their conversion to production for our use. As a result, the estimated current rate of species extinction (global competitive exclusion) varies from 100 to 10,000 times – the consensus is settling at about 1,000 times – higher than in pre-industrial times.

A corollary: If we are interested in conserving in non-human life on Earth, it might just be that the greatest disaster that could befall the ecosphere is for humans to discover another cheap, super-abundant source of energy to replace fossil fuels. If there's no change in the consumer values and behavioural characteristic of high-income countries – in other words, no change in the ways in which we use energy to exploit nature – then the present pattern of biodiversity loss and ecosystem degradation will continue on an even grander scale. This would spell calamity for the non-human world, whatever short-term good it *might* be for humans.

I have tried to make the case that human beings have an innate propensity to over-exploit their habitats. We are large, warm-blooded social mammals with correspondingly large demands and an inherent tendency to expand. The latter is part of our basic biology but, with the evolution of culture and the cumulative effects of technology, we

simply got better and better at doing whatever is necessary to extend our range over the entire earth. I've also made the point in passing that humans have no built-in inhibition against destroying their habitats. It's not hard to imagine why this is so. In pre-culture pre-technology times, humans were simply not capable of destroying whole ecosystems and would simply move on once favoured sites had been hunted out or picked over. In the absence of massive habitat destruction, there was no selection pressure for more moderate behaviour, so modern humans still lack instinctive restraints against doing the massive damage made possible by technology. With the evolution of intelligence and the subsequent rapid development of culture in the last 10,000 years, humans have therefore come to dominate (if not control) the ecosphere, uninhibited by natural constraints.

There is a second factor behind contemporary expansionism that has to do with perception and knowing (epistemology), and their relationship to prevailing cultural values and belief. To understand this factor it helps to recognize that the human brain is fundamentally an "illusion organ" (Regal 1990). For example, although we are a visual animal – in other words, our sight is our most important sense – and our vision is our most direct contact with reality, the fact is that what we "see" (our *perception* of reality) is really a multifaceted yet limited and neurologically altered *model* of the seen object that the brain constructs for our convenience.

Indeed, all perception is a combination of biophysical or social construction. If you can accept the argument that you don't "see" actual physical objects but rather you perceive reconstructed images in the brain, it is no great leap to accept that most of the fundamental beliefs, values and assumptions - the very underpinnings of our culture - are social constructions derived from shared perceptions, experiences and deliberate indoctrination.

A major element in the construction of social belief systems has to do with myth-making, a universal property of human societies which plays a vital role in every culture including our own. Nevertheless, most people today are biased against the concept of myth. We tend to think of myths as fanciful stories or primitive superstitions characteristic of the belief systems of relatively primitive peoples. By

contrast, we see ourselves as a science-based, fact-based society that has long-since abandoned its need for mythic constructs.

My argument here is that this is, itself, our greatest social myth. The common belief that techno-industrial society generally makes its major decisions based on scientific knowledge, fact and analysis, is simply wrong. We can find myriad examples where factual scientific knowledge has almost no impact on how people think, on popular (group) behaviour, or on the political process. In short, like every culture that has preceded us, we moderns are so embedded in our myths that we don't recognize them as such. Colin Grant, in his book *Myths We Live By* (1998), makes much the same point, that we delude ourselves if we think we are myth-free. He argues the case that even in the modern world, myths play a key role and, therefore, "Myths should be seen not as mistaken beliefs but as comprehensive visions that give shape and direction to life."

Like our expansionist tendencies, humanity's myth-making tendency also has a biological basis. The capacity for mass self-delusion, the creation of mutually satisfying stories, was a necessary quality for an intelligent species evolving in a world filled with mysterious and sometimes frightening phenomena. To make sense of their environment, to provide social cohesion and common reference-points, human beings created elaborate cultural myths. These became indispensable elements of people's understanding of their place in nature and of their relationships to each other. As Grant argues, myths then are essential categories of belief that "give shape and direction to life."

For all its positive functions, the human capacity for self delusion does have a perverse side. As Derek Jensen (2000) has argued, there are times such that for us to maintain our way of living, "…we must tell lies to each other and especially to ourselves. These lies act as barriers to truth [and] the barriers are necessary because, without them, many deplorable acts would become impossibilities." In these circumstances, the power of the myth disallows consideration of contrary evidence, including the best of scientific data.

What I am leading to here is an argument that, first, contemporary global culture is as susceptible to comfortable myths as any other and,

second, that today's unwavering commitment to sustained economic growth is the broadest and most widely held cultural mythic story in the history of humankind. In the last 25 years virtually all official international agencies and national governments have come to share a comprehensive vision of global development centred on unlimited economic expansion fuelled by more liberalized trade. At the heart of this vision is a singular belief that has now been raised to primacy in socio-economic policy circles everywhere: that human welfare, or human well-being, can be all but equated with a single variable: indefinitely rising per capita income (increasing GDP per capita). A corollary to the central myth asserts that, because humans can substitute other factors for natural resources and the life-support functions of ecosystems, contemporary species loss and resource depletion is merely of passing interest. As a result, even in already rich countries, we are sacrificing, through globalization, an inordinate array of other values in the name of the growth-inducing properties of economic efficiency and specialization. There is little question that this contemporary myth has been the principal force giving shape and direction to political and civil life in both high income and developing countries on every continent for at least the past quarter century.

There is also little question that this myth has armed the thinking of many against the hard scientific evidence. In fact, today's favoured development model is not even good theory. Sound economic theory recognizes that we ought to maximize human well-being, but also recognizes that many variables and values contribute to this goal. If society wants safe communities, good public education and health care systems, safe cities, etc., and people are willing to pay taxes (or forego the next increment of income) in exchange for more of these social goods, then well-being would increase despite people's reduced capacity to consume.

With this in mind, consider the argument that globally, with each increase in Gross World Product (GWP), we may well be destroying more value in the form of social and ecological damage than the world is gaining in income. Unfortunately, while we do measure the dollar value of GWP, the damage costs of growth go largely unmonitored because of our inability to measure them (and our lack of interest in

doing so). We may well have unwittingly already reached the point in global development where the marginal costs exceed the marginal benefits of further increases in GWP. If so, our modern scientific society is actually guilty of promoting uneconomic growth, growth that impoverishes (Daly 1999).[3]

Unfortunately the problem is even worse than this because of the grossly inequitable distribution of benefits and costs. The benefits flow mainly to the already rich while the world's poor suffer the largely unaccounted negative consequences. And because this distributional inequity is not generally considered in mainstream economic models – it doesn't show up in the GDP/GWP accounts, for example – it is easy for the beneficiaries to continue perpetuating the growth myth from which they benefit.

Science provides plenty of empirical evidence of other flaws in our prevailing economic myth. Data for most of the world's countries show that once a certain level of income is achieved – about 7,500 or 8,000 U.S. dollars per capita per year – there's no further positive correlation between various *objective* indicators of population health and income growth. Moreover, in many rich countries today we can find no *subjective* improvement in well-being as incomes increase. Robert Lane's recent book, *The Loss of Happiness in Market Democracies* (2000), actually documents a negative correlation in the United States between rising per capita income and the average numbers of people reporting themselves as happy or very happy in a standardized survey conducted annually over a period of some 50 years. [See Figure 4] And this American experience is not unique among rich market economies.

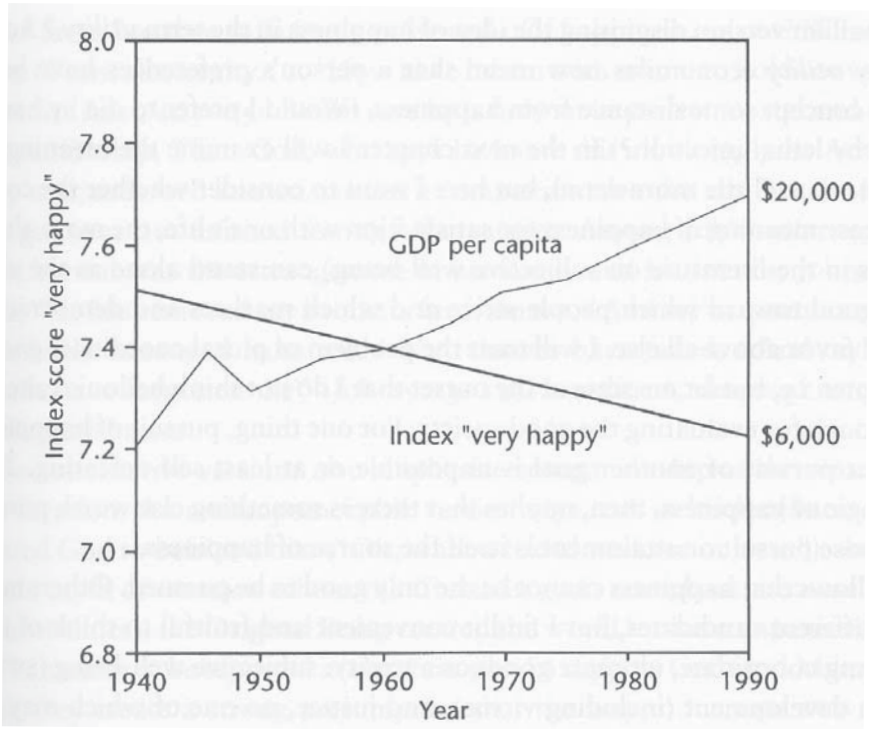
In summary, both theory and data reveal a serious disconnect between scientific knowledge and the global growth myth. The popular model represents bad economics to begin with, and the data show it is not achieving its stated goals, yet the delusional power of the myth overwhelms all the contrary evidence to keep us on our present destructive path.

There is yet another problem. The economic models we use to run the planet are structurally incompatible with any complex real world system. Most importantly, neo-liberal models do not incorporate any

information about actual ecosystem structure or function. Economist Paul Christensen (1991) is more specific, arguing that economic theory lacks any representation of the time and space-dependent behaviours of real-word ecosystems. Accordingly, the simple reversible mechanistic behaviour of many economic models is inconsistent with the connectivity, irreversibility and complex feedback mechanisms characteristic of ecosystems.

These conceptual flaws imply that the world is currently relying on economic management models whose behaviour is inconsistent at virtually every level with the behaviour of the systems we are trying to control. Of course, our mythic model *is* working at one very basic level – Gross World Product, the mesmerizing single variable on which we've focused is, indeed, growing. The economy has increased 40-fold in the last 150 years, 3-fold in the last 23 years or

FIGURE 4: Money doesn't buy happiness (Lane, 2000)



so, and we anticipate an additional 5-fold expansion of Gross World Output in the next half century. Meanwhile, the population has increased by 30% since 1980, is still growing at 80 million per year. We expect three billion additions to the human family by the middle of this century.

Little wonder that humanity becomes ever more dominant – half the world's forests have been logged, half the land on earth has been modified for human use, 70% of the fish stocks are in jeopardy, carbon dioxide levels are up by 30% in this century, and biodiversity loss is accelerating. These are remarkably massive impacts considering they are caused by a species whose mental constructs consider it to be essentially decoupled from "the environment" and unaffected by the consequences of ecological change. This is no minor cognitive lapse. Once we've separated ourselves mentally from "the other," then it doesn't much matter to us what happens to the other. But if the separation is only myth (and the empirical data show that the human enterprise is a fully embedded –subsystem of the ecosphere) then what happens to "the other" becomes absolutely critical to our own future survival.

I want now to examine our predicament using a tool I invented some years ago called "ecological footprint analysis" (EFA). I devised EFA explicitly to counter the argument that, because of trade and technology, the concept of carrying capacity is irrelevant to modern humans (Rees 2001, 2002). EFA estimates the proportion of the earth's surface dedicated to supporting any defined human population. Thus, the ecological footprint of a specified population is *the area of land and water ecosystems required in continuous production to produce the resources that the population consumes and to assimilate the wastes that the population produces, wherever on Earth the relevant land and water is located.* We can now estimate the ecological footprint of any human population for which data are available – an individual, a city, a country, or the whole human family. The method is fairly conservative and is more likely to under-estimate than over-estimate the human "load" on the planet (Wackernagel and Rees 1996).

EFA is now widely used in studies to assess sustainability by, for

example, comparing the eco-footprint of a study population against the area of its productive domestic territory. Most recently, the International Union for the Conservation of Nature (the World Wide Fund for Nature), which publishes a biannual report called "The Living Planet Report," has begun to apply eco-footprint analysis in its assessments of the state of the planet. Figure 5 presents WWF's plot of the increase in the human ecological footprint over the past 40 years or so. Compare this with Figure 6 which shows the steady decline in the WWF's own Living Planet Index, a measure of species diversity and biomass. These data support my earlier assertion that the steady increase in human appropriations from the ecosphere (the growing human eco-footprint) is driving the steady decline in non-human biodiversity. The WWF's and other eco-footprint studies suggest that humanity has already overshot the long-term carrying capacity of the earth.

Eco-footprint studies raise a new concern about the nature of sustainability. People are no longer merely displacing other species from their habitats; it can be argued that unnecessary consumption by the already rich is already beginning inadvertently to deny other humans the basic requirements for survival (Rees and Westra 2003). If critical resources (water, petroleum, arable land) become even

FIGURE 5: World Ecological Footprint, 1961-97 (WWF, 2002)

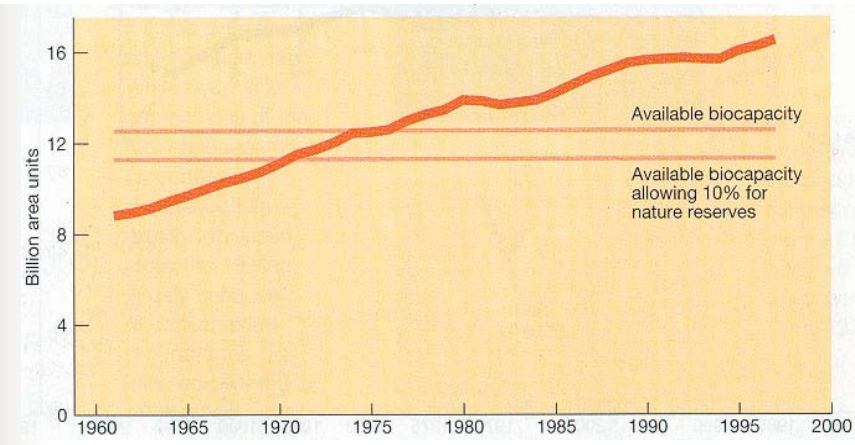
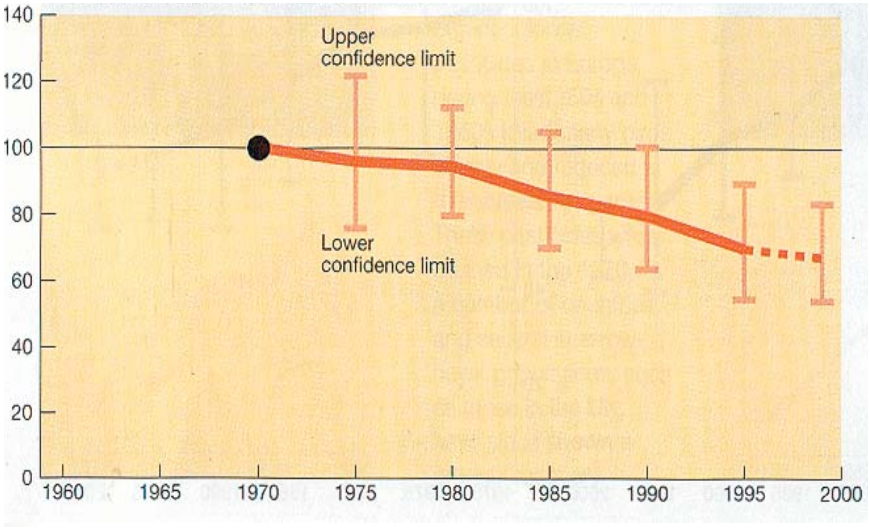


FIGURE 6: Living Planet Index, 1970-99 (WWF, 2002)



scarcer, will we extend competitive exclusion to other human groups *with intent*? We may soon have to confront an unprecedented moral and ethical crisis brought on by blind subscription to the global growth myth on a finite planet characterized by an increasing population and a declining resource base.

Certainly, world events in the recent past suggest we may well be entering an era of increasing geopolitical instability, of resource wars that pit the rich against the poor. There should be no surprise here. Political scientist Ted Gurr (1985), found as far back as 1985 that: "So long as ecological decline is temporary, advantaged groups are likely to accept policies of relief and redistribution as the price of order and the resumption of growth. But once we accept decline as a persistent condition, people will do almost anything to regain their economic and political power and thereby maintain their absolute and relative advantages."

Such overt dominance behaviour may seem abominable to the educated mind. However, as previously suggested, it is arguably a natural human response to scarcity. Human individuals and groups have always competed with each other for the dominance and power

that ensure survival in a resource crisis, for example. Such aggressive behaviours are apparently primarily rooted in the limbic system, the older parts of the human brain in evolutionary terms. (Obviously it served our mammalian forebears well.) The more recently-evolved, unique components of the brain - the thinking part, the imaginative part, the creative components such as the neocortex - were added later as a kind of overlay on top of the older mammalian and so-called "reptilian" brainstem that are central to the limbic system.

All human reasoning, emotions and behaviour result from an exquisitely complicated interplay of influences from all parts of our brain/nervous system and body, but it could be argued that when push comes to shove, the more primitive basic emotions and behaviours tend to often trump the higher rational/contemplative functions. Certainly the innate behavioural repertoire pertaining to dominance and aggression seem to hold sway in the political arena. Politics is all about status, prestige and power which goes a long way toward explaining why the political system seems incapable of responding to real data if necessary actions would challenge vested interests or jeopardize the power or position of the decision-maker. In short, politics is not primarily a rational thinking system oriented to determining the best way to serve the public good. It is mainly an instinctive/emotive system responding to – well, political pressures. Politicians tend to act in ways that enable them to maintain their positions of power and influence within their own group and, if necessary, to ensure that their group (corporation, tribe, nation) is able to assert control and dominance over other groups and communities.

Now, let's try to tie the above to ecological footprint analyses. It turns out that the average eco-footprints of residents of high income countries vary between 4 and 10 hectares (10 and 22 acres). We can then show by simple multiplication that many densely-populated, high-income countries today effectively "occupy" more productive land outside their own boundaries than is contained within them. The basis for resource competition and future conflict is thus revealed.

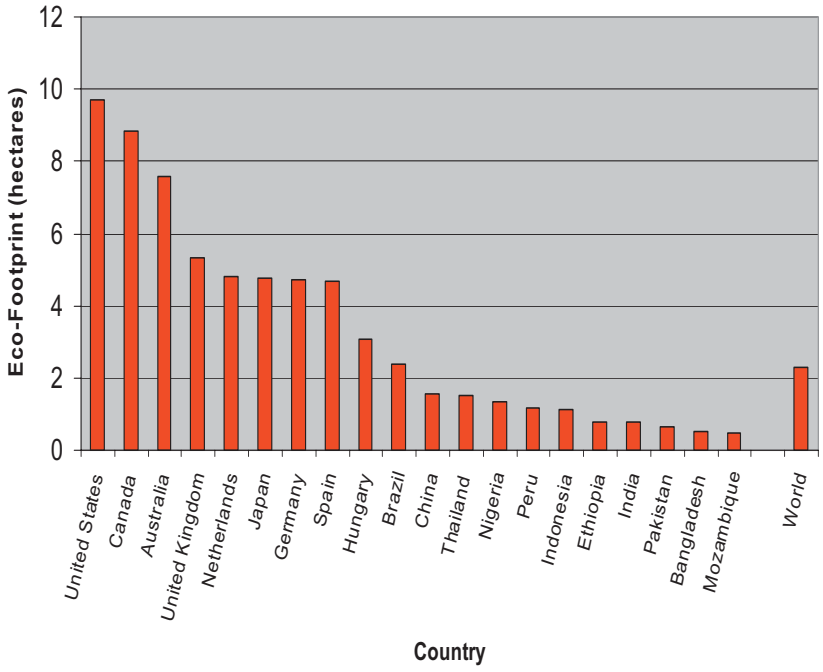
Let me illustrate. I was at a meeting in Europe not long ago where an economist described the miraculous efficiency of Dutch agriculture and held it up as an example for the developing world to

follow. The Netherlands is Europe's most densely populated country, with about 450 people per square kilometre, and yet the country has an agricultural surplus. What the economist really should have said is that the monetary value of Dutch agricultural exports exceeds the trade value of Dutch imports. The counter-fact is that the Dutch need to import fodder for their domestic livestock and this fodder is grown on an area several times larger than the productive land base of the country. Dutch "agriculture" converts that fodder into high value-added cheeses, meats, and other processed goods for export. So Holland may they have a dollar trade surplus in food products, but even when trade-corrected (exported food is not part of the domestic eco-footprint), this economic surplus turns out to be supported by a massive ecological deficit. In other words, the ecological footprint of Dutch agriculture occurs largely outside the country. And it's not just the agricultural sector. Total consumption of all goods and services by the Dutch increases the nation's overall demand to six times the domestic land base of the country. Clearly not all countries can follow *this* model!

What eco-footprinting shows is that, in ecological terms, the Dutch don't live in Holland. Similarly, urban dwellers don't "live" in their cities; urbanization simply separates us from the productive ecosystems that sustain us but lie far beyond the urban boundary. An apt analogy is "the city as human feedlot." Like the city, a livestock feedlot is an area with an extraordinarily high density of consumer animals and a corresponding major waste management problem. Cities and feedlots are incomplete ecosystems – the productive land component is some distance away. Incidentally, Holland is both a human and a livestock feedlot where the biggest waste management problem is animal manure!

Figure 7 provides a multi-national comparison of ecological footprints (1999 data from WWF 2003). Note how ecological inequity parallels the pattern of economic inequity among nations. In the poorest countries in the developing world – Ethiopia, India, Pakistan, Bangladesh and Mozambique, for example – people have eco-footprints as little as half a hectare per capita, or one twentieth of the average North American eco-footprint.

FIGURE 7: Equivalence-adjusted per capita ecological footprints of selected countries (Data from WWF, 2002)

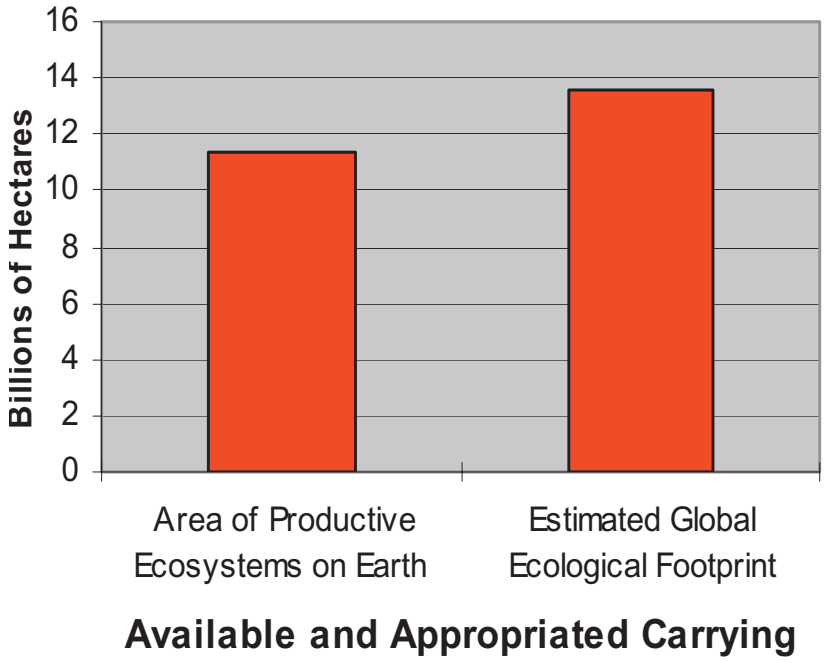


In 1999 the global average person required the bioproductivity of almost 2.3 hectares of land and water ecosystems to produce everything he/she consumed and to assimilate/recycle selected wastes. The difficulty is that there were only about 1.9 hectares of productive land- and water-scape *per capita* on the planet. Multiplying the then human population of six billion by the average human footprint gives a global ecological footprint in excess of 13.7 billion hectares, but there are only about 11.4 billion hectares of productive ecosystem on earth. It seems that we actually exceed long-term global human carrying capacity by about 20 percent. [Figure 8]

To recap, high-end consumers "occupy" ecologically up to 10 hectares each but there are only 1.9 hectares of productive land per capita on the planet. Arguably the two hectares represents our "fair earth-share" (Rees 1996). Where do we get the rest? We get

it through so-called trade liberalization. In ecological terms, we can interpret globalization as the socio-cultural process by which wealthy and powerful people and nations extend their ever-expanding eco-footprints into the "surplus" lands of weaker relatively impoverished countries through trade and into the global commons. In effect, the dominant powers now achieve globally through commerce what used to require territorial occupation.

FIGURE 8: Global carrying capacity



Such findings merely confirm a major stated benefit of globalization from the perspective of wealthy consumers – access to cheap resources and commodities from the developing world. However, the dramatic graphics of eco-footprinting sometimes stir political sensitivities. Several years ago the Department of Environment in Britain commissioned the International Institute for Environment and Development to undertake an ecological footprint of Britain (IIED

1995). Among other things, the IIED study examined significant trade flows and converted them into the area of land in other countries dedicated to sustaining the British population's consumer lifestyle. Almost as soon as it appeared, the study was removed from circulation, apparently because of political uneasiness associated with highlighting the extent to which Britain relies on the rest of the world for critical resources.

To get some measure of that dependence, consider the following: One section of the IIED document showed that to sustain consumption by Londoners alone required an area of bio-productive land equivalent to the entire land-base of the United Kingdom. In other words, were Britain forced to rely on its own bioproductivity – assuming we could convert forest to agriculture and vice versa in the proportions needed – it could barely sustain the population of London at 1995 levels of material consumption. This means, in effect, that most of the UK population is living on carrying capacity imported from other countries and the global commons.

The eco-footprint results for the Netherlands and the UK cited above underscore how, as always, money wealth confers the power to live high on the ecological hog even long after a country's domestic land-base has been over-taxed or even depleted. In these circumstances, it seems fair to ask whether under the present globalization paradigm the poor can claim *any* part of the hog. Or is the competitive exclusion of the poor by the rich already irreversibly underway?

In 1970 the richest 10% of the world's citizens earned 19 times as much as the poorest 10%. After a quarter century of accelerated global integration under the expansionist paradigm, with its emphasis on wider markets, trade and efficiency to stimulate growth in GWP, this ratio had actually increased to 27:1. In other words the very rich are getting rapidly relatively richer leaving the poor even further behind. In many African countries, people are actually worse off in both relative *and* absolute terms. GDP per capita is actually falling.

The bottom line is that global inequity is steadily increasing. By 1977 the wealthiest 1% of the world's people commanded the same income as the poorest 57%. Twenty-five million rich Americans – that's 0.4% of the world's population and less than 10% of the U.S.

population – had a combined income greater than the poorest 2 billion people, or 43% of the world's population (UNDP 2001).

Consider this in the context of international trade and eco-footprint analysis. The United States with less than 5% of the world's population consumes a vastly disproportionate share of the world's resources, including 25% of the world's energy, most of which is imported. The United States may be the world's mightiest military power and most powerful economy, but the country would be paralysed were it not able to extend its eco-footprint into the rest of the world. The same is true of many other densely-populated high-income countries.

This brings us full circle. What is the future for geopolitics if the global development scenario is characterized by growing demand, accelerating eco-degradation, resource scarcities and rapid climate change? Will we on this small blue Earth island descend like the Easter Islanders from civilization's peak into the valley of chaos, of tribal factions driven by sheer survival instinct and warring over the last remaining pockets of viable land and resources; or will reason prevail so that we, all members of the human family together, can plan an equitable way to find "the right balance with our environment." The contemporary dilemma is that the world is ecologically full – in fact it's full to overflowing. But so far the benefits of the growth that got us to this point are grotesquely inequitably distributed. We cannot grow our way to sustainability, but must instead come to share the world's economic and ecological output.

How we approach this problem will necessarily represent a dialectic between self-conscious reason and unconscious predisposition. It's well known that humans are disinclined to share with strangers, particularly in times of crisis or scarcity. We're not inherently altruistic, except to kin and to people with whom we've developed a reciprocally beneficial relationship. But if we don't learn to distribute the world's economic and ecological output more equitably, even as resource supplies are increasingly strained, we may have to face truly dire consequences. The question is: "is *H. sapiens* capable of achieving a justly equitable global stability based on a new variant of enlightened self-interest?"

It is often said that those who do not know their history are con-

demned to repeat it. In present circumstances I would argue that, even if we know our history, we are condemned to repeat it if we are unable to rise above certain primitive forms of survival behaviour. Instead, we must use our much vaunted intelligence and awareness of our predicament collectively to override our baser instincts. The question is: can humanity create the required new forms of social and cultural inhibitions, and will we be able to erect the international legal-institutional framework necessary to constrain the "rogue within"?

We can obtain some measure of the challenge by reference to the 20th century. The last century may have been technically and scientifically dazzling but it was also the most, destructively bloody century in human history. We may be the most intelligent species on Earth, we may be capable of astonishing feats of reason and analysis, but our own history reveals that "The rise and fall of cultures… has always been primarily determined by the tides of human passion not by the ebb and flow of reason" (Morrison 1999).

The primary goal of all life is to survive, but the self-oriented aggressive-defensive behaviours that served so well for that purpose early in our evolution are maladaptive in the ecologically full world today.[4] The challenge of the 21st Century is to rise above individual and tribal interests and recognize that our best chance for survival lies in collective self-restraint and mutual commitment to the common good. This is an unaccustomed mode of human political behaviour. As American political scientist, Linton Caldwell, wrote in 1990: "The prospect for worldwide cooperation to forestall a disaster seems far less likely where deeply entrenched economic and political interests are involved…. Many contemporary values, attitudes, and institutions militate against international altruism. As widely interpreted today, human rights, economic interests, and national sovereignty would be factors in opposition. The cooperative task would require behaviour that humans find most difficult: collective self-discipline in a common effort."

One well-tested and very powerful tool is available to us. We must make deliberate, creative use of humanity's myth-making capacity, our inherent need for unifying stories. Let's frankly acknowledge the weaknesses in the expansionist global development model with

its emphasis on efficiency, competition and survival of the few and replace it with a new myth that fosters equity, cooperation and mutual sustainability. The choice is between allowing all our various human "tribes" to assert their independent self-interests in a global free-for-all, or rising to the challenge of fully exercising the singular human quality that sets us apart from other advanced species, the capacity for rational thought. If enlightened reason does not triumph over violence and aggression as the means of settling our affairs, then we will almost certainly fall back into the ancient patterns that so darkly stained the 20th Century.

At a minimum, and for purely practical reasons, the required new myth must acknowledge the precarious state of both the ecosphere and geopolitics and set as its goal the stabilization of both. But surely we can do better than the bare minimum. The enlightened rationality I am invoking is different from hard, cold, calculating enlightenment rationality. Enlightened rationality incorporates passion for life and compassion for both other humans and non-human nature.

As noted earlier, our evolutionary history has provided us with no inhibitions against destroying our habitats, other species or other human beings, and no such inhibitions will come to us from our biology. We have reached the stage in human evolution where the products of the uniquely human mind, including socially constructed cultural factors, must assume the dominant role. The creation of a grand myth for global survival is a purposeful act of social engineering. And while this might seem a daunting task, is it really that qualitatively different from the social engineering that so effectively entrenched the expansionist globalization model around the world? Once again we must shift our values consciously, but this time away from the narrow focus on individualism, self-interest, competitive relationships, toward a greater emphasis on community/societal values, cooperative institutions, and a sense of participating consciousness in nature.

Certainly humans have all of the qualities necessary in their behavioural kitbag – we can love, we are compassionate, we can show empathy for other people and even other species. Of course, some people are better at these things than others, but these are the human qualities that we must draw out in our schools and universities, in

government and the private sector. It is a matter of deliberate social choice whether we stress in all our cultural institutions the darker colours of the human behavioural spectrum or emphasize the brighter shades. The point is that the sustainability crisis may be humanity's final opportunity to rise above mere animal instincts. Can we not elevate the qualities that make *H. sapiens* truly unique to a primary place in determining our species' future? If we succeed, the victory will mark the next great adaptive leap forward in human evolution.

FOOTNOTES

1. There's a corollary here related to our increasingly competitive global environment: the dynamics of unfettered competition among individuals, corporations, and economies in a finite, unregulated environment, will tend to eliminate any restraints on destructive behaviour affecting the global commons that individuals or single entities might have exercised were they the sole exploiters. We call this the (somewhat mistakenly) the "common property problem" or, more accurately, the "Open Access Problem."
2. Neither do most sea birds live in the sea – like people, they nest on land and go fishing for food.
3. This is in net terms. Growth is justified in poor countries where the benefits are positive, but not in the rich countries (where most of it is occurring).
4. It is possible that global conflict could leave the most powerful and ruthless to inherit what would be left of the earth thus satisfying the ancient mission of the genes in a minimalist way. However, the costs in lives and destruction are unfathomable to the civilized mind. Hence the option suggested here.

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ACKNOWLEDGEMENT

This paper is based on a lecture delivered by the author to The Vancouver Institute on March 15, 2003.