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The Vanishing Book of Life on Earth

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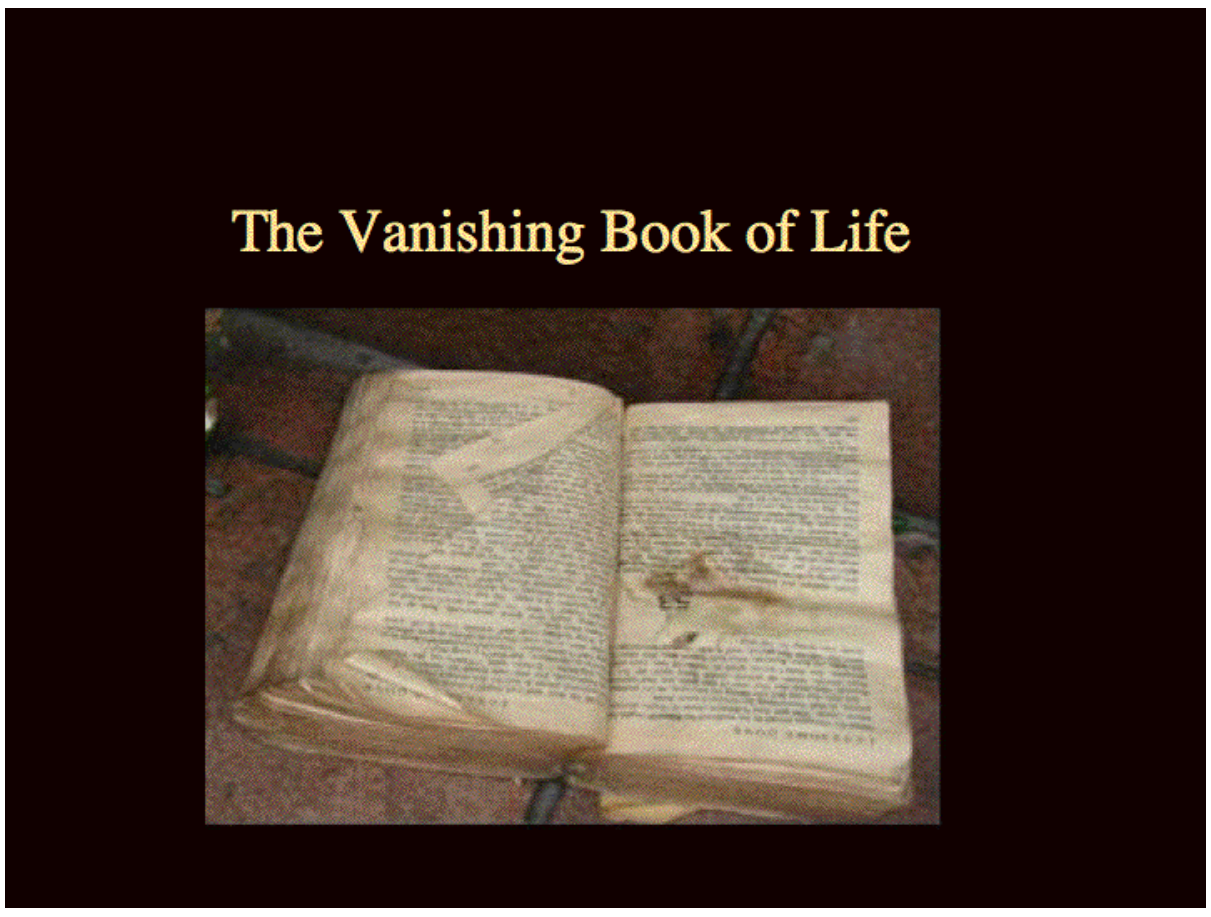


The great North American tall grass prairie -- we just took it and turned it all into agricultural lands. We exterminated the bison, wiped out the Indians, destroyed the prairie dogs and those black-faced ferrets. We just erased an entire ecosystem. Now this was very nice for Americans because that rich topsoil has allowed us to grow lots of food to feed ourselves and the rest of the world and we've grown fat and apathetic and miserable as a result of it. We've lost the bison -- we've lost an awful lot that we'll never be able to recover.

This essay is about an impending doomsday. I am going to take you down, down, down and then I'll try to rise up with a little bit of optimism at the end.

The great early American naturalist Henry David Thoreau embraced wilderness and used a book as a metaphor for life on Earth. Philosopher of science Holmes Rolston III extended Thoreau's metaphor as the "vanishing book of life." Rolston (1985) remarks "destroying species is like tearing pages out of an unread book, written in a language humans hardly know how to read." This book of life is disappearing before our eyes. Each page corresponds to one of the many species of life forms that lived or still lives on Earth, and describes everything one could possibly want to know about its natural history and ecology, its parasites, prey, and predators, how it is related to its closest ancestors, as well as much more. Each chapter, in turn, describes how every member of this myriad of millions of different microbes, fungi, plants, and animals interact within a particular natural

ecosystem. All of Earth's once pristine ecosystems, past and present, are thus described, metaphorically, in many volumes.

The massive amount of information contained in all life on Earth could never be recorded in a single book, or even in an encyclopedia, but would require something more akin to many libraries of Congress. This "Book of Life" is indeed the most valuable of all of our many books, as it contains the entire history of all life on Earth from its very beginnings 3,500,000,000 years ago. Unfortunately, this greatest book of all time is tattered and torn, pages are missing, and entire chapters have been ripped out. Humans are heedlessly destroying habitats, effectively ripping out pages of the "Book of Life" even before biologists have had a chance to read them. We are burning the greatest book for nothing more than to expand the human population, which is already precariously high.

Most people consider biology, particularly ecology, to be a luxury that they can do without. Even many medical schools in the USA no longer require that pre-medical students obtain a biological major. Basic biology is not a luxury at all, but rather an absolute necessity. Despite our anthropocentric (human-oriented) attitudes, other life forms are not irrelevant to our own existence. We need them to continue to exist ourselves. As proven products of natural selection that have adapted to natural environments over millennia, they have a right to exist, too. With human populations burgeoning and pressures on space and other limited resources intensifying, we need all the biological knowledge we can possibly get.

We rely on other organisms for food, medicine, shelter, and clothing. Simply put, humans could not exist without our symbiotic bacteria, let alone without the endosymbiotic photosynthetic chloroplasts housed by all green plants. Many of the genes that drive our physiology and metabolic processes were invented billions of years ago by microbes in Earth's primeval oceans. Even our blood plasma reflects our ancient origin: it is very close to sea water. We are but one small branch on the tree of life. We share most of our genes with other organisms, including bacteria and fungi.

Ecological understanding is particularly vital. Without understanding natural ecosystems, how can we hope to manage man-made ones wisely? Basic ecological research is extremely urgent simply because the worldwide press of humanity is rapidly driving other species extinct and destroying the very systems that ecologists seek to understand. No natural community remains pristine. Pathetically, many will disappear without even being adequately described, let alone remotely understood. As existing species go extinct and even entire ecosystems disappear, we lose forever the very opportunity to study them. Knowledge of their evolutionary history and adaptations vanishes with them: we are thus losing access to valuable biological information itself. Just as ecologists in many parts of the world are finally beginning to learn to read the "unread" (and rapidly disappearing) "book", they are encountering governmental and public hostility and having a difficult time finding support.

Let us consider the book of life: Several questions come to mind -- Can we read it? Will we be allowed to try to read it? Do we have time enough left to read it? I have been very fortunate to have spent most of my life studying the ecology of desert lizards. I'm finding that I am no longer allowed to do things that I used to be able to do because as we have taken over habitats and imperiled other species, they have become so scarce that they must be protected. I worry that before too long ecologists won't be allowed to touch a wild vertebrate. When this happens, time will have run out for us.

One of the biggest enemies we face is anthropocentrism. This is that common human attitude that everything on this earth was put here for our use -- to be used any way we want. An example of an

anthropocentric human is a man with a chain saw cutting down a redwood tree that's a thousand years old. That is audacity and that is anthropocentrism and that is wrong. When you couple anthropocentrism with technology and human greed, you get a terrible monster, a rapist and pillager of Earth.

I live in the hills about 35 miles west of Austin, Texas. It's turned into a bedroom community for the city. All kinds of people move out into the hills to avoid high city taxes in Austin -- they bring their mobile homes, their security lights and their cats and dogs so now there's a horrible, horrendous commute with new stoplights going in everywhere.

The city of Dripping Springs has had to build three new schools because of this and it's turned into a little suburb of Austin. Everything has gone downhill. When you meet your new neighbors -- usually over a fence -- they come up and say "Hi, who are you -- what are you doing out here?" I introduce myself, and they want to know what I do -- how do I make my living? I tell them I'm a university professor and a lizard ecologist and then I start to plead with them.

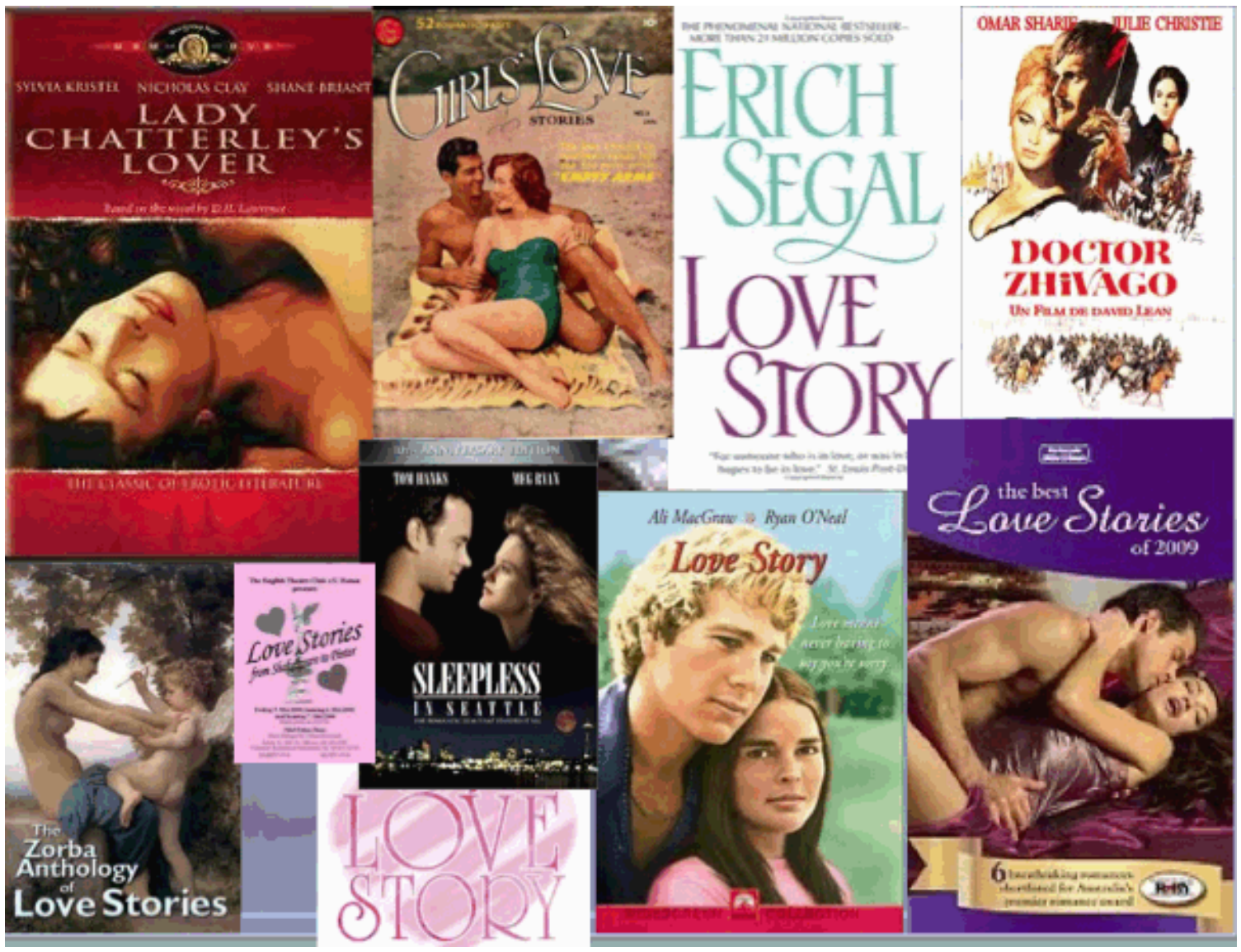
I point out that there used to be a lot of lizards and snakes living in these hills and that they're all disappearing because of this encroaching urbanization. I plead with them not to let their cats and dogs run loose -- cats are born killers. They let dogs run loose so they can "play" with the deer. Well, you can't do that -- dogs are wolves -- they pack up and they kill things. They don't belong out there. Another thing people do is put out feeders for birds -- that brings in urban birds -- blue jays that shouldn't be out there replace the scrub jays that should be there. I've seen rattlesnakes disappear completely.

When I pleaded with some new neighbors about not letting their cats kill lizards -- one of them made a huge mistake -- she looked at me and said "what good are lizards?" She shouldn't have said that to me . . .

I looked her in the eye and said "what good are you?"

Ecologists want and need access to wild organisms in semi-pristine natural environments because these are the places in which they've evolved and to which they have become adapted. Organisms don't make any sense if they're not in their natural habitat.

Rattlesnakes . . . People often call me to ask where can they see a rattlesnake. They don't want to see a wild rattlesnake; they want to see one behind glass. A rattlesnake in cage might as well be dead as far as I'm concerned. It doesn't have a natural habitat. It doesn't make any sense. I don't know where it evolved or what it's adapted to; I don't know anything about it.



It's as if you took a a pair of scissors to a collection of the world's greatest love stories and started cutting out the word "love" every time you saw it and putting the little "loves" into glass vials. You don't even know which book they came from, let alone whether they are verbs or nouns, you don't know who loves whom; love has been taken completely out of context. That's what's wrong with animals in zoos. They don't have any ecologies anymore. They might as well be dead.

We have to save the vanishing book of life, but we must also read it. And my point as a biologist is that anyone can help save it. There are tree-huggers galore out there and plenty of people who just want to save the planet. Anyone can do that. But it takes somebody who's dedicated and earnest and a little bit crazy to try to go out and read it and try to make sense of it. That's what we should do if we have the skills and motivation to do it. We should try to read it before it's gone. I don't see any point in trying to

save anything unless biologists are allowed access to it. I think that is a critical point here.

Today we have many powerful tools to help us decipher the vanishing book, most of which were unavailable a few decades ago. These include air travel, email, fax machines, the global positioning system (GPS), satellite imagery, geographic information systems (GIS), the polymerase chain reaction (PCR, which allows amplification of DNA), DNA sequencing, powerful personal desktop computers and imaginative powerful software. Unfortunately, just as ecologists have gained access to this vast array of new technological tools, the very stuff we need to study is disappearing.

Some of these things might not seem very new, but I remember when faxes first came out -- I was doing field work in Australia and I wanted to send something to my university in Austin, Texas, and I had access a new fax machine. As I was feeding it in down under, I could see it in my mind's eye in now time coming out in Austin -- to me that was mind-boggling technology. I'm still hoping they'll figure out how to fax me back and forth so that I can avoid the plane trip.

We've got technology now that is just out of this world. I started using the Net before it was the Internet, before we had email, it was called the Arpanet back then -- what I'm finding now with email is that I can have colleagues anywhere in the world and we can work really fast because if they're in Australia, when I'm asleep they're working, and when I'm working they're asleep. We can work 24 hours around the clock, faxing and emailing stuff back and forth, so our papers just come rolling out.

I wish GPS had been around earlier because when I was out collecting before lizards were gone from large parts of their geographic ranges I had to record localities as "15 miles north-northwest of Mojave, California," and I had to go to a map to try to estimate Latitude and Longitude. It would have been so much nicer to have a little GPS unit and been able to record these things accurately; but it's too late now because we've erased big chunks of information.

I've gone back to several of my North American study sites -- they were just crawling, literally teaming with lizards only 40 or 45 years ago, and now they are parts of little cities, trailer parks, and not a lizard can be found. Collections I made back then in storage in museums are really fossils. They represent what was there before humans took over the habitat. To me that is shocking. It makes those collections pretty valuable, too.

I'm not saying I don't approve of conservation biology -- Of course, we need it -- but I'm saying if you consider yourself a determined conservation biologist, please, please allow biologists access to the book of life. That's got to be one of the main reasons for saving it.

Conservation biology is a crisis discipline. It's an emergency and it's a man-made emergency. We wouldn't need it if we hadn't ravaged this Earth and taken over so much of its surface. Right now, humans are using half of Earth's land surface. Currently, we are using more than half of the available fresh water. We are now using half of the solar energy that impinges upon the land surface of the Earth. Worse yet, we have burned up fossil fuels that took millions of years to form in a single century. That is shocking. One species has taken half of everything for its greedy little self.

In physiological emergencies, we must intervene so we resort to surgery when somebody's dying. War is the equivalent in political science. When you have an international political emergency, you go to war. That's what conservation biology is -- it's a crisis discipline -- it's man-made, just like war. We

wouldn't need conservation biology if we could control our own numbers. "Wildlife management" is a pathetic joke, we humans cannot even control our own populations!

Conservation biology is actually more than just biology because it bridges the gap to the social sciences -- we have to start thinking in terms of the ethics of what we do with planet Earth. We should have started thinking about it a long time ago.

Problems in Conservation Biology

Recognition and management of endangered species
Restoration ecology
Ecosystem conservation
Ecological economics
Environmental ethics
Value of Biodiversity
Design of Nature Reserves
Minimum viable population size
Genetic bottlenecks
Population viability analysis
Sensitivity analyses of Leslie matrices

Here is a short list of some things conservation biologists are concerned with -- they design nature reserves, identify endangered species, help to prevent plants and animals that are teetering on the edge of extinction from going extinct, and all sorts of other things. And this is well funded in large parts of the world -- but this is not basic ecology -- it is applied ecology. It's not reading the vanishing book, it's simply aimed at trying to save what little is left. Money has to be spent on that. Nature reserves are only temporary holding places, as witnessed by the continuing onslaught by big oil on the Arctic National Wildlife Refuge.

When I was a little boy I spent hours and hours looking through "Audubon's Birds of the World." I remember looking at the photograph of the last Passenger Pigeon -- she died in a Cincinnati zoo in 1914. And as a little boy I couldn't believe it, because I read the text -- it said the sky was blackened with millions of these birds flying over. And then I read further and found out that humans in their greed went up to their nests and clubbed the babies and pickled them and shipped them off to Europe to be eaten as squabs. They did this for a few seasons and managed to stop reproduction of this species and effectively drive it extinct in a very short time -- a few years. Extinction is forever.

Photo by R. W. Shufeldt

THE LAST PASSENGER PIGEON
She died in the Cincinnati Zoological Park in 1914

Carolina Parakeets (above)

Ivory-billed woodpecker —>

When I first went to Africa to study lizards in 1970, rhinos were still fairly abundant and they hadn't been savaged by humans. There are several species of rhinos and now all are endangered because of a myth that came out of Asia that rhinoceros horns are an aphrodisiac -- rhinoceros horn can be worth twenty thousand dollars a pound. Rhinoceros are gone from most of their former geographic ranges. In some areas, they are under 24-hour armed guard, and would be poachers are shot on sight. The scales have tipped on the relative value of a human life versus that of a wild animal.

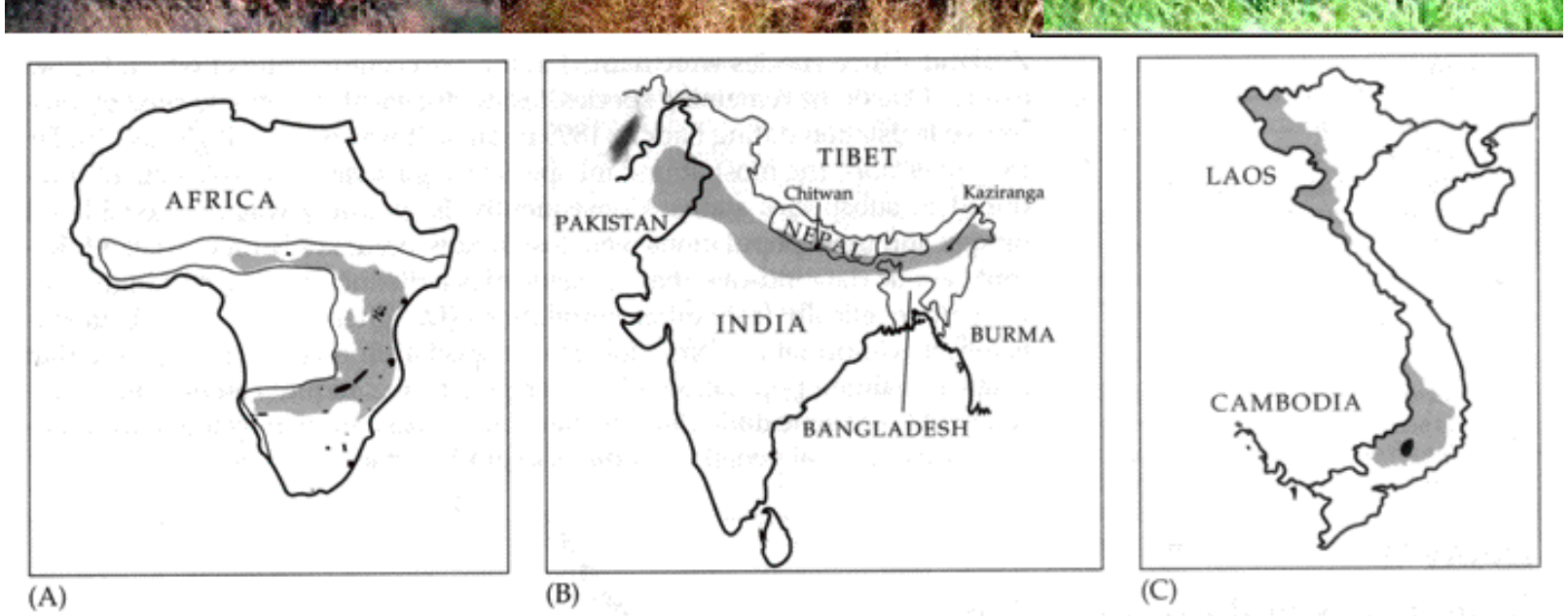
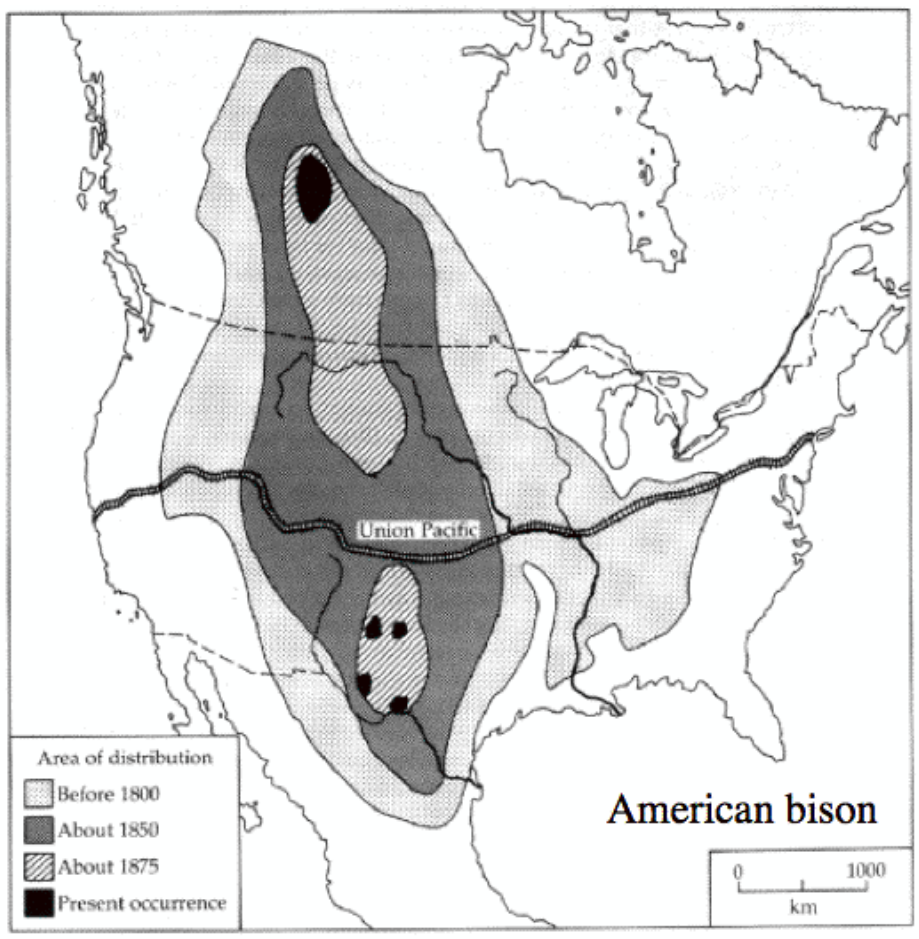


Figure 3.7 Present and former distributions of three species of rhinoceros, showing loss of populational diversity and retreat to a few refuges. (A) The black rhinoceros (*Diceros bicornis*), showing historical distribution (black outline), distribution in 1900 (shaded area), and distribution in 1987 (black areas). (B) The greater one-horned rhinoceros (*Rhinoceros unicornis*), formerly distributed across the shaded area, is now reduced to two populations at Chitwan and Kaziranga reserves. (C) The Javan rhinoceros (*Rhinoceros sondaicus*), showing historical (shaded) and present (black) distributions. (A, from Ashley et al. 1990; B, from Dinerstein and McCracken, 1990; C, from Santiapillai 1992.)

Powerful people convince poor people living in third world countries that if they could get them a rhino horn they'll pay a thousand dollars, which is more than the potential killer could make in their entire life. Then the rich guy gives him a gun and if the poacher succeeds, he buys it for a thousand dollars, takes it to Europe or Asia, grinds it up and markets it for tens or hundreds of thousands of dollars. Clearly, it's high time we switched to Viagra.



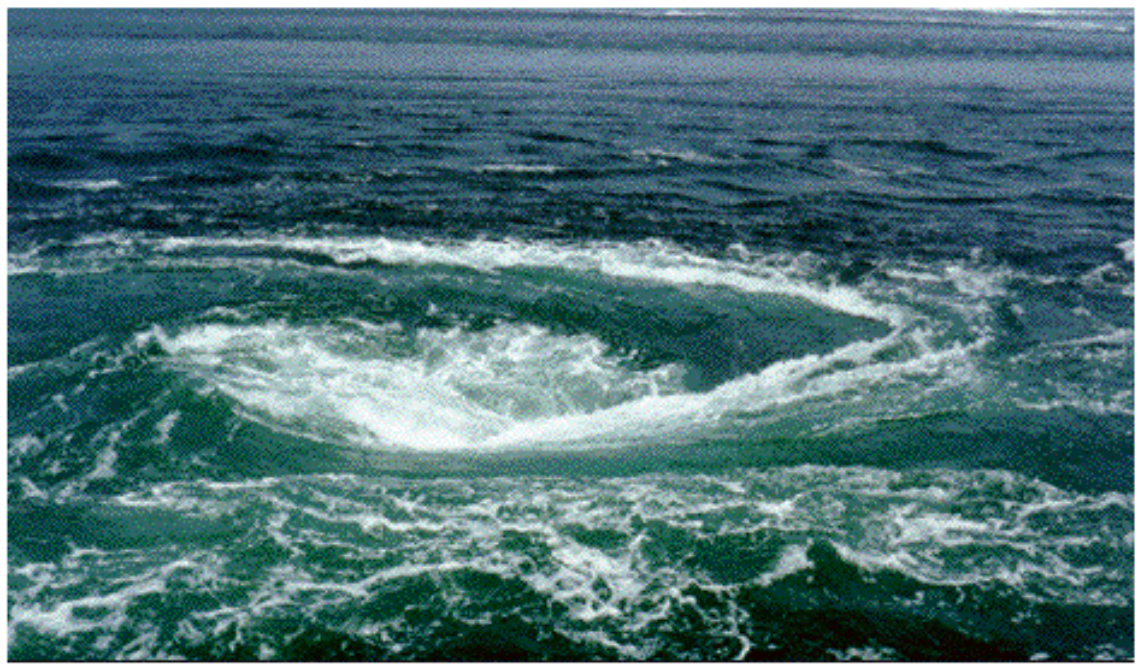
This is how we treat everything. Consider the history of the geographic range of the American bison -- a very beautiful animal originally found from Buffalo, New York, all the way to Sierra-Nevada before the 1800s. Huge herds of untold millions were quickly culled. People back then told about bison thundering all through the day and all through the night. They called it "prairie thunder." But that's gone for good, and you're not going to see or hear it in your lifetime, and that's a loss. When they built the Trans-continental Railroad, people would buy a ticket and get a gun and load it with big slugs and shoot bison as they rode across the continent, leaving their carcasses to rot on the wide open prairie. As you can see, they split the bison herd into northern herd and southern herd.

General Sheridan said that bison hunters had done more to control the American Indian than all the cavalry put together. We basically starved out a lot of American Indians -- those that we didn't kill instantly with smallpox and measles. Our ancestors practiced genocide. We stole this continent from other people. We just took it because we could.

I have a small herd of bison. They are absolutely magnificent animals. My herd bull, Lucifer stands six feet tall and weighs about 2700 pounds -- when Lucifer wants to, he goes over the fence -- and when he does (I've never actually seen it), the earth must shudder at this spot for a little while. His habit of jumping is how Lucifer earned his name.

We have to get off our anthropocentric high horse. Biodiversity has a value beyond how it can be used by humans. Other Earthlings have been here longer than us -- much, much longer -- and they have a right to this planet too -- that includes wasps that sting you, ants that bite you, scorpions and rattlesnakes -- it includes wolves and wolverines and all kinds of animals that we have pushed to very brink of extinction.

I cannot discuss all the things that concern conservation biologists but I do want to point out one that it is kind of pathetic: we have settled on the minimum viable population size -- how low can you go and still have something -- to me, this is tragic.



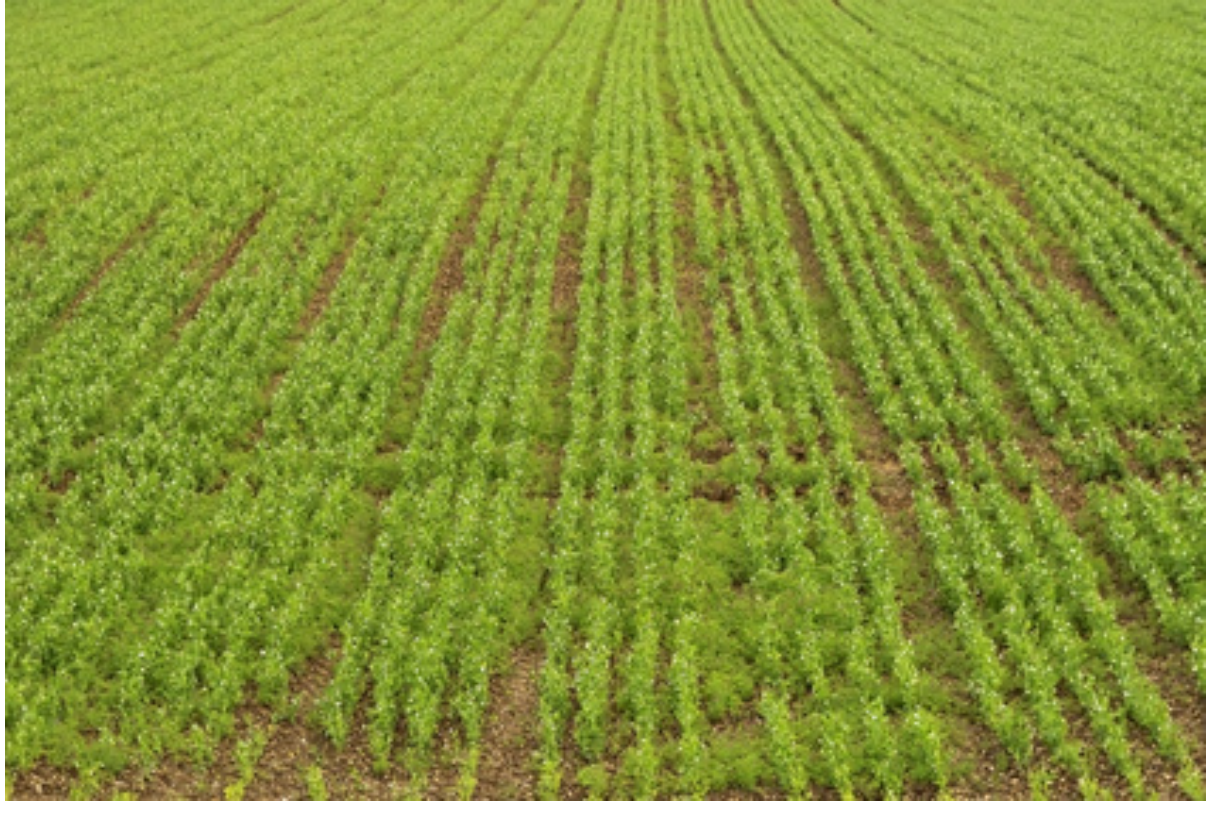
"Extinction vortex"

Habitat loss, habitat fragmentation, small population size, genetic and demographic stochasticity, toxic pollution and climatic changes

One conservation biologist coined the term "extinction vortex" -- as we drive populations down, so that they get precariously low, all kinds of factors come together to sweep them down to extinction -- and all are man-made. We stole their habitat. We fragmented their habitat. We've knocked their population sizes down to the point where genetic variability disappears -- and, don't forget, of course, climate change and toxic pollution. Quite simply, to other inhabitants of Earth, humans are truly monsters.

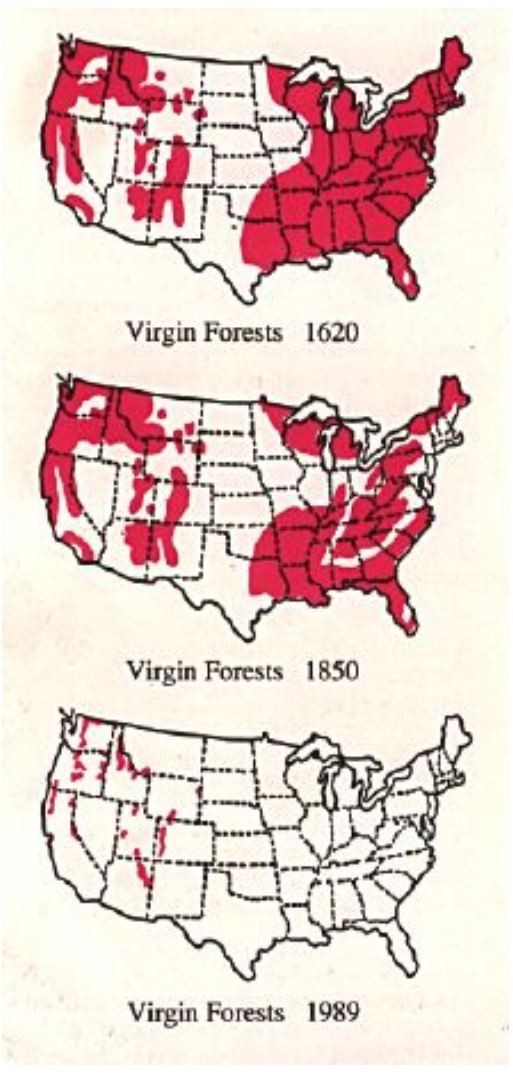
We're more concerned now about toxic pollution as it affects humans. It's causing cancers and feminization and all sorts of other maladies. But we ought to be worried about it as it applies to everything on this earth. And now, of course, people are finally, finally now beginning to be aware that we have polluted the atmosphere to the point that the entire planet is changing.

It's only a matter of time now until the climate changes really drastically. Some meteorologists have models that show thresholds ("tipping points") where it shifts almost instantly overnight.



About 10,000 years ago, we made one of our worst mistakes (Diamond, 1987) -- we invented agriculture, which allowed us to feed many more people and to reach unsustainable population densities. We began to live in cities and invented money. Food became a mere commodity that's bought and sold -- greedy people learned how to make money on it. Most people lost touch with the reality of where food comes from. When people go to the supermarket and can no longer find Triscuits on the shelves they will wonder "Where did Triscuits come from?" I fear that we will have to become hunter/gatherers again pretty soon but Earth cannot support very many hunter/gatherers.

One of the things humans do is deforest everything -- we cut down trees to burn to keep ourselves warm, build boats or houses. And deforestation has been pretty thorough in many places on the planet. The U.S. is fortunate -- we still have the luxury of trees because we got into coal and fossil fuels early and managed to keep ourselves warm and/or air-conditioned without cutting down too many trees. Still, we have managed to cut down almost all of the original native old growth American forests.



Out in the middle of nowhere in Northern Africa in the Sahara desert is an oasis that had three big palm trees. It was called 'Tres Arboles' in Arabic (I say 'Tres Arboles' because some of you might speak Spanish). But somebody cut those trees down, so although it is still on the map and it's still an oasis, there aren't any trees out there anymore. One cold night, a selfish human cut them down and burned them to stay warm.

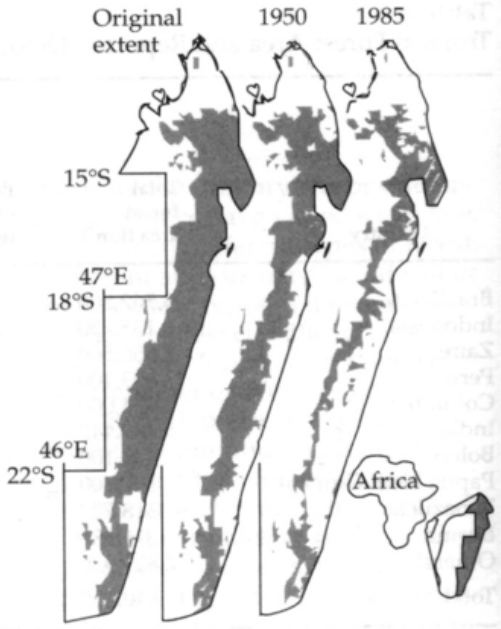
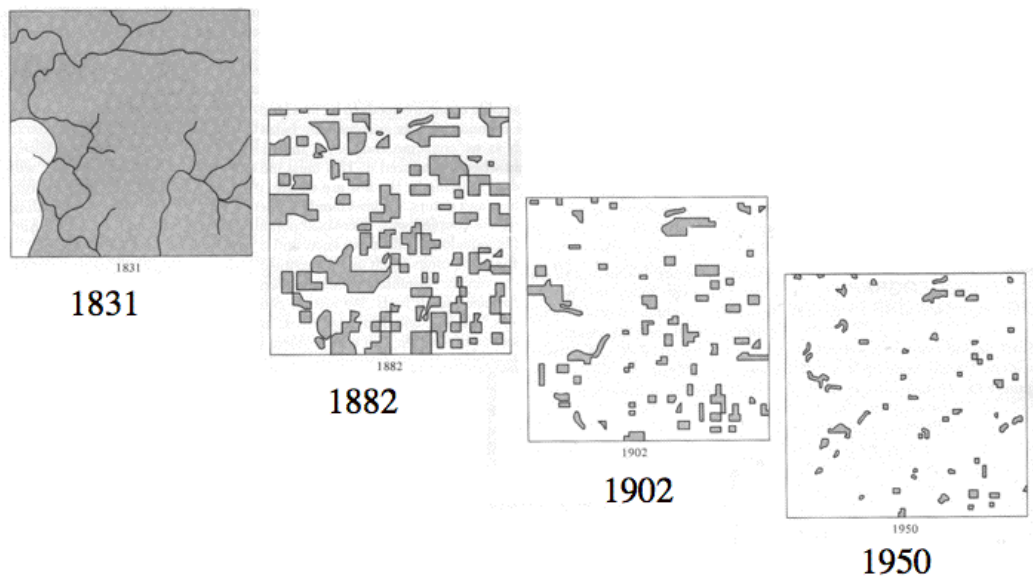


Figure B Distribution of rainforest in eastern Madagascar from before human colonization to modern times. Note the progressive loss of both overall forest cover and large blocks of forest. (From Green and Sussman 1990.)

Madagascar is one of the places that I want to go before I die because it has so many endemic species -- it split off from mainland Africa a hundred million years ago and it's got all kinds of creatures that are found nowhere else on the earth. Yet, the people of Madagascar are third-world, starving, over-populated, eating everything. An endangered land tortoise in Madagascar is highly protected on the world's list of "don't do anything to this turtle," but they are commonly made into turtle soup by poor people in Madagascar.



Once, we were surrounded by wilderness and wild animals, but now, alas, we surround them.

When humans first arrived in Wisconsin, a square mile was forested with a little piece of prairie in the southwestern corner. The prairie burned every year (prairie fires) and over the centuries the prairie built up deep black top soils, which are nourishing our nation today. The first thing settlers did was cut down the trees as you can see. In a little over a century, this was turned into tiny wood lots. Imagine the effects this must have had on whatever used to live in that forest.

Deforestation, Southeast Asia

Here's an example from Borneo. This is what we are doing to this planet. Wood has become extremely valuable and we're clear-cutting anything that's left.

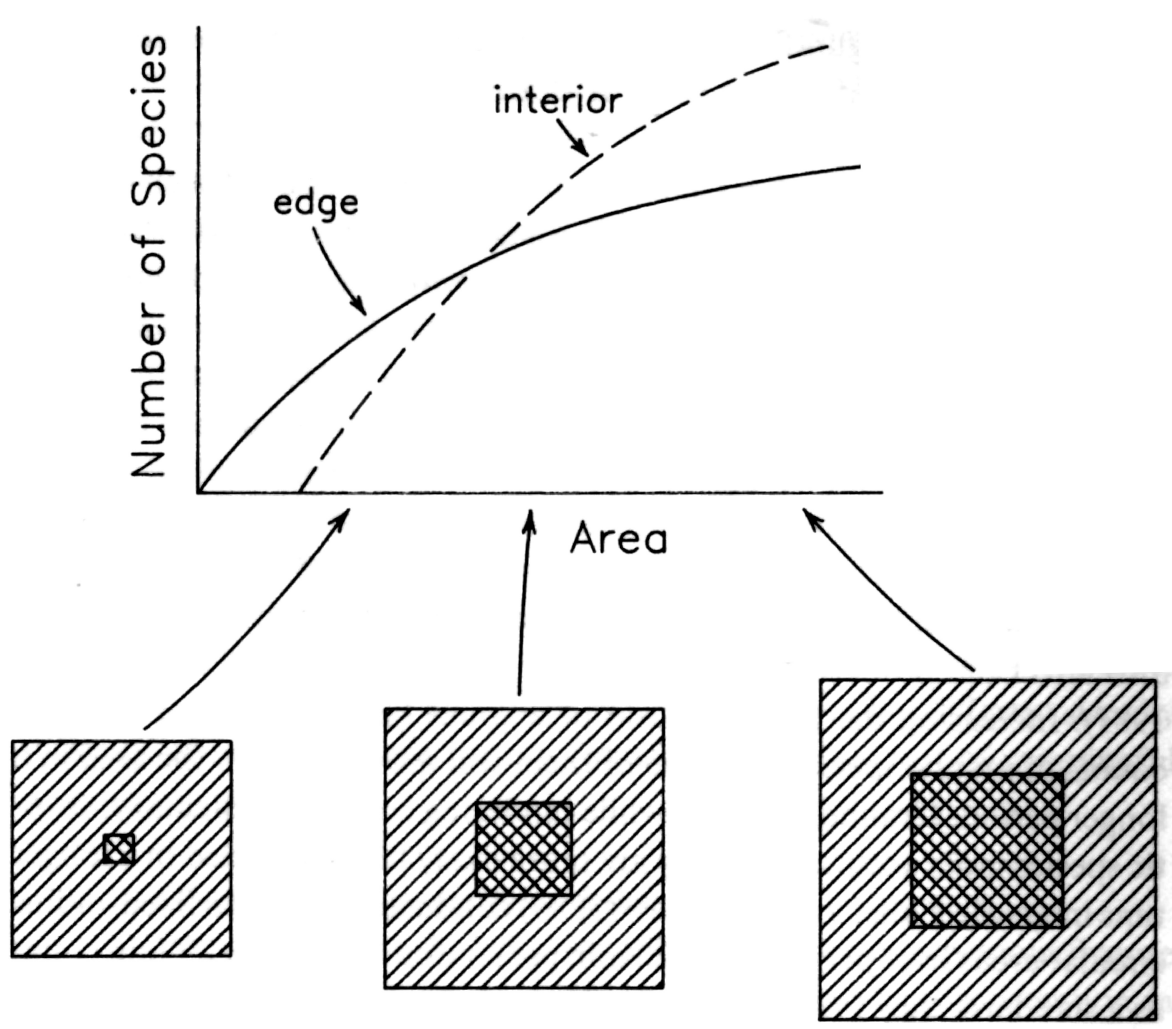


Fig. 3.2. The effects of increasing the area of a census plot on the relative areas of edge and interior habitat (below) and on the rates of accumulation of 'edge' and 'interior' bird species in the census (above).

One of the problems with habitat fragmentation is that you lose core habitat. In that scene that I showed you from Wisconsin back in the 1830s before humans got there, there was only a little tiny bit of edge between the prairie and the forest. Cowbirds lived along that edge. Cowbirds are brood parasites. They lay their eggs in nests of other birds. Cowbirds used to be very scarce in North America -- with habitat fragmentation, their populations have boomed and the only place that small songbirds like warblers can lay their eggs now to get away from these parasitic cowbirds is deep in the forest. When only tiny little patches remain, a small songbird simply cannot escape from cowbirds. Now cowbirds are very abundant, small songbirds are heavily parasitized and their populations are on the brink of going extinct because of our clearing and habitat destruction and fragmentation.

Freeport MacMoran Mine, Irian Jaya, New Guinea

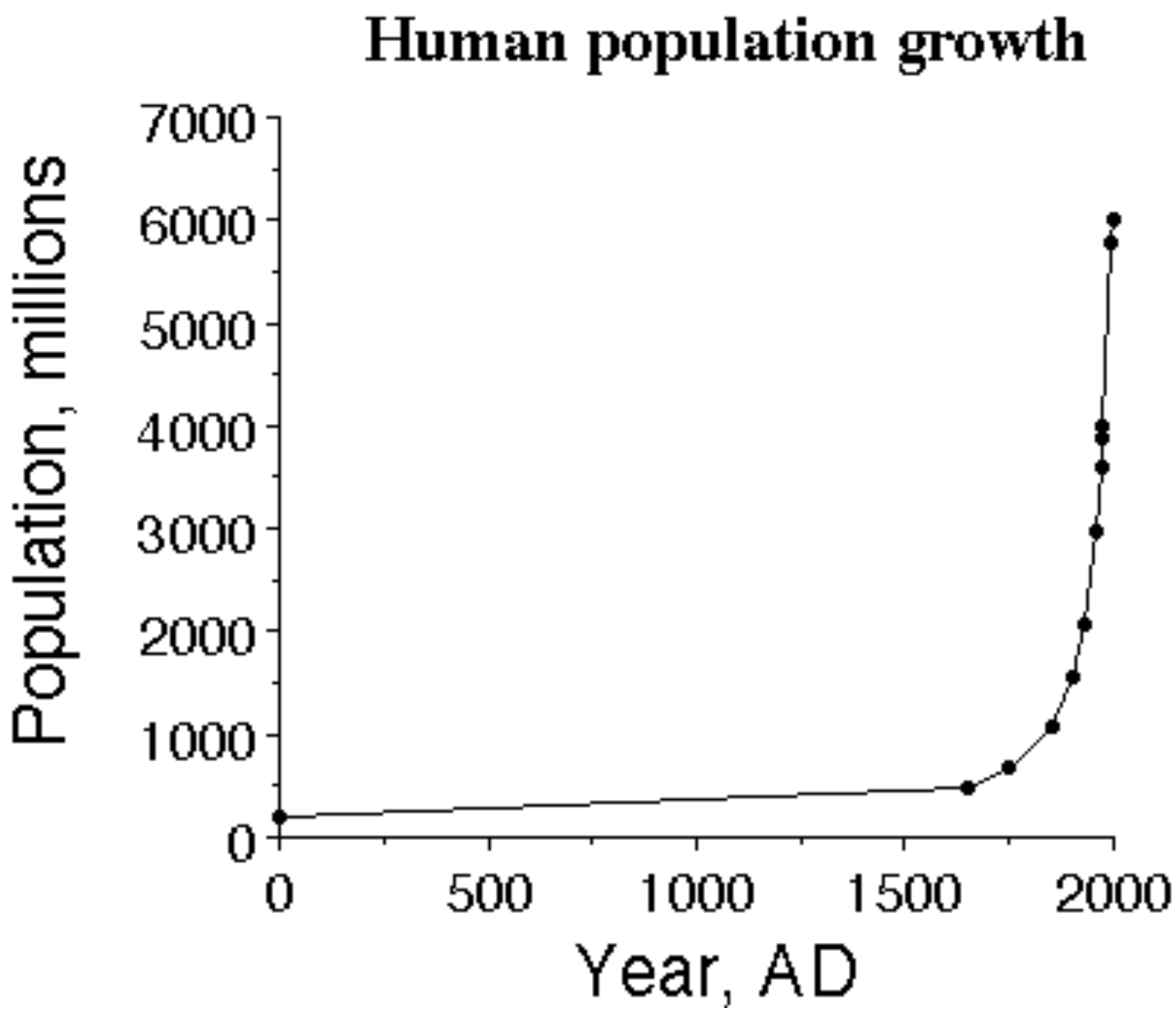
Here is more testimony to our anthropocentrism and human greed. This is the work of a Texas company called Freeport-McMoRan. They have formed an alliance with Indonesian officials, and they're taking

gold and copper off the top of this mountain in New Guinea (now part of Indonesia). They've stripped off most of the top of that mountain and shipped it down the side in great big slurry tubes that are ten feet in diameter to be sent back to smelters where they extract the gold and copper. The ore goes down to the sea where it is hauled away in ships.

You can see the damage this mining has done and is doing. It is causing huge mudslides on the sides of the mountain and these are polluting once pristine streams down below. Native tribes in the lowlands of New Guinea lived off these beautiful, clear streams with fish and crustaceans and food of all sorts -- now they can't get anything because the streams are clogged with mud from dirt from Freeport McMoRan's mining operation on top of the mountain.

Some of these people being dispossessed by this greedy company on top of the mountain broke into a supply shack and got some dynamite and primers and they blew up the slurry tube. One of Freeport McMoRan's CEO's complained that it was costing his company a million dollars a day not to have that slurry tube open.

Freeport-McMoRan has been strip mining for ten years. They've been taking a million dollars a day out of there for ten years. And, when they have exhausted this mountain, no doubt they'll move operations to the next one behind it.

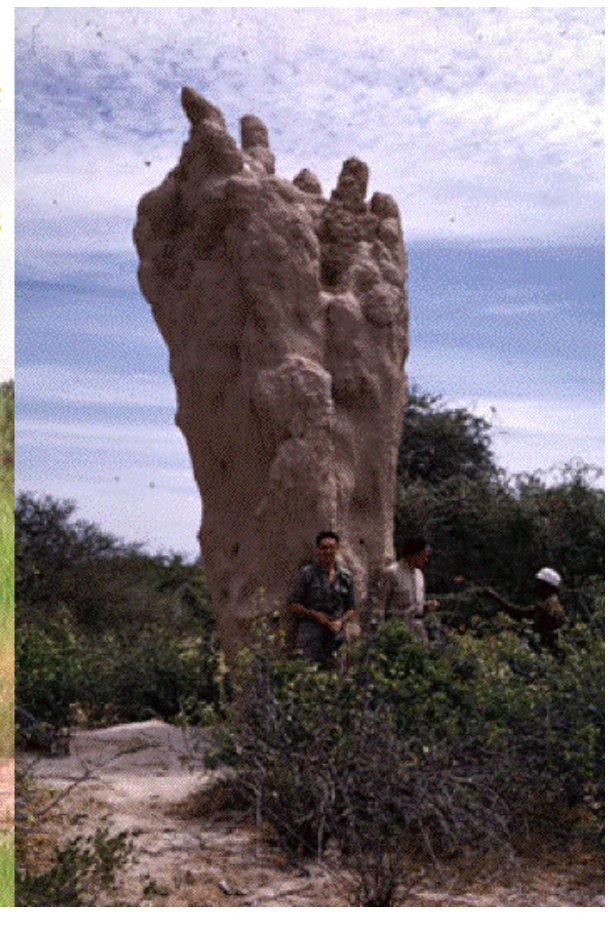


This is the scariest graph that you're ever going to see in your entire life -- take a good look at it. We hit six billion not very long ago and now we are at six and a half and we're still going, roaring. This kind of exponential population growth is unsustainable and has to stop. People sometimes ask "what is the carrying capacity for humans?" As I stated earlier, humans now occupy roughly half of Earth's land surface, consuming over half the freshwater and using about half Earth's primary productivity. However, lots of those people are living in poverty and not even getting adequate nutrition. Many are just little babies, still living under their parent's roof, who in a couple of decades, will need their own houses and cars. A tidal wave of humanity is coming. No politician will even recognize, let alone

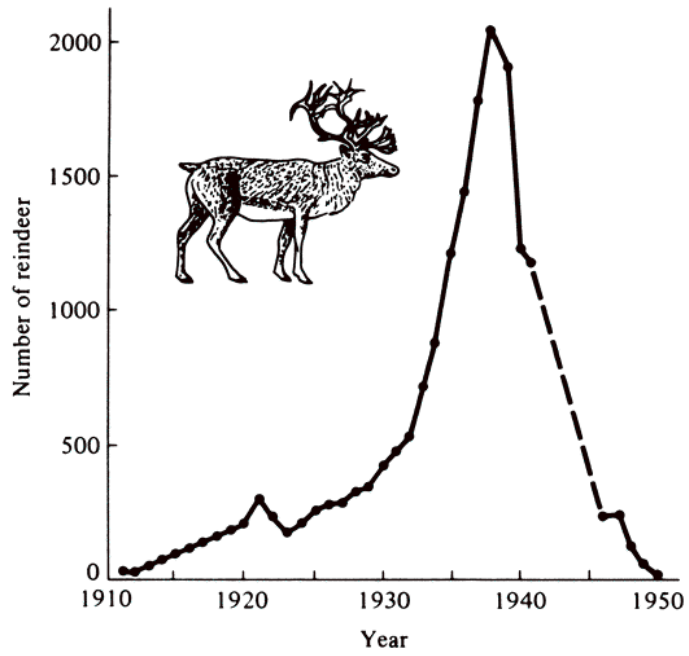
address, this enormous problem.

Now I'm going to try to convince you that human populations must be reduced. Paul Ehrlich, in the 1960s, wrote a nice little book, "The Population Bomb," calling attention to this. Nobody paid much attention to Ehrlich (1968). Even today, I hear people saying, "Oh, I've heard you doomsday ecologists before. We've still got water, there's no problem." They're so short-sighted.

Consider China. How would you like to live there? Look at all those little window A/Cs. They've got power, at least for now. Humans can really be packed in. Do you want to live like a termite? Are we termites? Come on, I want to be up on top of the hill where that chair is and I want to have some space around me -- don't you? It's a matter of quality versus quantity of human life.



People are in a state of denial -- they simply don't want to confront reality. We still allow people to have more than two kids. We actually encourage reproduction. You get a deduction for having kids. You should have to pay more taxes when you have your first kid. When you have your second kid you pay a lot more taxes, and when you have your third kid you don't get anything back, they take it all. Our tax system is completely backwards. But, then, so is our whole insane grow-grow-grow economic system. Earth and her resources are finite.



The U.S. Fish and Wildlife released caribou on the islands off of Alaska to help the Eskimos, the Aleuts, get protein. Herds from these islands grew exponentially just like the human population's been growing for quite a few years until they ate everything they could eat and then the deer populations crashed (Scheffer, 1951).

This is what's going to happen to us. This is going to happen in your lifetime. Does that look like fun? Do you want to go there? You've already gone there. We have waited too long.

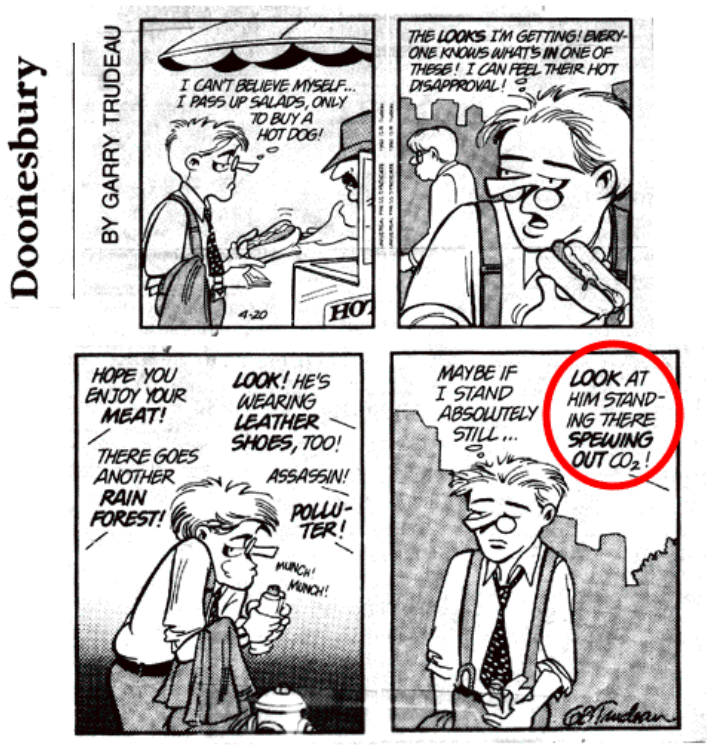
Cartoonists have had a lot of fun with this.

A check list from Genesis. I,28.

- [x] Be fruitful, and multiply,
- [ ] and replenish the earth,
- [x] and subdue it:
- [x] and have dominion over the fish of the sea,
- [x] and over the fowl of the air,
- [x] and over every living thing that moveth upon the earth.

Consider Genesis. We've checked all the boxes, except one. We have dominion over the fish and the fowl and everything that moves on this earth but we forgot, forgot to replenish it. We just shriveled it up like that little dried up raisin at the bottom -- we're sucking everything we can out of mother Earth and turning it into fat human biomass.

Then, there's this Doomsday cartoon:



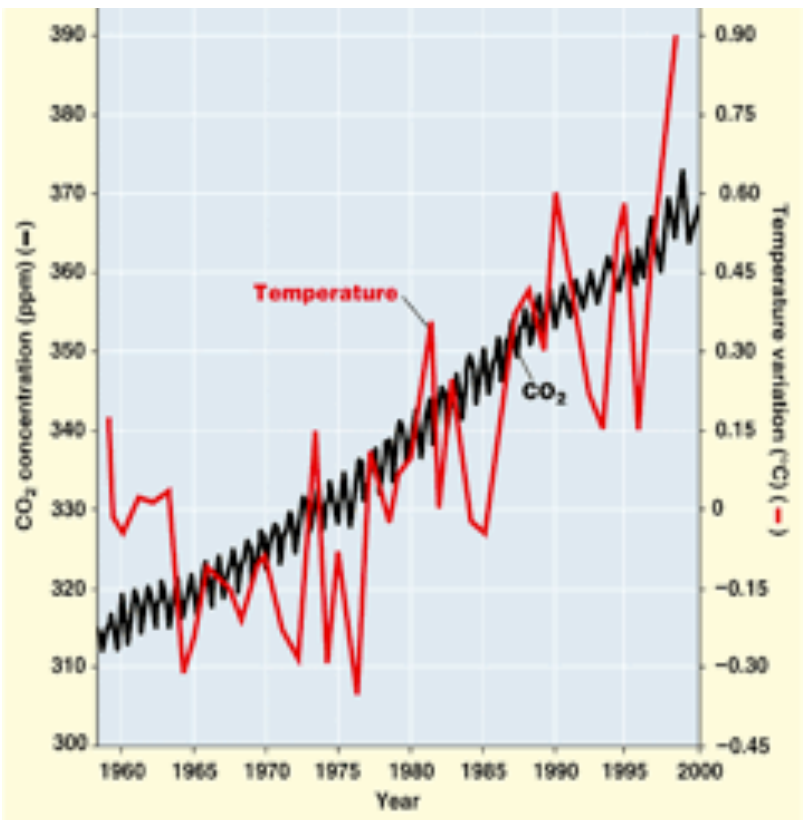
"I can't believe myself . . . I pass up salads, only to buy a hotdog!

The looks I'm getting -- everyone knows what's in one of these! I can feel their hot disapproval!

Hope you enjoy your meat! There goes another rainforest! Look, he's wearing leather shoes, too! Assassin. Polluter!

Maybe if I stand absolutely still. Look at him standing there spewing out CO_2!"

Everyone of us is guilty -- everything we do, every breath you take, every time you take a shower or flush the toilet, every time you drive your car, every time you buy anything we all contribute to the mess of pollution on this earth. In many cases you don't even know what you're doing.



Carbon dioxide is turning out to be a big thing that could really spell out our demise sooner maybe than many people think or realize. Big oil and governments don't want you to know about this. CO_2 has risen steadily to almost double normal levels due to our burning fossil fuels and cutting down and burning up forests. This has caused global warming, and it's changing Earth's climates -- some even speculate that it might be affecting things like earthquakes and hurricanes. Of course, the more humans you pack in on the surface of the earth, the more such events are going to decimate human populations.

Warming stresses ecosystems

- Coral reefs, tundra, Arctic

But, I'm a little more concerned about animals like polar bears. Polar bears are big, warm and fuzzy -- the WWF cares about them, and everybody thinks polar bears are nice and it would be a shame to lose them. Polar bears require ice and ice floes. They're arctic adapted animals, and as the ice floes melt, some people are thinking that it might be the end of polar bears.

And, of course, those of you that haven't thought about this will say, "Oh, we'll just keep them in zoos with the air conditioning turned way down." Let me remind you that they are not wild polar bears; they are like the words "love" trapped in senseless little vials.

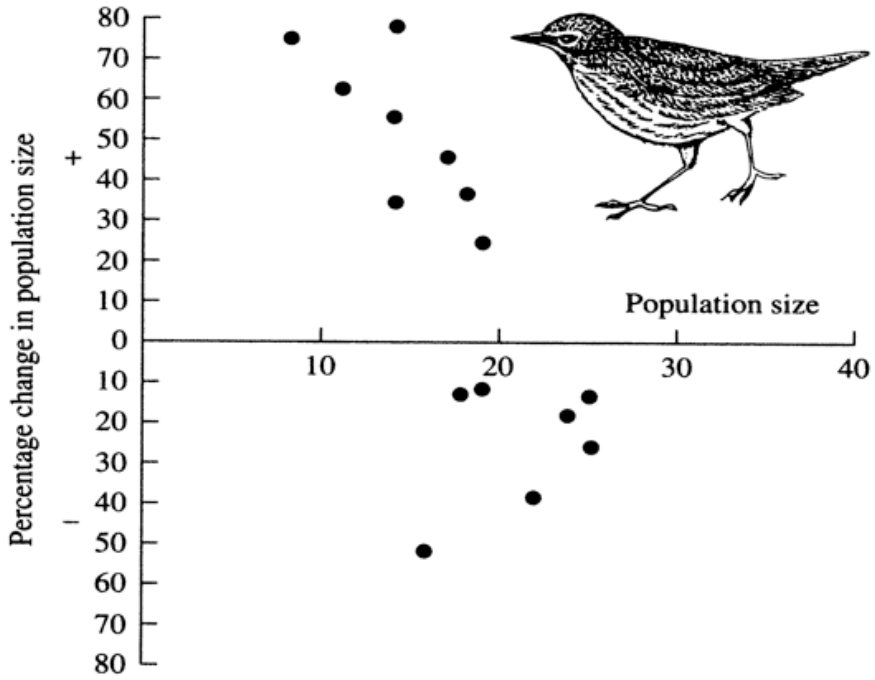
So, global climate is changing, and I come back now to Paul Ehrlich. I said this was going to go down, down, down and I meant it.

Ehrlich in the 1960s said, if humans don't have the political will to control their own population, microbes will control our populations for us. Now I want to remind you of 1300 AD when the "black death" swept down from China and one-third of the world's population died.

We killed off an awful lot of indigenous new-world people with smallpox and measles. These were things that white humans in Europe were adapted to because we lived with them, but the people that made it across the Bering Strait could not cope and a lot of those nasty microbes because of that. We're going to see this again, but on a much bigger scale. Humans have been very very lucky not to have experienced a worldwide plague for a long time, and one is overdue.

Surrealistic Painting of industrialized man
(compliments of END.CIV http://www.submedia.tv/endciv-2011/)

Microbes are small, and they reproduce very rapidly -- they have generation times measured in minutes or less. They also evolve really quickly, and we simply cannot keep up with them. We are doomed. The microbes are going to get us. We are a great big emerging substrate just waiting for microbes to grow on us. And even though we are still *Homo sapiens* -- *sapiens* means "smart" -- I'd say we're not. I'd say we're dumb because we're letting our population grow just like bacteria grow on an agar plate until they've reached the limits and used up everything; and that's dumb. Humans are no better than bacteria, in fact, we are just like them when it comes to using up resources. We need to use our brains to ease into a sustainable existence, rather than merely breed our brains out.



So, to try to convince you that populations are regulated, I want to show you this plot -- a plot of the percentage change in population size versus population density. When populations are large, they tend to decrease and when populations are small they tend to increase. If the slope of a regression line through those data points is negative, populations are controlled through population regulation.

Frequencies of Positive and Negative Correlations Between Percentage Change in Density and Population Density for a Variety of Populations in Different Animal Groups

	Numbers of Populations in Various Categories					
Taxon	Positive (P<.05)	Positive (Not sig.)	Negative (Not sig.)	Negative (P<.10)	Negative (P < .05)	Total
Inverts	0	0	0	0	4	4
Insects	0	0	7	1	7	15
Fish	0	1	2	0	4	7
Birds	0	2	32	16	43	93
Mammals	1*	0	4	1	13	19
Totals	1*	3	45	18	71	138

* ***Homo sapiens***

That plot was just one example. The table above summarizes a hundred-plus others. Most of these studies were done with birds. Birds have been well studied, but a few invertebrates are also included. To the right you see significantly negative regressions, like the one I just showed you, to the left are positive ones. The vast majority are negative, and half of them are significantly negative.

There is just one conspicuous exception -- far, far off to the left -- one species among these one hundred and thirty-eight thinks it can violate the rules of the natural world and that it can grow indefinitely -- humans think they are so smart that they can defy the rules. We are *Homo* the *sap*, not *sapiens* (stupid, not smart).

The Web is such a wonderful place. I thought, what would really jostle the audience? And I thought of the Four Horsemen of the Apocalypse, and so I typed that in -- somebody spent days painting this for us.

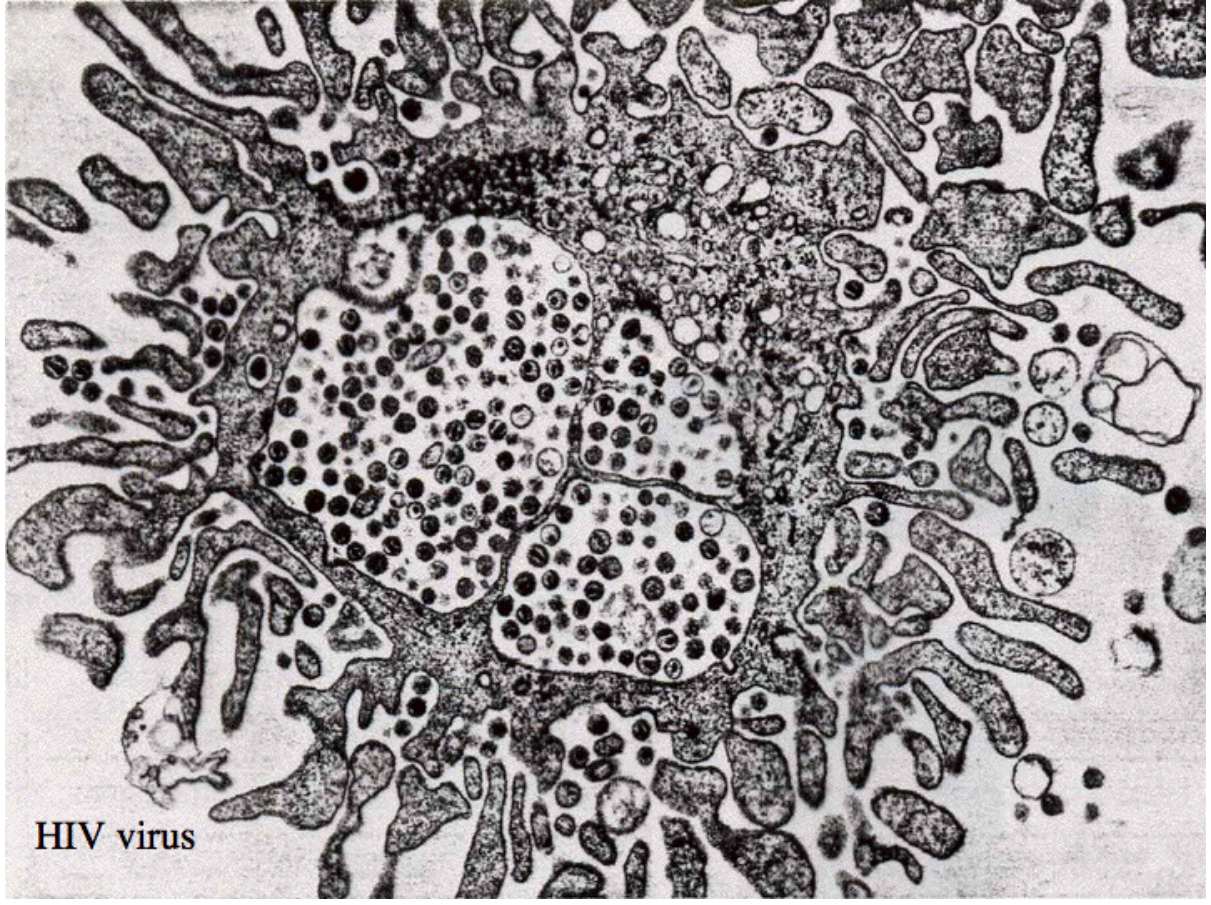
The Four Horsemen of the Apocalypse

Conquest War Famine **Death**

That's Conquest in front, then War, Famine, with Death bringing up the rear. If humans don't go out in a blaze of nuclear holocaust, or starve in a massive famine, death by a lethal pandemic seems a likely prospect.

Then I typed in "skull" and got this, complete with flashing red eyes. Great, eh? Death awaits us all.

Think about everything I've said and more.



This is an AIDS-infected T-cell of a human. Each of those little round things is an HIV virion that can infect a new human. Basically, this virus uses our T-cells as factories to make copies of itself. HIV is a pandemic spread worldwide. It's increasing in frequency in a lot of places and it's a big concern to everybody. But, it's not going to be the one that gets us because HIV acts too slowly, it lets us live several years while it passes itself on to new hosts. HIV works too slowly to control human populations.

Ebola zaire

Ebola reston

Now let's consider some other viruses -- *Ebola zaire*has potential. It kills nine out of ten humans, and quickly, within a few days. It's never gotten out of Africa because it is so virulent it kills everybody before they can move. You can only catch *Ebola zaire* by direct contact with a human who is infected. It causes you to bleed. It breaks capillaries and you bleed out your orifices and if you touch somebody who's sick with it you get it and you die, too -- nine times out of ten.

Another variety of *Ebola*, *Ebola reston* did get out of Africa and into the U.S. in the form of green monkeys imported for medical research -- it's named after Reston, West Virginia where there is a quarantine facility for these monkeys. All the monkeys died in an epidemic without any contact with each other. The monkeys were sharing a common ventilation system in a room, with recirculating air. All the monkeys in that room that breathed the same air caught the virus and died. It was airborne

transmission between hosts. Luckily for us, *Ebola reston* doesn't infect humans.

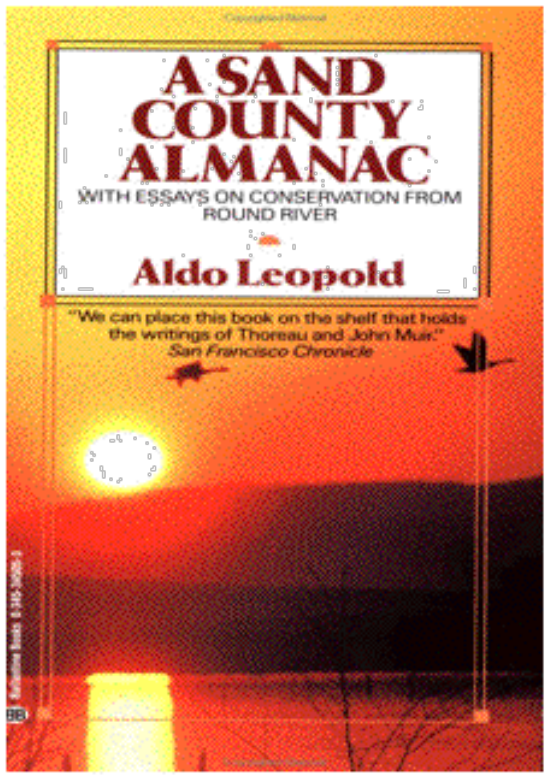
Now it is only a matter of time until *Ebola zaire*evolves and mutates a little, it will eventually become airborne, and then we might finally see it spread. And if and when it finally does, it will sweep around the world -- we're going to have a lot of dead people. Every one of you lucky enough to survive will get to bury nine. Think about that. If it isn't *Ebola* that gets us, another virus will (Nee, 2005).

Did you ever wonder why things like SARS and now the Avian Flu are continually cropping up? They're arising because we were dumb enough to make a perfect epidemiological substrate for an epidemic. Instead of using our brains to keep our one and only spaceship habitable, we bred our brains out and destroyed its life support systems, and now we're going to have to pay for it. The microbes are going to take over. They're going to control us again as they have in the past. Think about that.

Humans could have been stewards of Earth and all its many denizens, microbes, plants, fungi, and animals. We have the ability to have been God-like. Instead, for a short-sighted and selfish transient population boom, we became the scourge of the planet. We wiped out and usurped vast tracts of natural habitat. We ate any other species that was edible and depleted Earth's multitude of natural resources. In a single century, humans burned and wasted fossil fuels that took millions of years to form. We fouled the atmosphere, polluted the waters, and damaged all of our one and only Spaceship's life support systems. The disparity between what humans could have been versus the pitiful creatures we actually managed to become is tragic and unforgivable. If only more people would live up to their full potential!

Part Two

Now, here's a breath of fresh air: Aldo Leopold (1949). This is the start of the tiny little up. We've been to the lowest of the low where the microbes are going to get us. Now, I'm going to try to be a little bit more optimistic. Aldo Leopold was one of the first conservation biologists. He was in wildlife management at the University of Wisconsin back in the 1950s. Leopold died young, but his children have put together a collection of his essays into a small book, "A Sand County Almanac." I encourage all of you to read it. Some of the things he describes in this little book bring tears to my eyes. I mean I literally break down and weep.



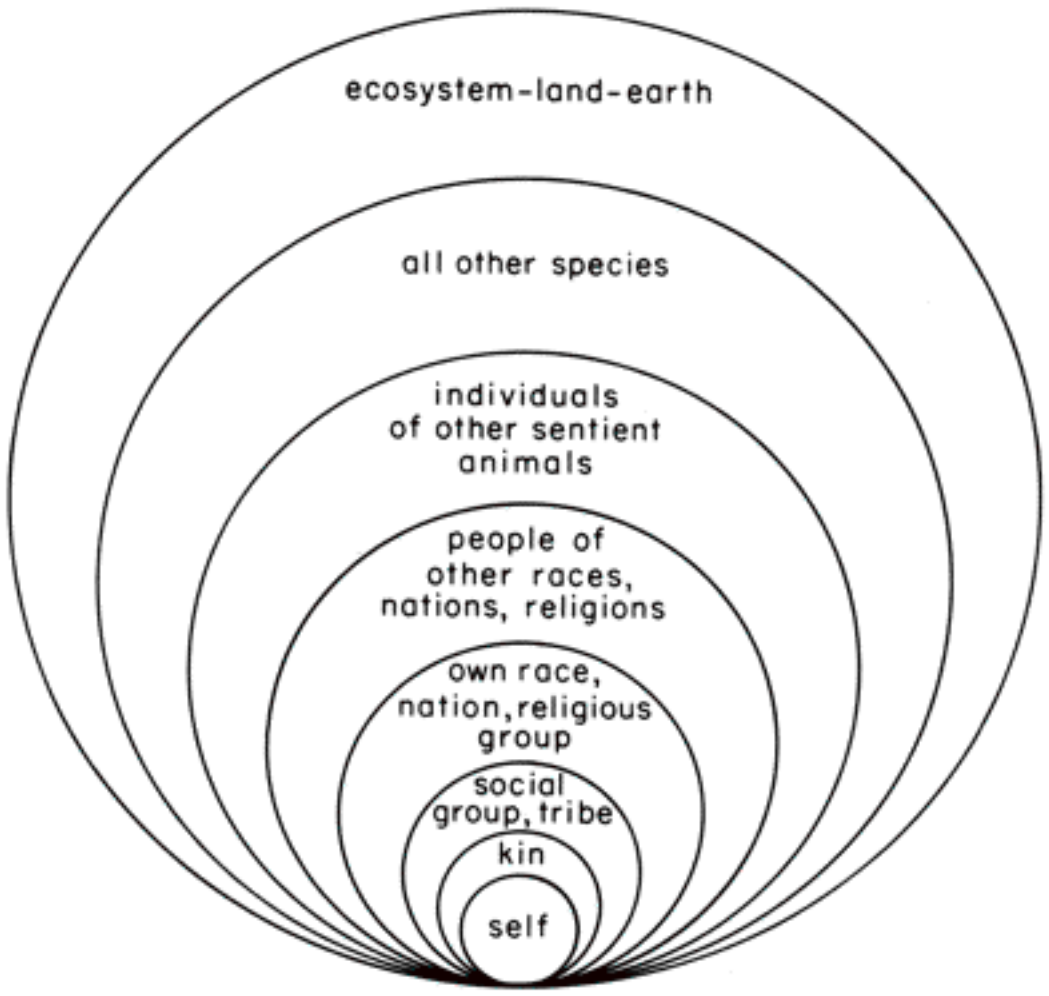
Aldo Leopold:

"A land ethic changes the role of *Homo sapiens* from conqueror of the land community to plain member and citizen of it. It implies respect for his fellow-members and also respect for the community as such."

One of the profound things Aldo Leopold said was that each generation doesn't even know what has been lost -- only previous generations remember. "Perhaps our grandsons, having never seen a wild river, will never miss the chance to set a canoe in singing waters."

When I was a boy, I could walk out my back door to a semi-pristine creek and catch snakes and lizards. Kids these days simply don't have that opportunity. There aren't any pristine creeks anymore and they're living in cities, and that's unfortunate. I became a biologist largely because of my exposure to wild animals when I was young.

One of Leopold's statements was that we cannot continue to act as conquerors -- we weren't given some God-given right to do anything we want like chop down redwood trees -- we must have respect for fellow inhabitants of this earth. We need to transcend anthropocentrism. Other Earthlings have a right to this planet, too.



AN ETHICAL SEQUENCE

An Ethical Sequence (see Leopold 1949; Nash 1989). The sequence portrayed as a nested hierarchy to emphasize that concern for higher levels is an extension, not a replacement, of traditional ethical concern for lower levels. The ecosystem-land-Earth is equivalent to a broader, ecological self (A still broader concern, for the universe or cosmos, is philosophically attractive but of less relevance to conservation and could diffuse concern for Earth.)

This figure is from a conservation biology textbook, it's very appropriate these days. Once we lived in small little tribes in caves -- cave men kept around a few elders for their wisdom -- because they had lived through droughts and solved other problems. For example, old guys might know how to treat a broken leg or some illness. And, of course, medicine men and women specialized in such information.

At the end of the Pleistocene, just 10,000 years ago, only about 500 generations before now, humans were hunter/gatherers, living off the land in small bands or tribes. We had no electricity, no cars, and no supermarkets, let alone fast food joints. We did not live in houses, but found refuge in caves and crude shelters. We hunted animals with spears, bows and arrows, and nooses. We caught fish with crude nets and fish hooks made from sharp pieces of bone. We gathered nuts and berries. We used sinew as twine and made our own ropes. We had no jeans or shirts, underwear, or toilet paper -- we clothed ourselves in animal skins and furs, and wiped ourselves with leaves. We had no television but sat around campfires telling one another stories and passing on vital information from one generation to the next (this was the origin of human knowledge). Survival through a winter in the temperate zones was no easy feat under such conditions, requiring substantial advanced preparation and food storage, as well as no small amount of good luck.

Tribes probably defended territories against other small bands of humans, but must have occasionally exchanged members. Our primitive hunter/gatherer ancestors must have enjoyed a good life during times of plenty in spring and summer when food supplies were bountiful. There was limited "ownership" of such resources, and people could help themselves to whatever they could find. Money had not yet been invented and food was essentially free for the taking. Many fewer humans dwelled on Earth then, and the planet could easily supply their needs.

Things are very different today -- demand for limited resources now greatly exceeds supply, and virtually everything is claimed as "owned" by someone else. As their populations burgeoned, humans invented agriculture and money, and made the transition from being cave men and women to modern civilized urbanites quite rapidly. Many of our behaviors and instincts, once suitable for a caveman's existence, such as greed and revenge, became anachronous, even dangerous.

We lived in little inbred groups and occasionally people would move between caves but these family groups were little tribes that battled over resources. That's at the bottom of this figure. We're all familiar with selfish behavior in those small circles at the bottom. We're all selfish and natural selection favors selfish behavior. You can be altruistic towards your kin, as long as they share genes that are identical by descent.

Cavemen tribes prospered, but now as we expand outwards to less closely related individuals and to larger social groups, finally to races or entire nations, altruistic behavior vanishes.

Look at the polarization in America today -- 50 percent one way and 50 percent the other. We are not doing very well at cooperating as we go outside of that tiny circle to larger and larger domains such as dealing with people in other nations with different belief systems. We need to engage in dialogue and communicate and change each other's minds. All of us need to consider the health of the entire Spaceship Earth.

Going still farther out, you get to individuals of other sentient species. Here I'm thinking of chimpanzees, gorillas and orangutans. They're our closest relatives. They share our blood groups. They probably can think. If one of those species had been the lucky one to inherit the earth and evolve the big brain and take control over everything else, how they would be treating us? We might be in cages -- they'd be using us for medical experiments and eating humans like we now eat gorilla "bush meat" in Africa. Think about that.

Actually this goes beyond gorillas and apes to the entire earth. Humans need to become responsible

stewards of this planet rather than remain mere conquerors and rapists.

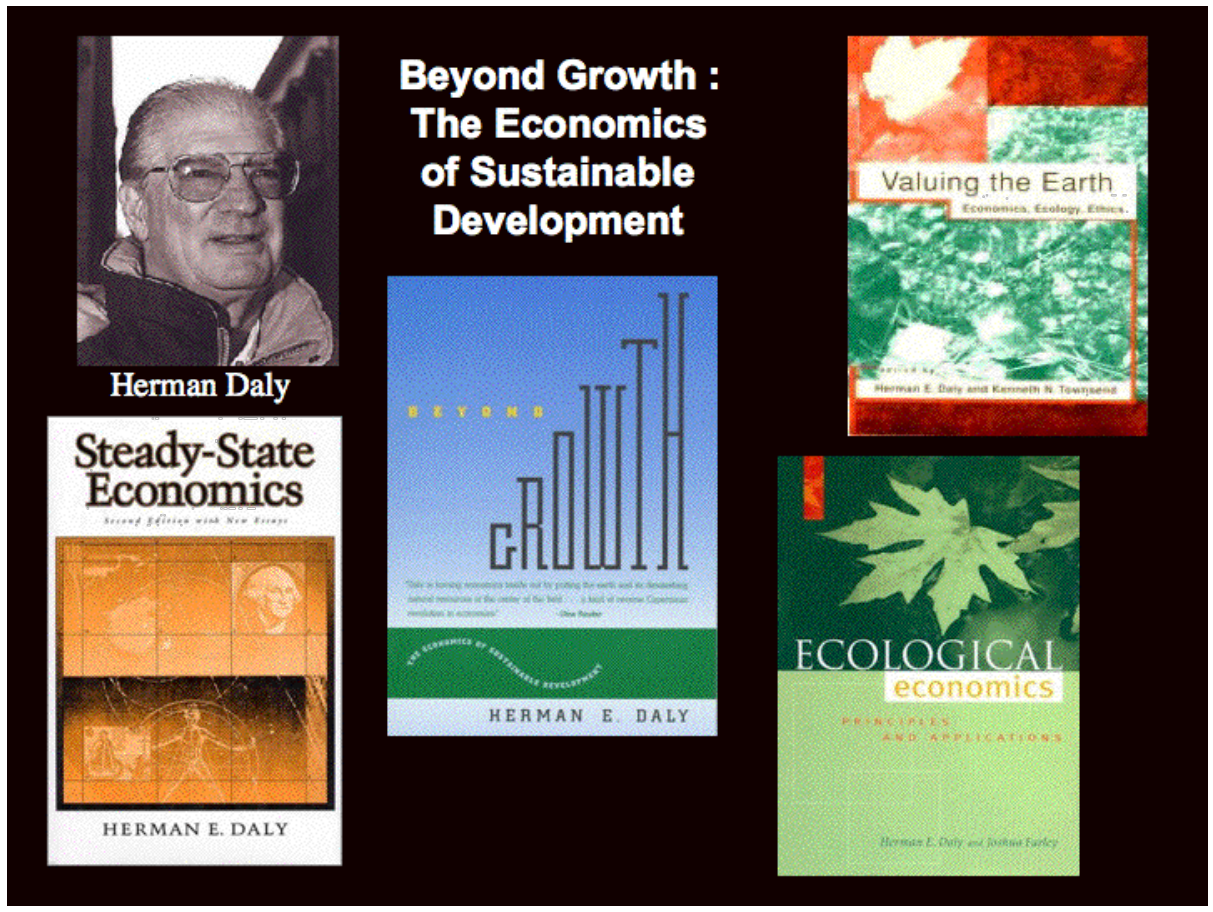
Here's one more little upbeat thing, but unfortunately this isn't very much of an up, Herman Daly has identified the big problem, which is our economy. It's basically completely flawed. You've heard politicians talk about "growing the economy." Our economy is based on the principle of a chain letter, a pyramid scheme. That simply cannot work. Upside down pyramids must fall over. Bubbles always burst and this bubble is bursting.

It's bursting right now in terms of fossil fuels. The price of gasoline isn't going to go down again. Some greedy oil men are getting very rich from peak oil. We have institutionalized greed in the form of limited liability offshore corporations -- if we do not control runaway greed, it will destroy us all.

You need to hone your survival skills. On your way home tonight, stop and get a real tarp, one that's made out of waterproof canvas. Don't get one of those crummy plastic ones -- they deteriorate too fast. Start packing it with the absolute necessities you must have to stay alive. These would include things like needles and thread, a blanket, some sharp knives, pliers and wire, water containers, some string, rope, and twine, among other things.

I'm not talking toothpaste. I'm not talking about a lot of things. Wrap them up and figure out how you can carry it on your own two shoulders because you are not going to be able to take public transport or drive your car when civilization finally collapses. You will need to get as far away as you can from any other human beings because they will take your stuff away from you. Try to snare a rabbit, if there is still a rabbit out there to catch. And, when you catch that rabbit, skin it and tan its hide (learn how to use tannins to tan hides -- soon you'll be wearing one!)

Our economic system based on continual growth must be replaced by a sustainable system where each of us leaves the planet in the same condition that it was in before we were born. This will require many fewer of us and much less extravagant life styles. We won't be able to move around so freely (airplanes will become a thing of the past) and we will have to go back to walking and riding horses. In addition, humans will have to be more spread out, living without big cities. Before it is all over, we are going to have to limit our own reproduction, un-invent money, control human greed, revert back to trade and barter, and grow our own crops, among other things.



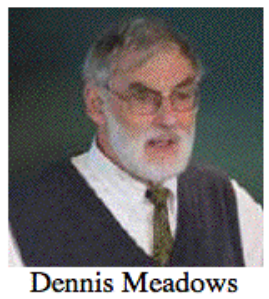
Let's get back to Herman Daly. He wants us to live in a sustainable world, and he has the idea of an equilibrium economy. Solzhenitsyn (1974) had the same idea. In an equilibrium economy, every one of us would leave this earth in exactly the same shape it was when we came into it. None of us are doing that. None of us.

Mainstream economists think Daly is some kind of a nut, they just ignore him. The economists that advise our political figures have relied completely on grow, grow, growthmania -- impossible voodoo economics. They place no value on wilderness and actually assume that resources are infinite! Read Nadeau's "The Economist has No Clothes".

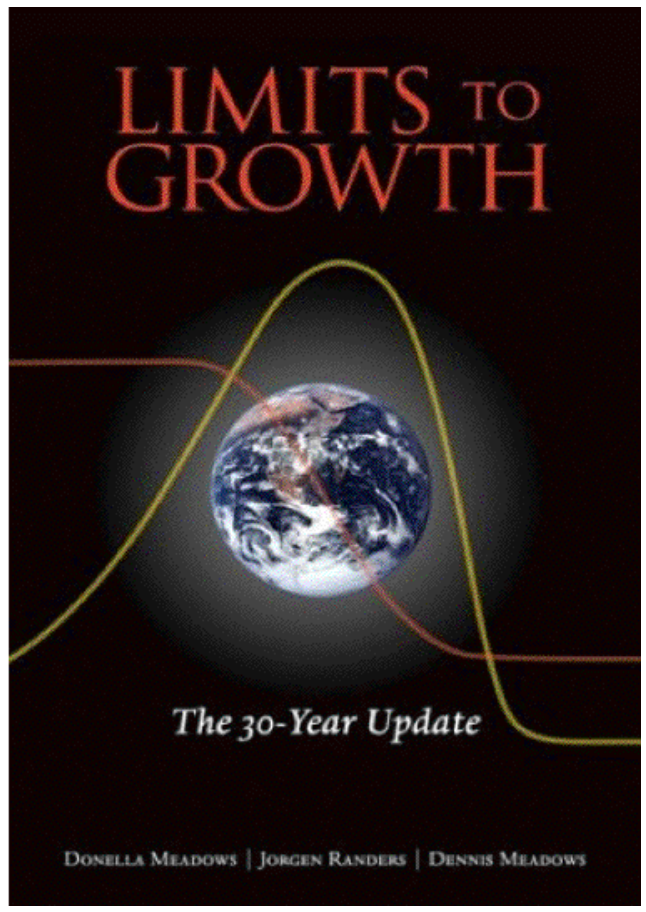
So, if you have a leaning towards economics, here's a challenge for you. Economics must be reinvented. Herman Daly published four books on equilibrium, or sustainable, economics. Others must join him. People must stop denying reality and ***think***. They can't just keep behaving like sheep thinking resources are ever expanding. We've got to realize that per capita shares of resources are ever contracting, and we're running out of everything that matters -- oil, food, land, clean air and water.

Donella Meadows

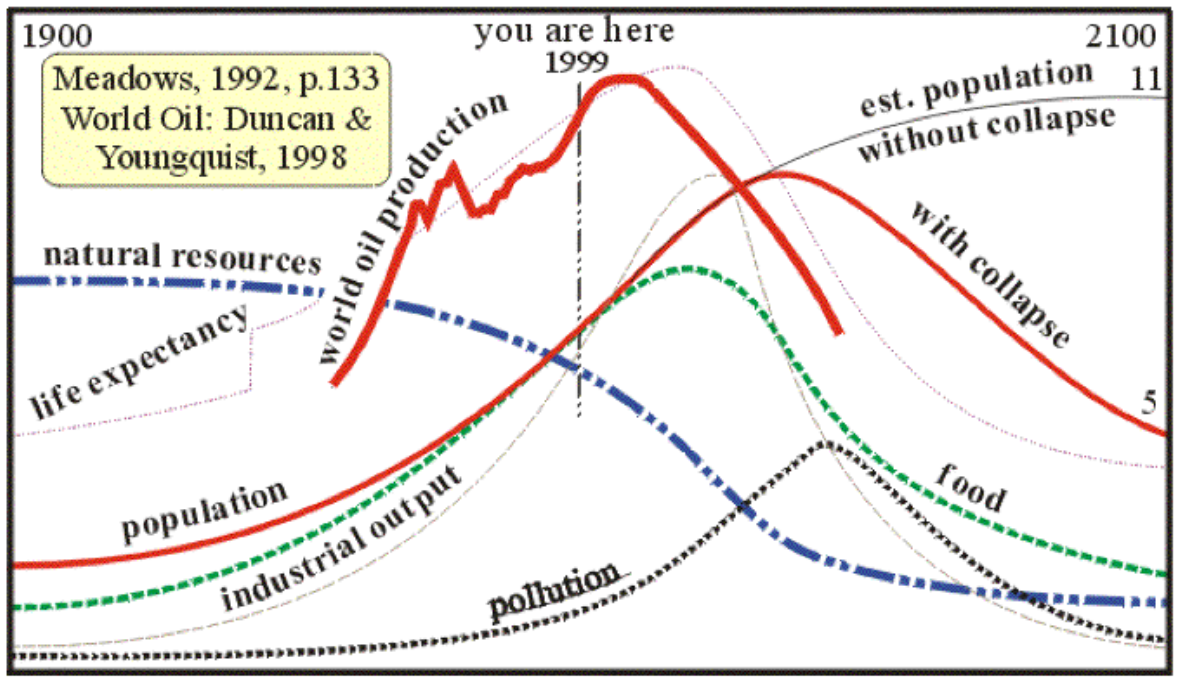
Jorgen Randers



Dennis Meadows



Meadows et al. wrote a book on some of this, actually, three versions. The first one was commissioned by some people concerned about the environment back in the 1970s. Dennis Meadows was the first author and it was called "Limits to Growth" -- they developed a systems model for the earth and its resources and how many people the planet can support. They worked through various scenarios including unlimited technology and many other things. Of course, big oil and some fools still claim that we will keep finding new supplies of oil and keep on going. I cannot understand people who refuse to face the fact that the world is finite.



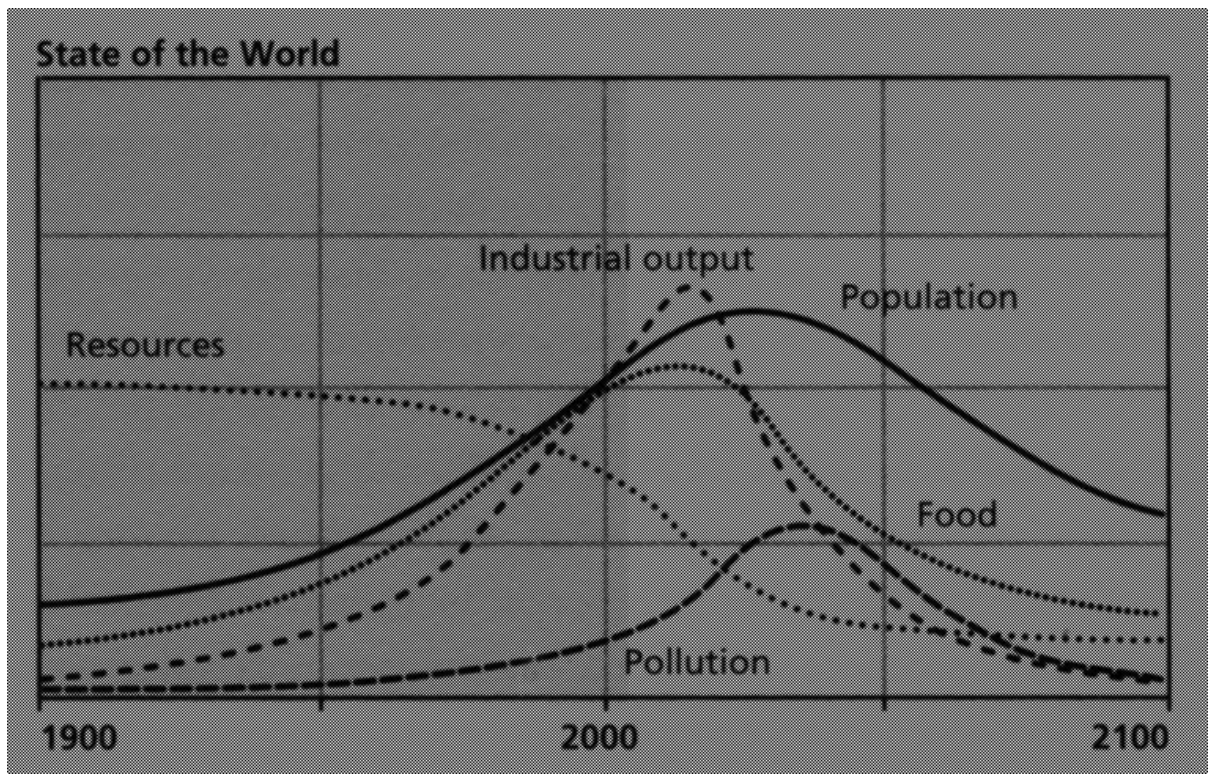
Notice the estimated population curve with a collapse -- things are going to get better after the collapse because humans won't be able to decimate the Earth so much. And, I actually think the world will be much better off when only 10 or 20 percent of us are left. It will give wildlife a chance to recover -- we won't need conservation biologists anymore. Things are going to get better for the other denizens of Earth as they deteriorate for humans.

Technology lures us out on to thin ice. I learned this years ago, when I got my first 4-wheel drive vehicle. Thinking that now I could go anywhere, I soon discovered that you get stuck using four wheels, too, but much worse than you can get stuck with two-wheel drive (a Land Rover stuck up to its axles in deep mud is sad to contemplate!).

Unlimited cheap clean energy, such as that so ardently hoped for in the concept of cold fusion, would actually be one of the worst things that could possibly befall humans. Such energy would enable well meaning but uninformed massive energy consumption and habitat destruction (i.e., mountains would be leveled, massive water canals would be dug, ocean water distilled, water would be pumped and deserts turned into green fields of crops). Human populations would grow even higher and the last vestiges of natural habitats would be destroyed. Heat dissipation would of course set limits, for when more heat is produced than can be dissipated, the resulting thermal pollution would quickly warm the atmosphere to the point that all life is threatened, perhaps the ultimate ecocatastrophe. Read the Weakest Link.

In 1972, Meadows basically said, we better do something fast. And, of course, like all of us who grew up in the 1960s, people were in denial and nobody paid any attention. We just kept breeding our brains

out and ignoring it. Then in 1992 they wrote a second book called "Beyond the Limits," in which they pointed out that we could never ease back into a sustainable society, that we had already gone too far in 1980.



Now it's 30 years later and, with his daughter, Donella, and Jorgen Randers, Meadows has put out "Limits to Growth -- The 30 year Update." This is quite a depressing book because in every scenario they run, humans must experience collapse. Collapses are worse in some scenarios than in others, but we must face all in the immediate future.

You are going to see it in your lifetime and the important thing is this is just the beginning, this peak oil/peak food problem we are experiencing right now. We aren't prepared for a what's coming and we cannot avoid it. The future is coming up on you fast -- if you are fortunate enough to survive, you are going to become a hunter-gatherer. Get prepared for that.

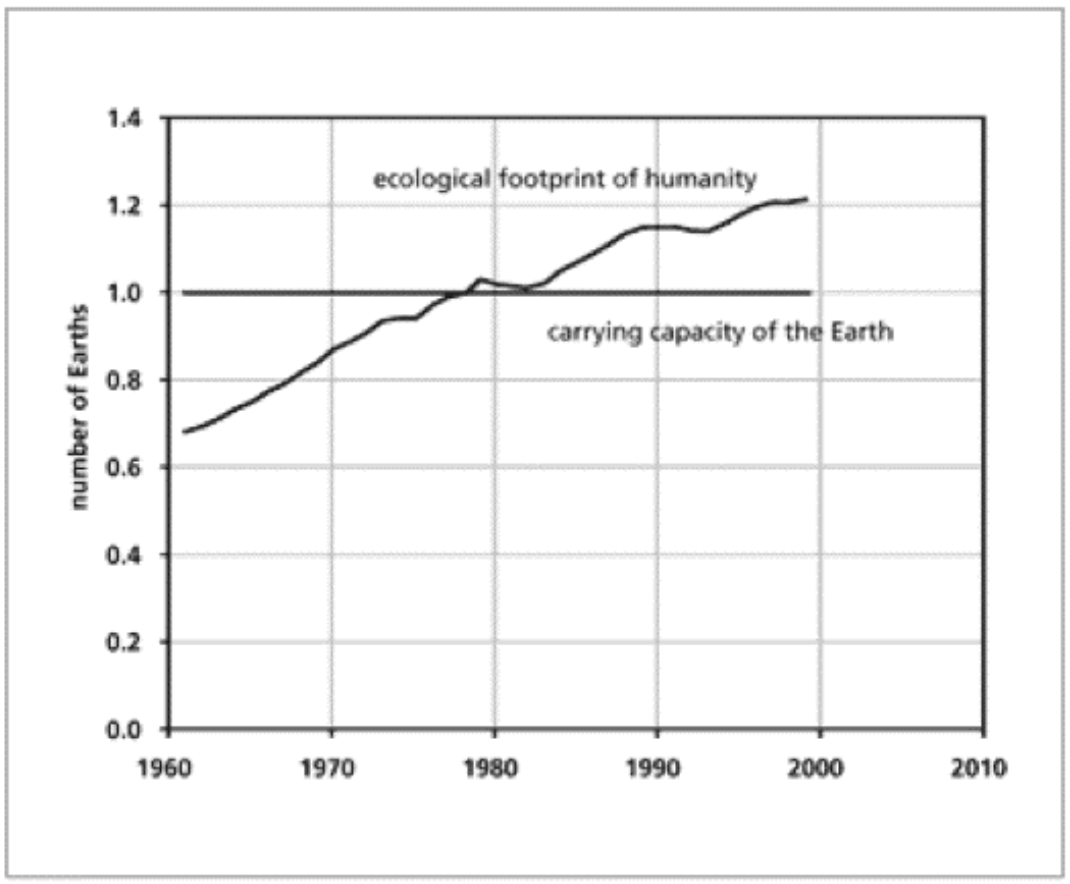
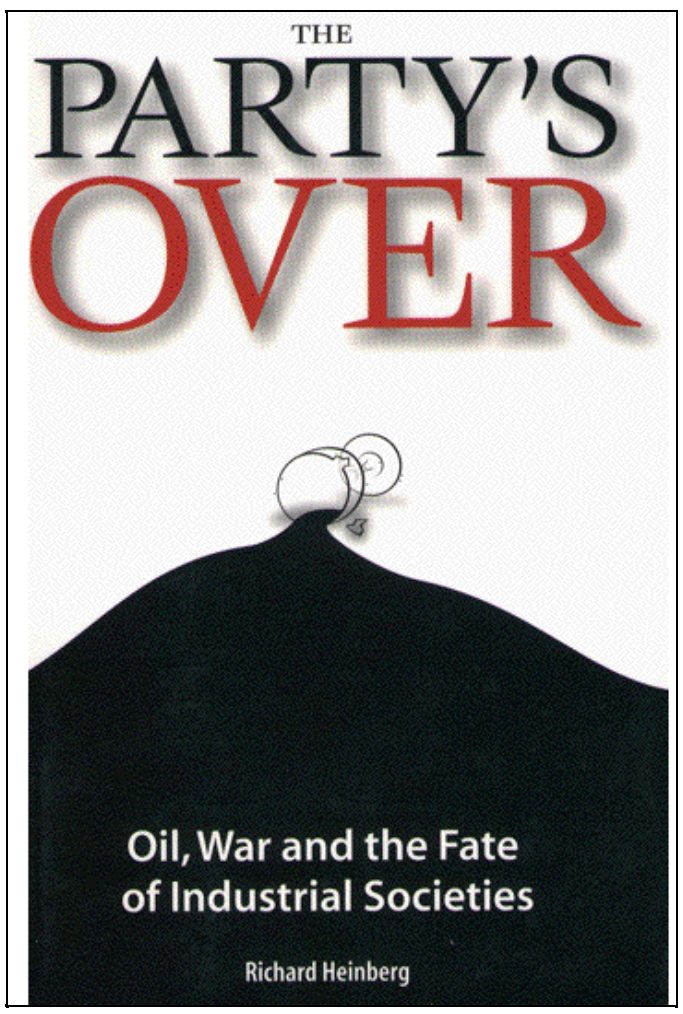


FIGURE P-1 Ecological Footprint versus Carrying Capacity
This graph shows the number of Earths required to provide the resources used by humanity and to absorb their emissions for each year since 1960. This human demand is compared with the available supply: our one planet Earth. Human demand exceeds nature's supply from the 1980s onward, overshooting it by some 20 percent in 1999. (Source: M. Wackernagel et al.)

Here's a graph comparing Earth's carrying capacity for humans to our human footprint: the horizontal dashed line is the carrying capacity and the solid black one represents resources used by our actual population -- you can see we crossed the maximum level about 1980, and in 1999 we were more than 20 percent above according to their estimate (it's probably at least 25% now).

This graph is overly optimistic because we could never have reached six-and-a-half billion without fossil fuels. Basically, we turned oil into food and food into humans, and we used the oil to build highways and cars and take over and make this mess -- the carbon dioxide pollution and all the rest. But now we're running out of fossil fuels and haven't invested enough in developing renewable resources, especially solar energy.

So this is really a very exciting time in the history of mankind. Remember that ancient Chinese curse: "May you live in interesting times"? Right now has got to be just about the most interesting time ever and you get to see it. Hopefully, a few of us will live through it.



I recommend Heinberg's "The Party's Over. Oil, War and the Fate of Industrial Societies" -- a chemist once told me, "it's like we were on a luxury liner and we're on the upper floor of the ship and there's a hole in it and it's sinking, but everybody's having a big party up here, and it's just a matter of time until we are all underwater." This is Heinberg's message -- he carefully researched all the facts. It's a doomsday book but he's an optimist so he has this optimistic end where he lays out what we can do, as individuals, if one is to live lightly on the land, you know, lessen your footprint -- drive a Prius instead of an Excursion -- it'll save you money -- ride a bicycle -- grow your own food. He has all kinds of good ideas. Unfortunately, even if you do all you can to minimize your own footprint on Earth, many others won't. Cleaning up the trash along highways merely makes things seem better and fosters litterbugs.

Educated people tend to have fewer children than uneducated people. Garret Hardin (1964, 1998) pointed this out, and said those who don't have any conscience about the Earth are going to inherit the planet, because those who don't care are leaving more progeny than those who do care and make fewer babies. And so human conscience is on its way out, if we persist on our present course, we're going to evolve into uncaring humanoids. That's probably already happening and cognitive abilities are falling for the same reasons, too (Herrnstein, 1989).

To conclude, I want to quote John Stuart Mill (1859) to point out that bright people have seen this coming for a long, long time:

> "I cannot . . . regard the stationary state of capital and wealth with the unaffected aversion so generally manifested towards it by political economists of the old school. I am inclined to believe that it would be, on the whole, a very considerable improvement on our present condition. I confess I am not charmed with the ideal of life held out by those who think that the normal state of human beings is that of struggling to get on; that the trampling, crushing, elbowing, and treading on each other's heels . . . are the most desirable lot of humankind . . . It is scarcely necessary to remark that a stationary condition of capital and population implies no stationary state of human improvement. There would be as much scope as ever for all kinds of mental culture and moral and social progress; as much room for improving the *Art of Living*, and much more likelihood of its being improved" (my italics).

Mill wrote that almost 150 years ago -- it's basically a statement about how a stationary world can be a good world. In a stationary world you don't have to worry about bubbles bursting, losing your stock, running out of oil, or survival kits. A stationary world is sustainable and the world stays the same from day to day.

We've got to reign in runaway greed -- we could live in a stationary world as opposed to one that's based on growthmania where everybody has to elbow the other guy and compete to get to the front and be concerned about who's going to win and who's going to lose every day in the stock market. In a stationary world, we can focus in on things that really matter -- I love Mill's phrase "the art of living." Let's get to work on improving the art of living.

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