

# Carrying Capacity

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The carrying capacity of the Earth is nearly always cast in terms of human populations: "How many human beings can this world (or niche, or plot of land) sustain indefinitely, assuming a more equitable division of food and resources, and further assuming that technology will solve most of our problems as necessities arise?" The science is lacking here for the long-term answers and we are thrown back on thought experiments. The equations simply have too many variables. This uncertainty is often all that's needed to justify proceeding with business-as-usual, until more has been learned. Answers to the global question vary widely. The majority seem to think our population can stabilize successfully somewhere around 9-10 billion, with plenty of others in the wider range from 5-20 billion. And we all get to keep our dogs and cats. But the majority also thinks that the world was created in six days by a bronze-age tribal deity afflicted with clinical paranoia, who has a talking snake for an arch-enemy. Even a good percentage of the so-called greens consider the problem to be largely one of more equitable distribution of food, as though this were our only weak link, as though all an enlightened society needs to do is sit in the garden, in the rain and snow, without building materials or transportation, and eat vegetables. Diet, including high-quality protein and safe drinking water, is one of many concerns, but there are several further dimensions to the question of carrying capacity that take us well beyond "how many humans can survive here?"

Even if we assume that Earth and its web of life is nothing more than a kit of raw materials with which to build a human civilization in order to maximize our numbers, and that any value nature may have must be cast in the economic terms of the environmental services it provides, it really takes an utterly delusional species, with no vision at all beyond a single generation, to fail to see that we are already well over the limit. We have, in no particular order: biodiversity loss, habitat fragmentation, global fisheries collapsing, overgrazing, ocean acidification, reef destruction, accelerating global warming, deforestation, desertification, topsoil loss and

degradation, methane releases from permafrost and clathrates, waterway siltation, soil salinization, over-paved agricultural lands, aquifer draw-downs, groundwater pollution, ozone depletion, glacial melt, growing fresh water shortages, grain deficits for fuel production, mass extinctions, bio-invasions, pollinator losses, heavy metals in the food chain, plastics pollution, eutrophication, algal blooms, malpredation with its genetic pollution, pandemic vulnerability, environmental refugees, hypertrophy or overextension into geo-hazardous regions, peak oil, peak fertilizer, Ponzi economics, and increasing per-capita food consumption at the third trophic level. The artificial inputs we're using to maintain current levels of food production, from fertilizers and pesticides to fossil-fueled mechanization, are already beginning to falter. The life forms that aren't our friends are rapidly finding new ways around our cleverest wonder drugs, herbicides and pesticides. We're getting inferior, delayed, and deliberately distorted information about the long-term damage being done to our environmental support systems. But this shortsighted, linear, anthropocentric thinking is only the beginning. The question of our fitness to survive, as suggested by Spencer and then Darwin, has little to do with our strength or our might, and everything to do with how well we fit into our niche. We are not a good or long-term fit at present.

The first dimension of carrying capacity is sustainability, with the word used here in an honest sense, not the "greenwashing" sense that humans are currently using to mass-market products: a sustainable activity is one that can be sustained indefinitely, for millennia, while unsustainable activity can't be continued long-term: it must extinguish itself. This is most of our present human behavior, at least at our current population levels. Such activity must necessarily respect the conditions which sustain it. Sustain means to hold up from below. The natural consequence of unsustainable behavior, by definition, is its own extinction. The extinction of a behavior, or life form, thus defines the boundaries of sustainability. This means that if an activity is relying on non-renewable resources, then all of these resources must eventually be recycled, or else replaced with sustainable substitutes, not merely a token percentage of them to make our guilt go away. We must put it out of our minds that our extractive natural resource industries are sources of new wealth or income instead of capital expenditures. We also need more honest accounting than what we're used

to performing, with true life-cycle costs, cradle-to-cradle, and a closer examination of total embodied resources throughout the life-cycles of everything we use. Management of this will be easier and more self-governing when actual costs are reflected in consumer pricing, instead of being actively subsidized by corrupt, corporation-run governments, as most are now. Scarcity is valuable information and shouldn't be hidden from view or removed from prices paid. The politicians who are currently championing free markets have no clue what free markets are: they have this completely confused with corporate capitalism. But free markets, reflecting true supply and demand, can only move us halfway in the right direction. We also need to internalize all environmental and other external costs into commodity pricing, and then find ways to prevent the rising of prices due to scarcity from leading to the accelerated exploitation of diminished resources. Even the word resource needs rethinking, as the prefix "re-" suggests that this is a source that we can keep coming back to, and thus should apply only to true renewables.

The second dimension of carrying capacity is recovery or remediation of our support systems from the long-term damages that we have already inflicted. The carrying capacity itself is suffering increasing long-term impairment. Ultimately, the inputs to the global ecosystem are few: solar energy (including wind and hydro), geothermal energy, meteoric dust, the weathering of rock and microbial activities that release new nutrients into the soil, and new deposits of volcanic ash. Seral succession will build habitable niches only at geological speeds. The great fossil water aquifers are not going to replenish themselves as long as our demands exceed slow resupply. Losses of biodiversity through extinction are permanent. The deserts we've made will take thousands of years to come back to life and even that's assuming that the climate has not run amok with the added heat we're trapping. When the wild animal populations crash, whether from overgrazing, disease related to stress, or extremes of climate variation, recovery of the niche is often fairly quick, but only due to populations being reduced to well below carrying capacity. Eventually, populations re-stabilize, with numbers usually oscillating first above, then below capacity, but at a lower capacity until the long-term damage has been repaired by seral succession. This is where humankind has been headed, to diminished carrying capacity and a population crash to levels below that. If we're

going to avoid this, we're going to need to conduct what amounts to a controlled population implosion. Our best alternative is rapid deceleration of growth and eventually a decline to below replacement levels. This seems to be occurring as a matter of course in certain local populations, but this developed-world phenomenon also requires a higher standard of living, hence a larger ecological footprint, and education, particularly women's education. If we cannot manage to do this prior to reaching first-world levels of development, it will need to be done nature's way, and every number in a population crash means real people dying younger than they would in a better world, the suffering and premature death of living individuals.

The third dimension is contingency, the backup plan, stocks, stores, and reserves. We currently assume that our evolving technology, combined with our human ingenuity and the inventiveness of Mother Necessity, will cover this, so we continue to discount the future instead of allowing safety margins. From time to time, our world is hit with abnormal and extreme events, new diseases, long periods of drought or ice, large objects arriving from space, solar storms, earthquakes and tsunamis, hurricanes and floods, volcanoes and super-volcanoes. These events, which now include our wars and other moronic pursuits, demand a surplus of resources for emergency use only. Most of us know by now that civilizations come and go. One of the things that sends them packing is the occasional hundred-year drought. Another is the exploitation of one-hundred percent of their occupied niche, with nothing lying fallow or given time to recover. And raiding adjacent niches isn't always an option, or when it is, this leads to war and then to accelerated collapse. In other words, it's unwise to occupy an entire niche, and wiser in the long term to under-develop. Wisdom will allow much of our forested, arable and grazeable lands, in any normal year, to lie fallow, or managed by natural processes, with a chance to recover some natural health. Wisdom will often look just like restraint. Lebensraum, room for living, can use some recycling as well. An as-yet unnamed horseman of our apocalypse is overextension, hypertrophy, our crowding into the flood and tidal zones, onto the slopes of Vesuvius, on top of the earthquake faults, and into our armed neighbor's yard. Ecological spacing was the last good excuse we had for war, but we lost it when we outgrew our tribes. Having enough set aside for the future, for contingencies and emergencies,

is key to good stewardship, while it's insecurity that overproduces, overplants, overgrazes, and generally over-consumes. Security is the steward: it has something worth protecting or securing. Hyperextension and security are fundamentally incompatible. The bubbles pop and populations crash. While there's no need to paralyze ourselves with excessive precautionary principles, we nonetheless have been cashing in the benefits of doubt when we should be accepting more burdens of proof. It's no matter of prophecy that big challenges are coming, magical calendars or planetary alignments won't be the cause: it's simply statistics and human stupidity.

The fourth dimension to carrying capacity is our quality of life, an acceptable minimum standard of living that allows self-actualization to any human beings who care to seek it. This means that the poorest among us should be not be impeded in meeting all of the basic human needs by interference or surcharge from their governments, and without repression or exploitation from economic or corporate entities. This isn't the same as a right to be handed the basic requirements with no personal effort. There must one day be a right to achieve this "economic floor" within an amount of time that still leaves hours for leisure, recreation, travel, education and family, because these too are among our real human needs. But meeting this condition would elevate the global per-capita ecological footprint to a level well beyond the current global average, though still well below the footprint of several of the developed nations. A closely related problem is the greater longevity we have given ourselves, which also increases our individual footprint. We also have higher infant and child survival rates, and less need to provide the world and our little farms with children to spare. There are two questions here, the first being: "What does it take to meet our basic needs?" In the U.S., the generally accepted response is "the Poverty Line," the cumulative average cost of a specified basket of goods and services. Up to this line, people must be preoccupied with meeting needs over which they have little control, while beyond this, discretionary expenditures of both hours and money will bring a degree of liberty and happiness back into life. The second question is: "Within these parameters, what more can be done to minimize our ecological footprints?" Provided that we can learn to need less, which seems to be easier said than done, we can revisit the whole notion of economy that has been so deviously twisted of late. At bottom, we can learn a degree of control over our own power to

assign value to this or that. We can, for instance, learn to value time above money. If we have no choice but to work a forty-hour week, but we only really need the income from twenty-four, wisdom suggests that this be fairly rigorously applied to investing now in working less later, instead of being resigned to spending it all now when it only appears to have more value. We would need to learn to stop discounting the future. In sum, the carrying capacity should count the number of people able to live healthy, good, educated and meaningful lives, and not the number of people who could survive here in poverty, ignorance, and squalor, or doing nothing more than tending their gardens and eating vegetables.

One of the more positive steps that this civilization is taking now is towards free, online education. Unfortunately, accreditation for the self-taught still lags well behind, with G.E.D. and CLEP excepted. Hopefully there will soon come a time when any autodidact can challenge any higher education course of instruction, or any academic degree, including those of the guild monopolies like medicine, law, engineering and architecture. The subject of education might seem out of place here, but it isn't. Education of women in the third world, for example, might do more than any other factor in curbing our population problem. Then we can rate contraception, abortifacients, abortion, and infanticide in their proper order of preference. The introduction of a core critical-thinking curriculum early in elementary school could go a long way towards neutralizing the ideological ignorance and short-sightedness that prevents us from even seeing our problems. We have to see what is coming before we can see our need for restraint.

The fifth dimension is our view of technological advance as savior or the cavalry. It's true that we will most likely invent our way out of some unknown number of problems, and avoid some serious tipping points at the eleventh hour, just prior to cascade failure. Nonetheless, we have to survey how well this has worked in the past, with a special eye to both real life-cycle costs and unintended consequences. New products are often touted for their benefits while their salesmen pitch nothing about their impacts, and many impacts are new and cannot yet be known. They may be billed as the greenest thing in history, while providing only a 10% improvement over old ways. Huge windmills and electric vehicles must still have their component materials mined from the Earth, must still be manufactured at substantial energy and water costs, must still be delivered

along maintained roads using fuel, and must be repaired and eventually replaced. Some pollution of the commons will almost certainly occur. Paying interest on their financing usually requires extra work, also done at some cost to the environment. Honest efficiency calculations will expose all of the real costs. Note also that converting to a friendlier product will often alleviate some of the guilt that went along with the old product's usage. When you drive your Prius twice as far as you drove your old pickup truck, you haven't reduced your footprint. In sum, the techno-fix dimension of the carrying capacity problem might not have anything close to the sustainability value we have hoped for. On the whole, our march of progress hasn't really solved our problems and we may want to leave this out of our calculations entirely, or make a much-needed contingency line.

The sixth, and tragically, the most controversial dimension is an allowance or reservation for wilderness and non-human life, sufficient for this to continue on its own, without our help, management, or interference, and even eventually perhaps in our absence. Aside from the argument that Earth's biosphere provides us with economically valuable environmental services, the controversy lies in our inability to get our heads out of our arrogant, anthropocentric asses and allow that Life itself has intrinsic value and rights all its own. The perceptual and cognitive ability that this vision seems to require is a much-extended time horizon, such as one we might develop with a ten-millennium sustainability ethic. We could start with a seventh generation ethic. We would need to recognize that life preceded us and will eventually succeed us. In Loren Eiseley's words: "There are other things brewing and growing in the oceanic vat. It pays to know this. It pays to know that there is just as much future as there is past. The only thing that doesn't pay is to be sure of man's own part in it. There are things down there still coming ashore. Never make the mistake of thinking life is now adjusted for eternity." We're currently about to face mass-extinctions on the scale of the K-T event, while we need to be targeting a restoration of biodiversity that at least has the potential to evolve back into pre-human levels, despite our having created so many tragic dead-ends to millions of years worth of struggle.

While environmental services arguments may one day be quantifiable by science, the "intrinsic rights of Earth and non-human life" position is, at bottom, an ethical decision to be made. Such a decision ultimately has to

be based on our capacity for empathy, reverence, respect, and gratitude for Life, for a deep appreciation of this world, which, as we should have seen by now, has little or nothing to do with our religions. It demands a greater maturity. Consequently, all we can really do here is make a choice out of conscience and then take a stand. Mine would be for a world that is at least 50% wilderness, with the human half including all lands in current use for farming, grazing, hunting, forestry, mining and recreation, in a lattice spread across all of the niches on Earth, and including many of those that we find most hospitable to our human habitation. Further, the wild areas should form a connected network with relatively free movement between zones and ecotones. This is the exact opposite of the approach taken by the American government in delineating the reservation boundaries for the aboriginal inhabitants, who were simply driven onto the worst land the government could find. Even more stringently, we should not permit ourselves to even consider reoccupying these spaces as buffers, set-asides, stores, surpluses, and reserves for purposes of the contingency planning mentioned above. In times of large-scale environmental crisis, whether manmade or natural, nature has plenty of stresses of its own to deal with.

It's becoming increasingly obvious that we humans aren't going to attain to much of this voluntarily. Even decades down the road from here, there might still be a majority who deny that we even have a population problem, who deny that we are parasites and parasitoids, a majority that does little more than pray that the Lord return and save us by ending it all, by closing up His shop of horrors on Earth following our liquidation sale. Our capacity for denial is as intractable as our parasitism. Nevertheless, by definition, unsustainable behavior leads necessarily to the extinction of that behavior. So where does this thought experiment leave us, if all six of these carrying capacity dimensions are given due attention? It's a SWAG, or "Scientific Wild-Ass Guess" at this point, but I would put the number at a billion humans or less (roughly our numbers in the year 1800), living on roughly a quarter of our present geographical footprint. I would have to admit, though, that this is more of an optimization than an anthropocentric maximum, which I might put at around two billion, at the expense of the biosphere's health, biodiversity, and quality of-life dimensions.

It might only be an interesting coincidence that, quantitatively, one-hundred-percent of us have only come a tenth of the way to solving our



global problems, such that our efforts at renewable energy, for example, can now nearly solve the energy challenges of a population under a billion. For an alternative, if we must wait for a population crash, ecology-as-a-science suggests that populations first crash to numbers that are below the long-term numbers. Time, of course, will tell us what this number is or was. But it will make big difference whether we can manage our “descent” before we really start to crash. Without better population control, we may never have the leisure to govern by vision instead of by crisis. Much of the “smoothness” of our civilization’s operations relies not on our best and brightest minds, but on hive mind, which in turn requires either things to run smoothly on their own or maintain a systemic resilience that we are seriously compromising on multiple fronts by flirting with more than a dozen tipping points at once. A serious breakdown of order now will force a very large number of specialists to learn general skills in too much of a hurry. Our hive mind could suffer a widespread dementia. The costs of overpopulation will not just be our nations. It will be civilization, and with it, the means to come up with our magical techno-fixes.