

October 23, 2014



If I had a hammer

William H. Schlesinger

Adapted from a Presentation by William H. Schlesinger, President, The Cary Institute of Ecosystem Studies April 25, 2014, as the 5th Ned Ames Honorary Lecture Millbrook, NY

Currently, we are seeing that the behavior *Homo sapiens* is not really much different from the other species that occupy our planet. When overcrowded and with short resources, fighting, malnutrition and disease erupt. Self-centered, rather than group, behavior dominates. We listen to a few (economists and religious zealots) who promise that a better future awaits. We pursue our biological fitness and cannot talk about over-population as part of the problem. In the end a few will survive and most of the rest are extinguished. We are scarcely *sapiens*.

Herein, I want to hammer on four key points, which I call the horsemen of the apocalypse. Some of the view is science and some is personal opinion, I hope correctly informed by science. I'll try to offer some bright spots, but it is not pretty. No one said that scientists must make you feel good.

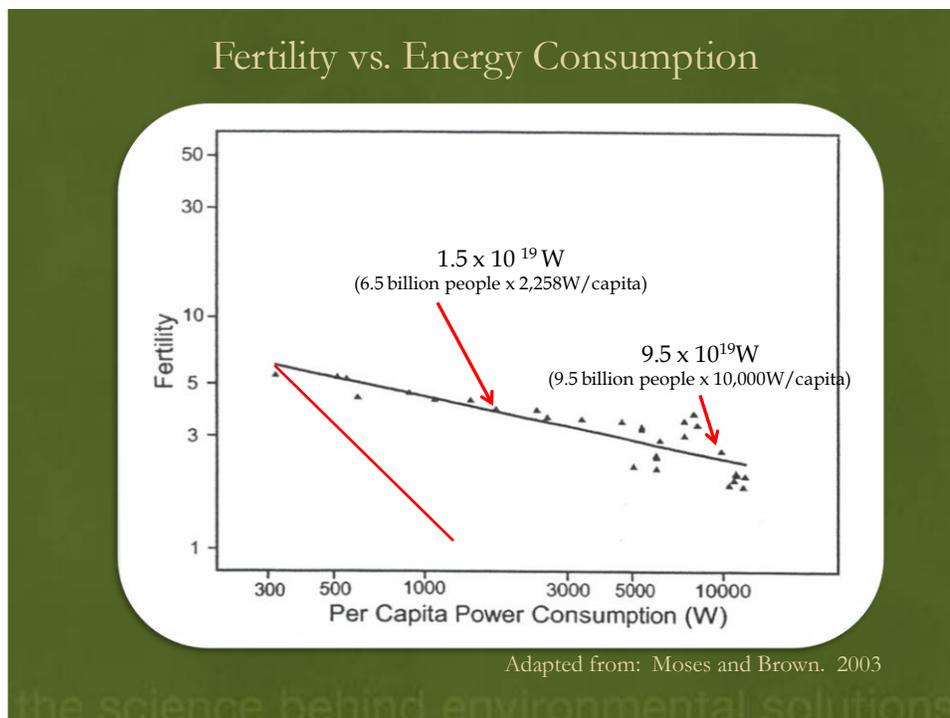
Still, there is time for us to make a difference, and I'll try to show the way.

My first Horseman echoes what Alan Weisman has said in his new book.¹ There is no question that the Earth's population is above the carrying capacity for our planet. The overshoot is manifest in the rising concentrations of CO₂ in Earth's atmosphere, the declining fisheries in its seas, and the loss of biodiversity in nearly all habitats we have studied well. There are too many of us, and we are fouling our nest.

¹ Alan Weisman. 2013. *Countdown*. Little Brown, New York.

I've heard it said that population is not part of the problem, and that the rate of population growth is going down. The latter is true, but just as a bathtub will fill more slowly when the rate of inflow declines from one to ½ gallon per minute, overflow it will. It's all a matter of time. Following our roots in Darwinian biology and the teachings of our religious traditions, we have done exceptionally well in multiplying our numbers. Studies of past human populations show some alarming oscillations, but they are superimposed on an unrelenting increase in population that is today exponential.²

I've also heard it said that the rate of population growth will naturally decline, as standards of living increase. That is also true, but the slope of the line is not nearly steep enough.³ Multiplying the human numbers by resource use all along this line shows that when global reproduction reaches the replacement level, we'll be using more than 6X the energy resources that we do today.



Fertility in the US dropped between 1850 and 2000 as a function of increasing power consumption (slope -0.31; $r^2 = 0.83$). Assuming the world follows a similar trend, total power consumption will increase by a factor of 6.3 as fertility drops from its current rate to the replacement rate. The red line shows the decline in fertility with power consumption that would be necessary to avoid an increase in total power usage.

One reason we don't talk about population is that family planning has gotten mixed up with troubling ancillary topics—abortion and immigration policy. We're going to have to get beyond our squeamishness about the population issue, because there is little doubt that all our current

² Turchin, P. 2009. Long-term population cycles in human societies. *Annals of the NY Academy of Science* 1162: 1-17.

³ Moses, M.E. and J.H. Brown. 2003. Allometry of human fertility and energy use. *Ecology Letters* 6: 295-300.

environmental problems are exacerbated by a rising number of people on the planet. As we see essential habitat in the developing world lost to its population growth and resource extraction, we will face a critical question regarding immigration to this country, where half of the land clearing is attributed to greater numbers. When will our lifeboat be too full?

Thus, we should ensure that every child is a wanted child and that women are empowered, recognizing that with fewer of us, the planet will offer a greater chance for better life. At all cost, we must preserve a woman's right to choose. Since *Roe vs. Wade*, 50,000,000 legal abortions have been performed in this country, equivalent to 15% of the current U.S. population. In the U.S., recent declines in the rate of abortion are linked to better and more widespread use of contraceptives.⁴ Even conservatives must agree that, done well, universal family planning services would largely make the abortion issue disappear. Now is the time to restore the U.S. support for family planning services at home and abroad, where Alan Weisman finds women desperately want fewer children.⁵

Of course, economists love population growth. Chevron's ad campaign endorses the arrival of 70,000,000 new citizens each year, perhaps looking forward to the number of new drivers that will join us on the highway. Growth in our local area means more toilets for plumbers to fix, more faces for doctors to lift, and more houses for developers to build. The rise in CO₂ over the past 150 years shows a tight correlation to rising human numbers over the same period.⁶ It is not rocket science to see that more of us will use more resources on the planet, unless all of us want to live in poverty.

The second horseman is economic growth itself. We need to revamp the mentality that growth is always good. Investors typically reward companies that promise growth; what's wrong with those who crank out a quality product year after year, to make a steady profit, with a pot for further research and development? In my own life, I have often found that bigger is not necessarily better—in laboratories, classrooms, and entire universities. We need to focus environmental economists on how to transition our society to steady-state economics, rather than to focus merely on how to maintain a culture of growth as resources become ever more limited. As Kenneth Boulding once put it: Anyone who believes that exponential growth can go on forever in a finite world is either a mad-man or an economist.

Recognizing that our population growth is exponential, economists will argue that unlike the well-known population of reindeer on an island off the coast of Alaska—where unchecked population growth led to the decline and collapse of the population and a denuding of the landscape⁷—humans have the ability to increase the size of the pie that is offered by planet Earth.⁸ True, we are now feeding way more people than would have been possible without the invention of artificial nitrogen fertilizer a century ago, but our production of nitrogen fertilizer fouls the air and water around us.⁹ The health costs associated with nitrogen fertilizer in the

⁴ Erik Eckholm, 2014. Abortions declining in U.S., study finds. *New York Times*, February 3, page A10.

⁵ Alan Weisman. 2013. *Countdown*. Little Brown, New York.

⁶ Hofmann, D.J., J.H. Butler, and P.P. Tans. 2008. A new look at atmospheric carbon dioxide. *Atmospheric Environment* 43: 2084-2086.

⁷ Klein, D.R. 1968. The introduction, increase, and crash of reindeer on St. Matthew Island. *Journal of Wildlife Management* 32: 350-367

⁸ Ridley, M. 2014. The Scarcity Fallacy. *Wall Street Journal*, April 26, p. C1-2

⁹ Smil, V. 2001. *Enriching the Earth*. MIT Press, Cambridge.

Midwest are thought to be equivalent to half the value of our agricultural exports.¹⁰ And, the production of nitrogen fertilizer comes with the use of fossil fuels—a finite resource that we spend more and more each year to find and extract.

Each year to sustain our numbers, we harvest the fossil fuel equivalent of 400 years of the Earth's primary (plant) production in the geologic past.¹¹ The fossil fuel pie is not getting larger; we are simply running down our store of captured sunbeams. Someday soon, solar power may allow us to enlarge the energy pie and perhaps even enlarge stores of freshwater by desalinization, but especially for the biodiversity of our planet, it seems clear to me that the resource pie will not be getting larger. As Mark Twain once said: "Buy land, they are not making any more of it." Judicious use and reuse of what we have will be essential, and fewer people will help.

You can see that my second horseman, economic growth, rides alongside the first horseman of population growth.

My third Horseman rides the wave of greed. Resource use is certainly not uniform across the peoples of the planet, but I can think of no more unpopular platform than to tell any group of voters they must get along with less. That's why I am no politician! As I compare the behavior of squirrels on my birdfeeder and the daily activities on Wall Street, I see that *Homo sapiens* has not freed itself from Darwinian self interest. We like large houses and large cars. We like more stuff, and we want to think that our kids will have even more stuff. And, when it snows in winter, we like salted roads, so our stuff gets to us fast. We don't seem to mind getting our stuff from overseas—exporting our environmental impacts—even as we deplore the loss of manufacturing jobs here at home. Five percent of total CO₂ emissions that can be attributed to the U.S economy are produced in China.¹² It is so easy to overlook environmental impact when as a shareholder or a customer, the impact is far away.

Darwinian behavior is manifest among the people who supply our stuff and don't like it when environmental science discovers problems with their current efforts. Witness the defense of atrazine, a billion dollar product line from Syngenta, in the face of its documented effects on the deformity of frogs, as so wonderfully outlined a few years ago by Tyrone Hayes.¹³ We've seen the same with leaded gasoline, phosphate detergents, neonicotinoid insecticides, and mountain-top removal mining. If we are really *Homo sapiens*, we should bring environmental science to the table for the *à priori* evaluation of products, rather than too late, when the full line of defense attorneys, fattened profits, and the Darwinian instinct of corporations take over. Indeed, I believe that the role of the corporation, which answers only to delivering profits its shareholders, needs to be reevaluated. And a corporate world without regulation is a direct road to the apocalypse.

¹⁰ Fabien, P, and Daniel J. Jacob. 2014. Hidden cost of U.S. agricultural exports: Particulate matter from ammonia emissions. *Environmental Science and Technology*

¹¹ Dukes, J.S. 2003. Burning of buried sunshine: Human consumption of ancient solar energy. *Climatic Change* 61: 31-44.

¹² Davis, S.J., G.P. Peters and K. Caldeira. 2010. The supply chain of CO₂ emissions. *Proceedings of the National Academy of Sciences* 107: 5687-5692.

¹³ Tyrone Hayes' battle with Syngenta is reviewed by Rachel Aviv in "A valuable reputation," in *The New Yorker*, February 10, 2014, pp. 52-63.

The arguments in nearly all environmental debates that I have tackled in the past couple of decades boil down to jobs versus environment. I see this along coastal Maine, where with the demise of cod, herring, sardines and scallops, fishermen now want to turn to scrape the brown algae from the rocks to sell as fertilizer and food and cosmetic additives. I hear it when the EPA is touted as the job-killing agency. I see it in Europe, where a roll-back of its admirable low-carbon emission targets has followed a soft economy. The greed of a few spoils life for many. The actions are local, but the impacts are increasingly global, crossing all boundaries and polluting the global commons. Those who argue that we should not interfere in the environmental affairs of sovereign nations remind me of the old story of two men in a rowboat. When one begins to drill a hole in the bottom of the boat and the other complains, his response is “shut up,” I’m drilling this hole under my own seat.

One-third of the rising CO₂ in Earth’s atmosphere is due to population growth vs. 2/3 to increasing resource use.¹⁴ Both contribute, so we must tackle both to reduce our impact on the biosphere. Human impacts on the movement of other chemical elements at the surface of the Earth are enormous. Along with a 36-fold increase in CO₂ mobilized to the atmosphere, we’ve caused a 12-fold increase the natural movement for phosphorus, 8X for nitrogen, 3X for mercury and 1.5X for sulfur.¹⁵ It is these enhancements that cause concern for the eutrophication of streams and lakes, the toxicity of Hg in fish, and the origins of acid rain. The movement of chemical substances at the surface of the Earth, as affected by life and particularly by humans, comprises the science of biogeochemistry.

Comparison of Biogeochemical Cycle to Anthropogenic Cycle (Flux in 10 ¹² g/yr)			
Element	Geological Flux	Anthropogenic Flux	Anthropogenic/Sedimentary
C	240	8700	36.3
N	25	221	8.8
P	2	25	12.5
S	80	130	1.6
Cl	262	170	0.65
Ca	620	65	0.10
Fe	7.5	1.1	0.14
Cu	0.10	1.5	14.3
Hg	0.0007	0.0023	3.3

¹⁴ In 2005 world energy usage was about 71 million BTU per capita or about 2258 W, for 6.5 billion people (Energy Information Agency, <http://www.eia.doe.gov/iea/wecbtu.html>, accessed 30 January 2008). If population were to stabilize at 9.5 billion, each using 10,000W, energy usage will have increased by a factor of nearly 6.3

¹⁵ William H. Schlesinger and Emily S. Bernhardt. 2013. *Biogeochemistry: An analysis of global change*. Elsevier.

When Gene Likens began his studies of acid rain in the eastern U.S., fully half of the acidity he encountered was due to human emissions of sulfur dioxide to the atmosphere. Looking backward, it seems surprising that some argued that this acidity would have no effect on nature. Indeed, I still hear that argument. Thank goodness wiser heads prevailed and the levels of sulfate and acidity in our rain are slowly returning to normal. We can make a difference when we want to.

I'm not running for office anytime soon. And my wife promises that she will immediately run to the press if I decide to. So, let me say that the best way to reduce our dependence on fossil fuels, will be to place a tax on carbon emissions to the atmosphere. It's simple, fair and effective. The Canadians will get the oil from the Alberta sand deposits whether or not we build the Keystone XL pipeline, but not if oil is priced unattractively versus other forms of energy in the global market. The same is true for every ton of coal from mountaintop removal in the Appalachians. Same is true of the Constitution pipeline in New York State and the production of natural gas by fracking. In each case, we need to treat the disease and not merely the symptoms. We need to tax the carbon release from these fuels and use the tax dollars to lower the tax rate on income and provide additional monies for R & D on alternative energy.

In sum, if we want to stop CO₂ emissions, we need to make carbon-based energy unattractive and stop the endless arguments about how to regulate how it's done. A carbon tax on energy simply asks the users to pay the full cost of the impacts of energy on the environment, upon which we all depend. We can be smart and proactive about this if we care to. Nothing will stimulate a domestic industry in alternative, renewable energy, more than higher prices for its product. As the popular slogan goes: the Stone Age did not end because we ran out of stones. We simply thought of something better.

My fourth horseman leaves a trail of diminished species diversity. Like Stuart Pimm, Tom Lovejoy and others, I'm a species person. Nevertheless, I am the first to admit that the track record of ecologists in showing the importance of species is poor. We seem to be doing all right without the passenger pigeon and the American chestnut. And, I don't expect the oceans to fall apart anytime soon without the blue-fin tuna.

Still, will a world without Woodcocks and Wood thrushes or the Humpback Chub and Black-footed Ferrets be as interesting as our world today? And, as popularized by Paul Ehrlich, who while thinking about removing rivets from an airplane, asked how will we know when we've lost the critical species—the rivet that holds the biosphere together.¹⁶

Tomorrow morning, if I were to go outside and shoot a wood thrush, I would be subject to severe penalties under the Migratory Bird Treaty. At some point, policy makers deemed such behavior was unacceptable. But, if as a land developer, I cut down a tree with a wood thrush nest full of young, there is no penalty; in fact, I am praised for stimulating economic growth. The laws are similarly silent on pollution of the global commons—our atmosphere. If power

¹⁶ Ehrlich, P. and A. Ehrlich. 1981. *Extinction: The Causes and Consequences of the Disappearance of Species*. Random House, New York

plants create acid rain which leaches calcium from the soil so wood thrushes can't make eggs¹⁷, or release CO₂ which changes the climate so wood thrushes can't nest, there is little notice.

Some 1/3 of the species on Earth are predicted to be lost as a result of climate change.¹⁸ Add to that the species that are lost in competition with exotic invaders, as documented by Dave Strayer, and as a result of loss of critical habitat, and we will be looking at an impoverished world. The satellite view of the Earth at night shows the extent of our impact on the planet.¹⁹ Dick Holmes long-term studies show a decline in the bird populations at Hubbard Brook.²⁰ If we like species, we need to preserve their habitat—on land and at sea. When birds are excluded from forests, insect damage rises and plant condition falls.²¹ Birds are not just pretty; they make a difference. Other species do as well. The science of ecology has numerous examples of higher productivity and greater stability in natural communities of greater species richness.²² A diversity of plant species lowers the loss of nitrate in soil drainage waters.²³ Unfortunately, I feel an increasing movement amongst our environmental organizations away from traditional conservation biology and towards the management of natural ecosystems solely for the benefit of humans, rather than nature. We should remember as Bobby Kennedy Jr. has said, when God asked Noah to take two of each species on board the ark, he meant two of *all* the species on Earth, not just those of immediate economic value.

So, my workbench has a hammer and some nails: reduce population and stabilize the human population by universal family planning and the empowerment of women; reduce resource use by taxing carbon-based fossil fuels and other resources to reflect their full impact on our environment; regulate and tax the inherent greed in our species, and preserve habitat for the species that share the planet with us. We can be *sapiens* if we care to be.

Embrace the blue planet.

MAHB-UTS Blogs are a joint venture between the University of Technology Sydney and the Millennium Alliance for Humanity and the Biosphere. Questions should be directed to joan@mahbonline.org

MAHB Blog: <http://mahb.stanford.edu/blog/if-i-had-a-hammer/>

¹⁷ Hames, R.S., K.V. Rosenberg, J.D. Lowe, S.E. Barker, and A.A. Dhondt. 2002. Adverse effects of acid rain on the distribution of the Wood Thrush *Hylocichla mustelina* in North America. *Proceedings of the National Academy of Sciences* 99: 11235-11240.

¹⁸ Thomas, et al. 2004. Extinction risk from climate change. *Nature* 427: 145-148.

¹⁹ http://eoimages.gsfc.nasa.gov/images/imagerecords/55000/55167/earth_lights.gif

²⁰ Holmes, R.T. 2007. Understanding population change in migratory songbirds: Long-term and experimental studies of Neotropical migrants in breeding and wintering areas. *Ibis* 149: doi 10.1111/j.1474-919x.2007.00685x.

²¹ Mantyla, E., T. Klemola and T. Laaksonen. 2011. Birds help plants: a meta-analysis of top-down trophic cascades caused by avian predators. *Oecologia* 165: 143-151.

²² Hooper, D.U. et al., 2012. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature* 486: 105-108.

²³ Tilman, D., D. Wedn, and J. Knops. 1996. Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature* 379: 718-720.