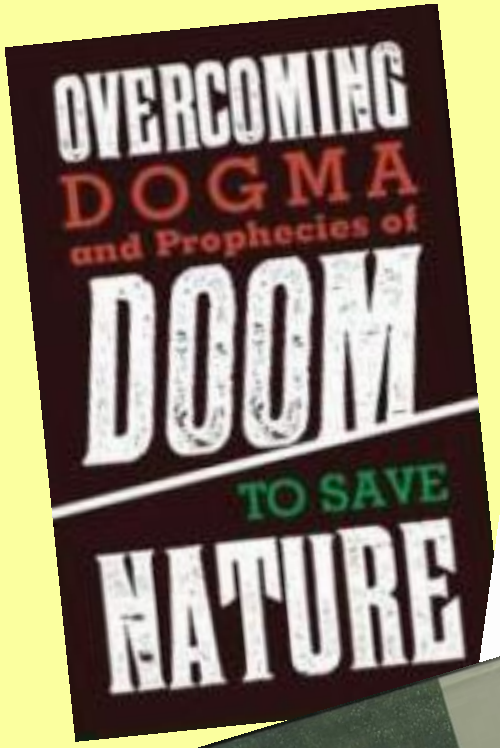
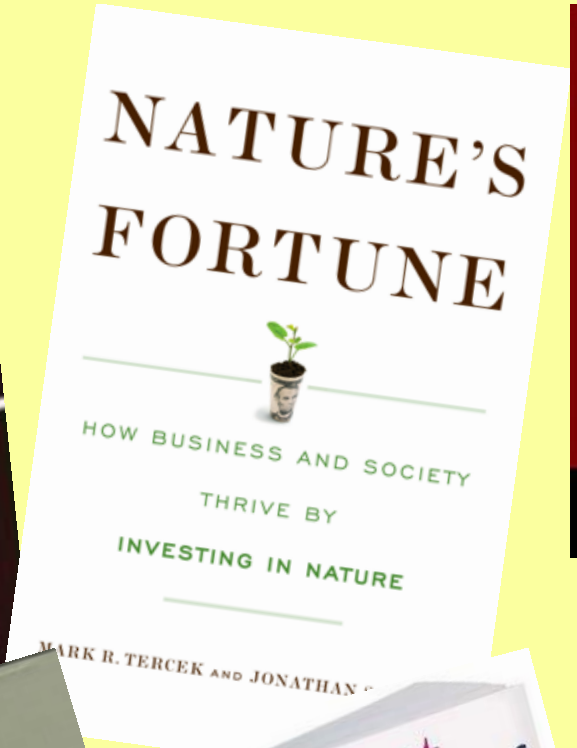
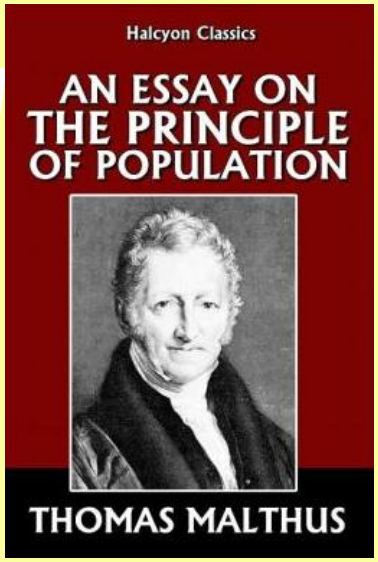
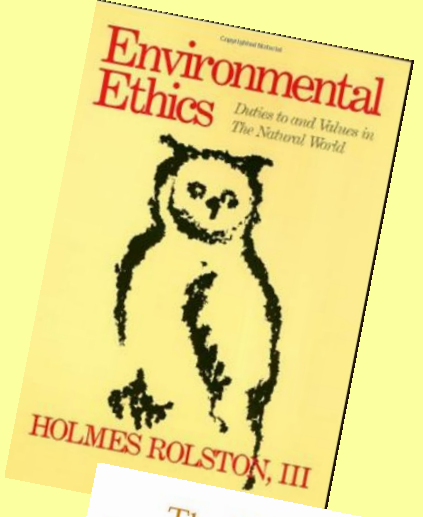
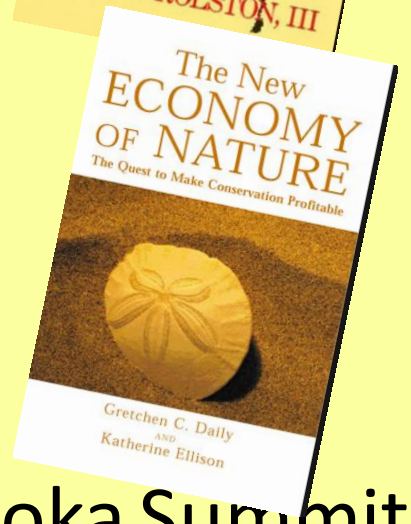
Are “sustainable” environments and “robust” economies compatible?

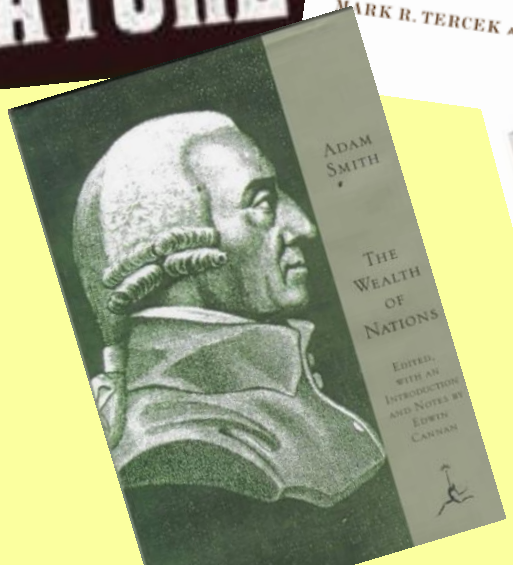


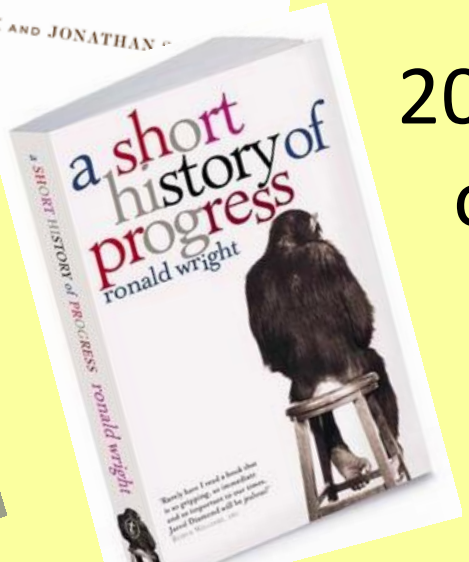












2014 Muskoka Summit on the Environment

Dan Simberloff
University of Tennessee

Then God said, “Let us make man in our image, after our likeness. And let them have dominion over the fish of the sea and over the birds of the heavens and over the livestock and over all the earth and over every creeping thing that creeps on the earth.”

10 March 1967, Volume 155, Number 3767 SCIENCE

The Historical Roots of Our Ecologic Crisis

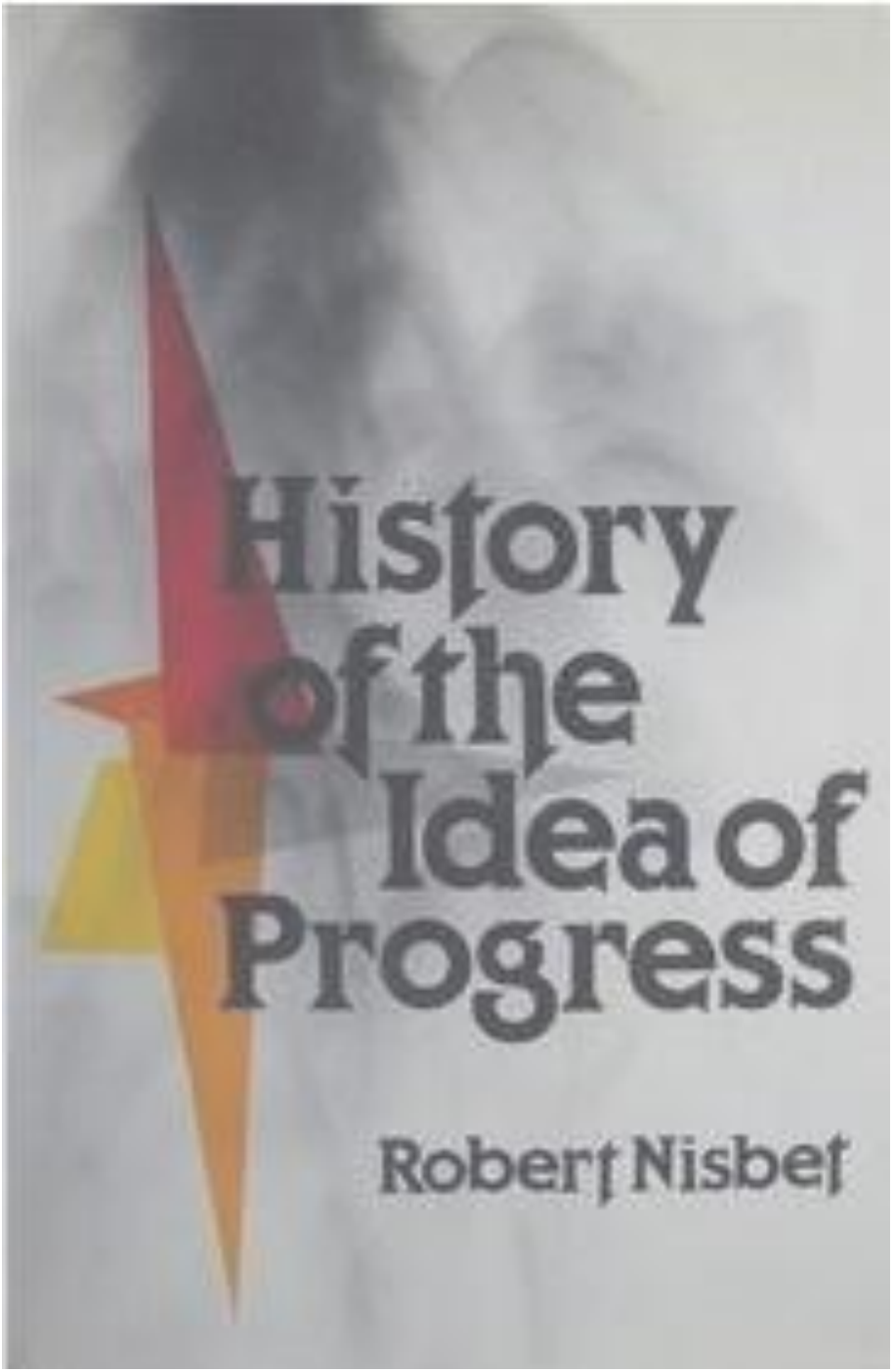
Lynn White, Jr.

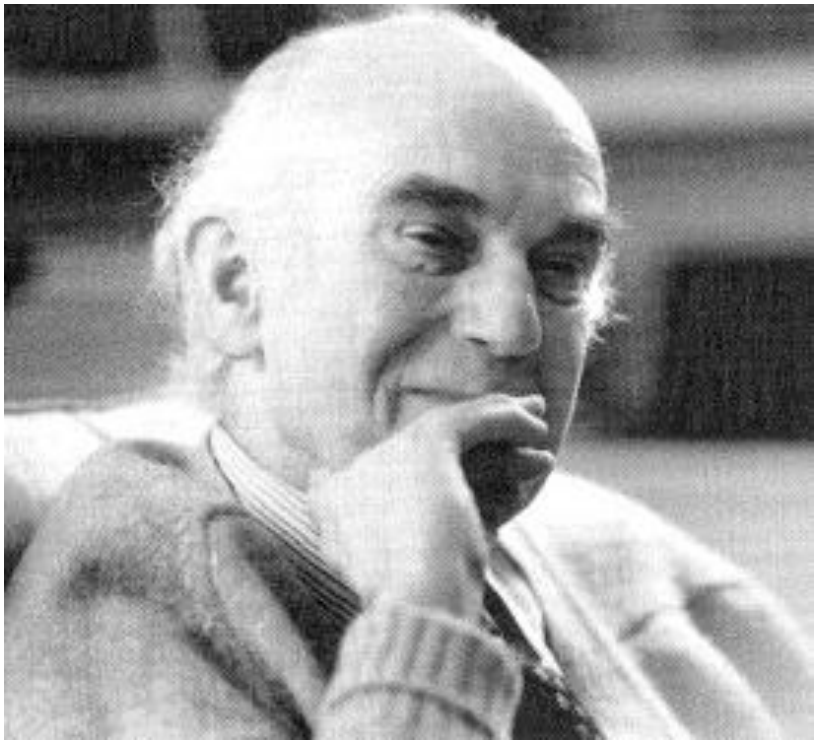
A conversation with Aldous Huxley not infrequently put one at the receiv-

helped to exterminate the monster mammals of the Pleistocene from

nating in our own time in the reclamation of the Zuider Zee. What, if any, species of animals, birds, fish, shore life, or plants have died out in the process? In their epic combat with Neptune have the Netherlanders overlooked ecological values in such a way that the quality of human life in the Netherlands has suffered? I cannot discover that the questions have ever been asked, much less answered.

People, then, have often been a dynamic element in their own environment, but in the present state of historical scholarship we usually do not know exactly when, where, or with what effects man-induced changes came. As


History of the Idea of Progress
Robert Nisbet



“hidden hand”

THE

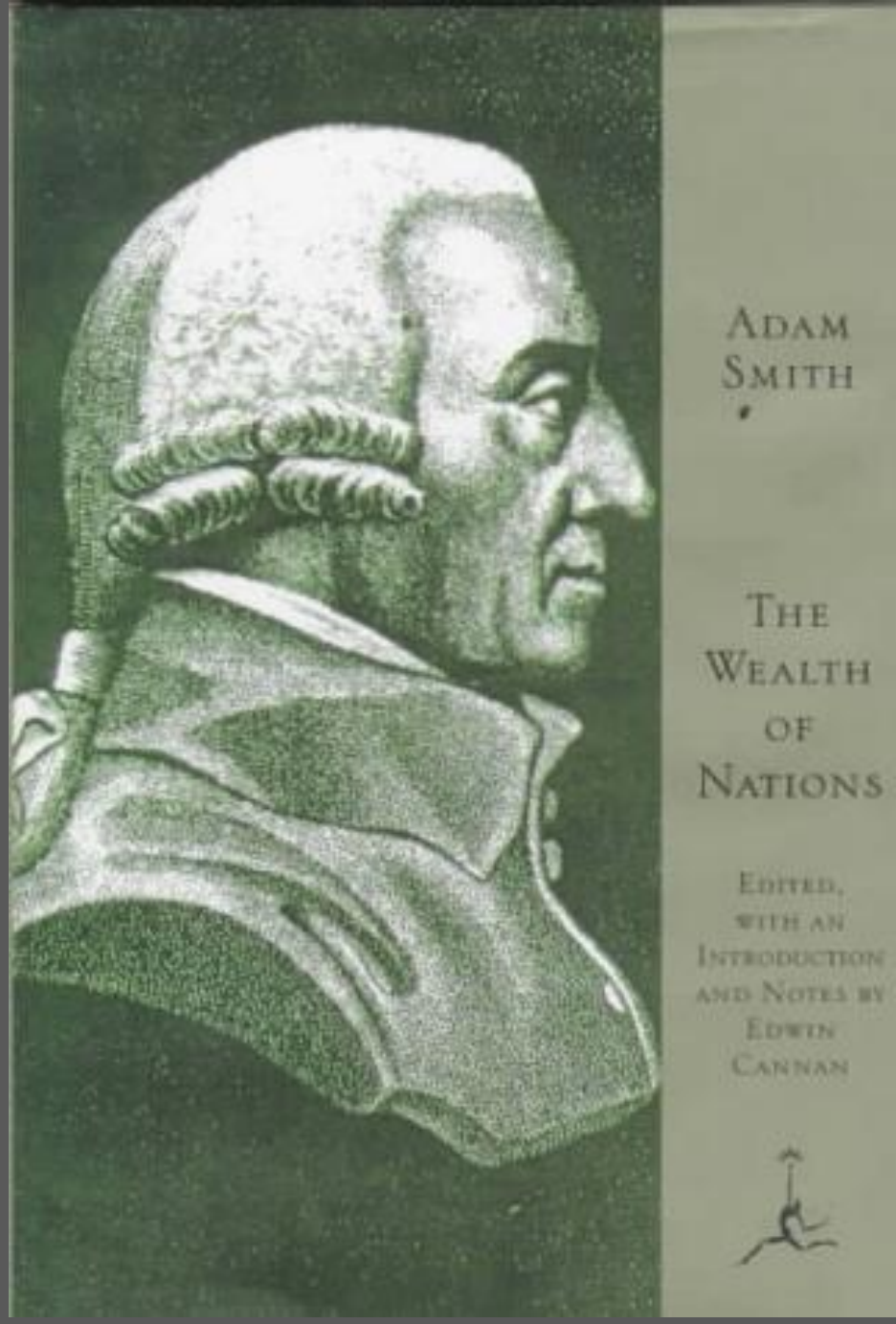
INVISIBLE HAND,

BY

ADAM SMITH.

IT IS NOT FROM THE *benevolence*
OF THE BUTCHER, THE BREWER,
OR THE BAKER
THAT WE EXPECT OUR DINNER,
BUT FROM THEIR REGARD
TO *their own interest.*

Penguin Books
GREAT IDEAS



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

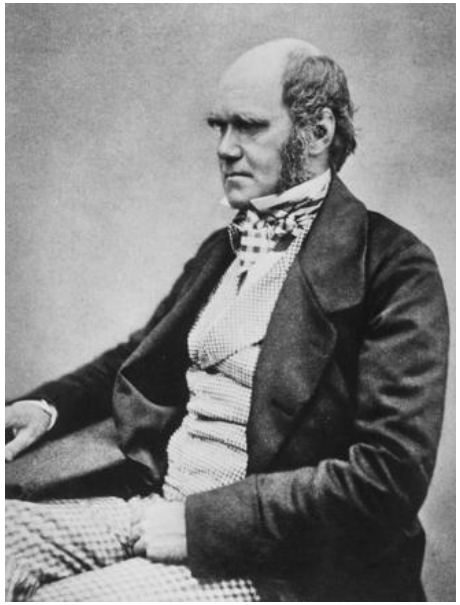
FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;

AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1859.



the “economy of nature”

Chapter 4 – “…for as all organic beings are striving to seize on each place in the **economy of nature**, if any one species does not become modified and improved in a corresponding degree with its competitors it will be exterminated.”

Chapter 4 – “…we should then have places in the **economy of nature** which would assuredly be better filled up, if some of the original inhabitants were in some manner modified “

Science, 1977

Economic Models in Ecology

The economics of resource allocation provide a framework for viewing ecological processes.

David J. Rapport and James E. Turner

Ecological processes have traditionally been studied from several vantage points. One approach focuses on energy flows through ecological communities from primary producers to consumers at higher trophic levels (*1*). Another approach considers species interactions in

These developments have occurred in a number of diverse areas of ecology, including models of optimal foraging (*6–8, 11, 12, 15, 16, 21*), reproduction strategies (*9, 12, 19, 20*), territoriality (*10*), altruism (*20*), and social caste systems (*17*). Viewed as a group these and other

inquiry into a general study of the give and take, the effort, accumulation and consumption in every province of life'' (*22*, p. 961).

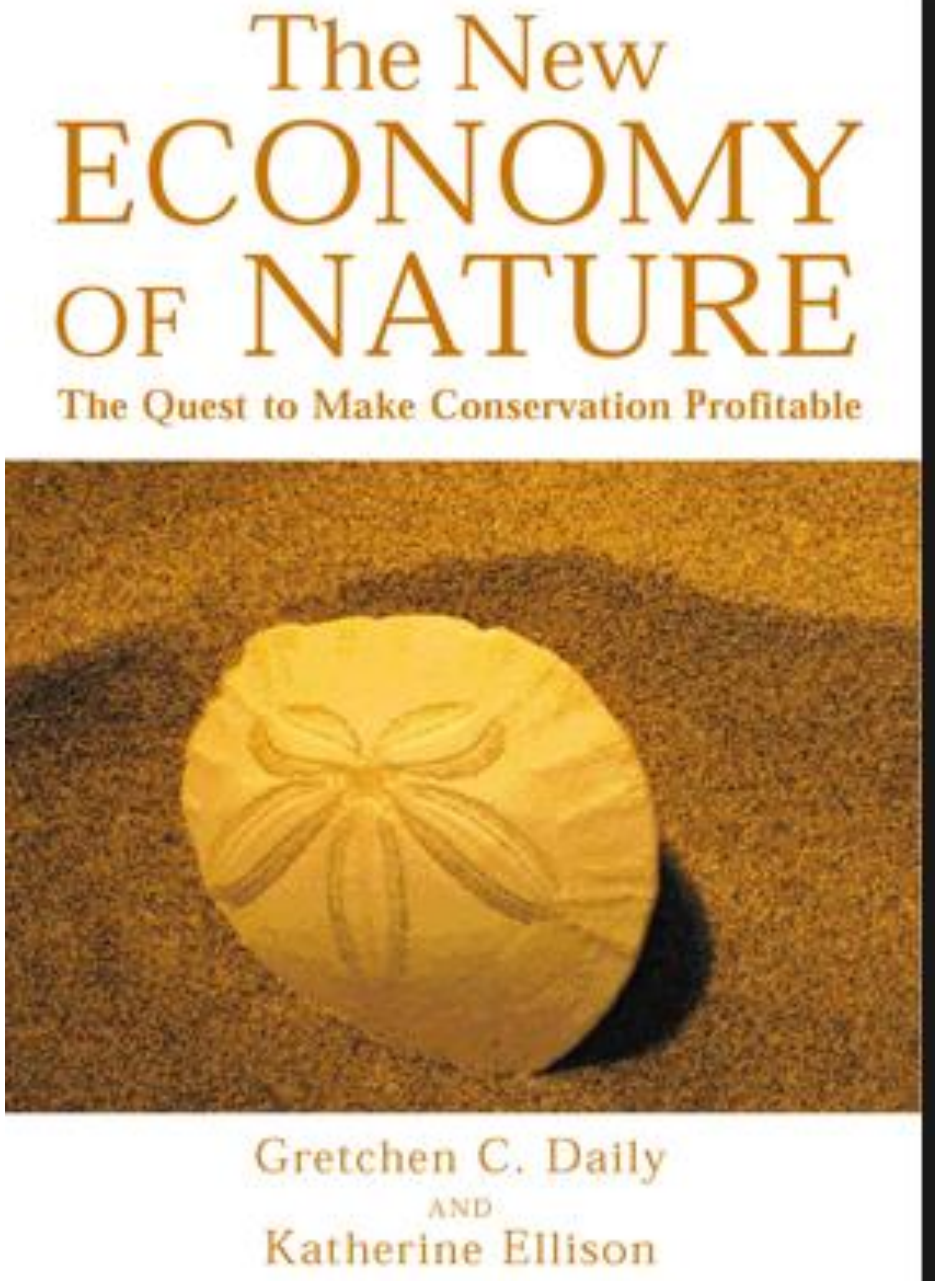
In the history of science, biological-economic analogies have played a significant role. Malthus (*23*) borrowed from ''the laws of natural increase in the animal and vegetable kingdom'' in forecasting a dismal economic future for mankind. Darwin (*24*), as is well known, received a critical inspiration for formulating his theory of evolution by means of natural selection from a reading of Malthus's essay on population. It occurred to Darwin that not only man, but all other species too, are engaged in a struggle for existence owing to their requirement for limited resources, and that those species that evolved ways to use resources more efficiently would be favored in their struggle for survival.

Dissatisfied with the predominance of

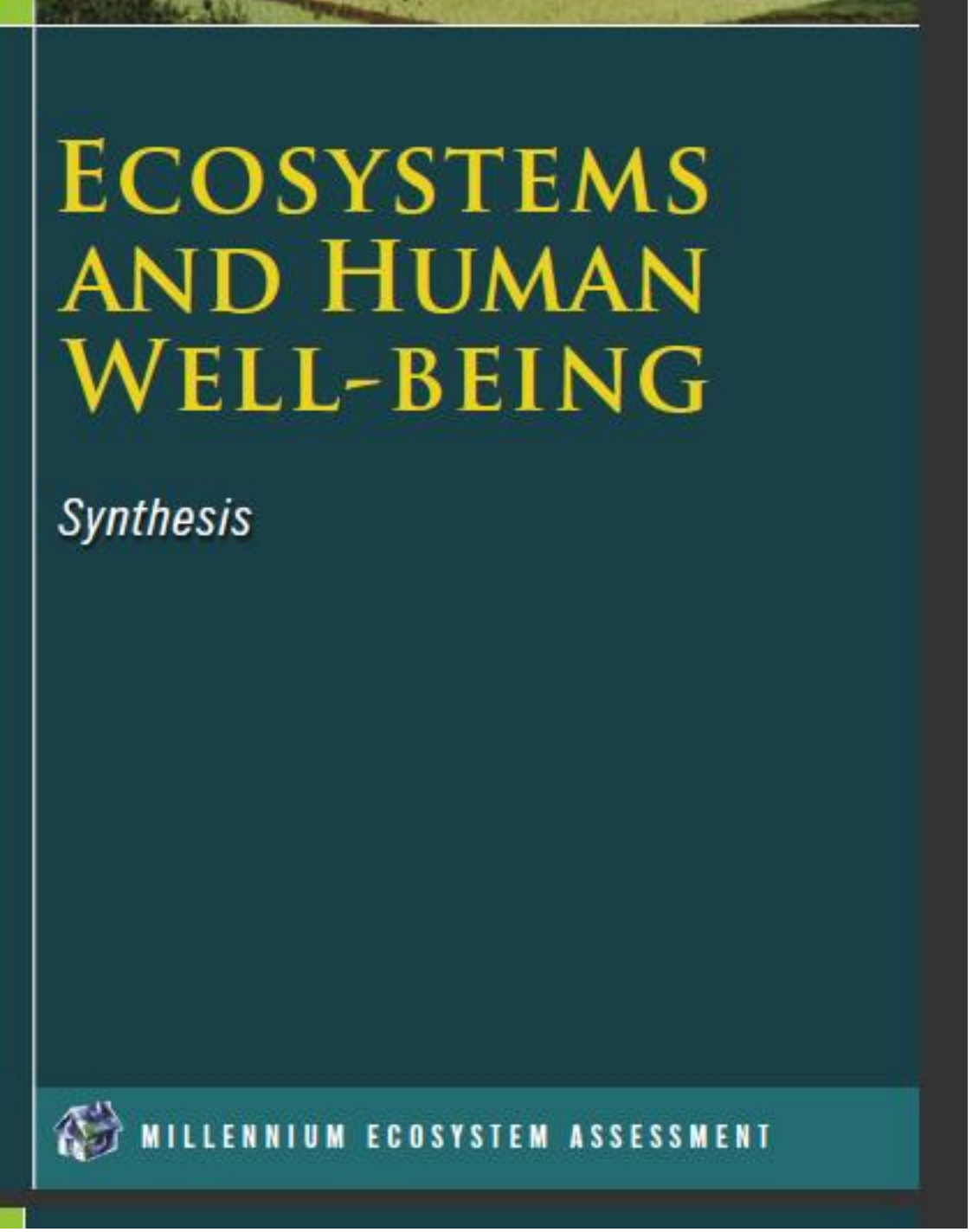
McAfee K, 1999

"Selling nature to save it? Biodiversity and green developmentalism"

Environment and Planning D: Society and Space 17(2) 133 – 154


The New
ECONOMY
OF NATURE
The Quest to Make Conservation Profitable
Gretchen C. Daily
AND
Katherine Ellison

2002



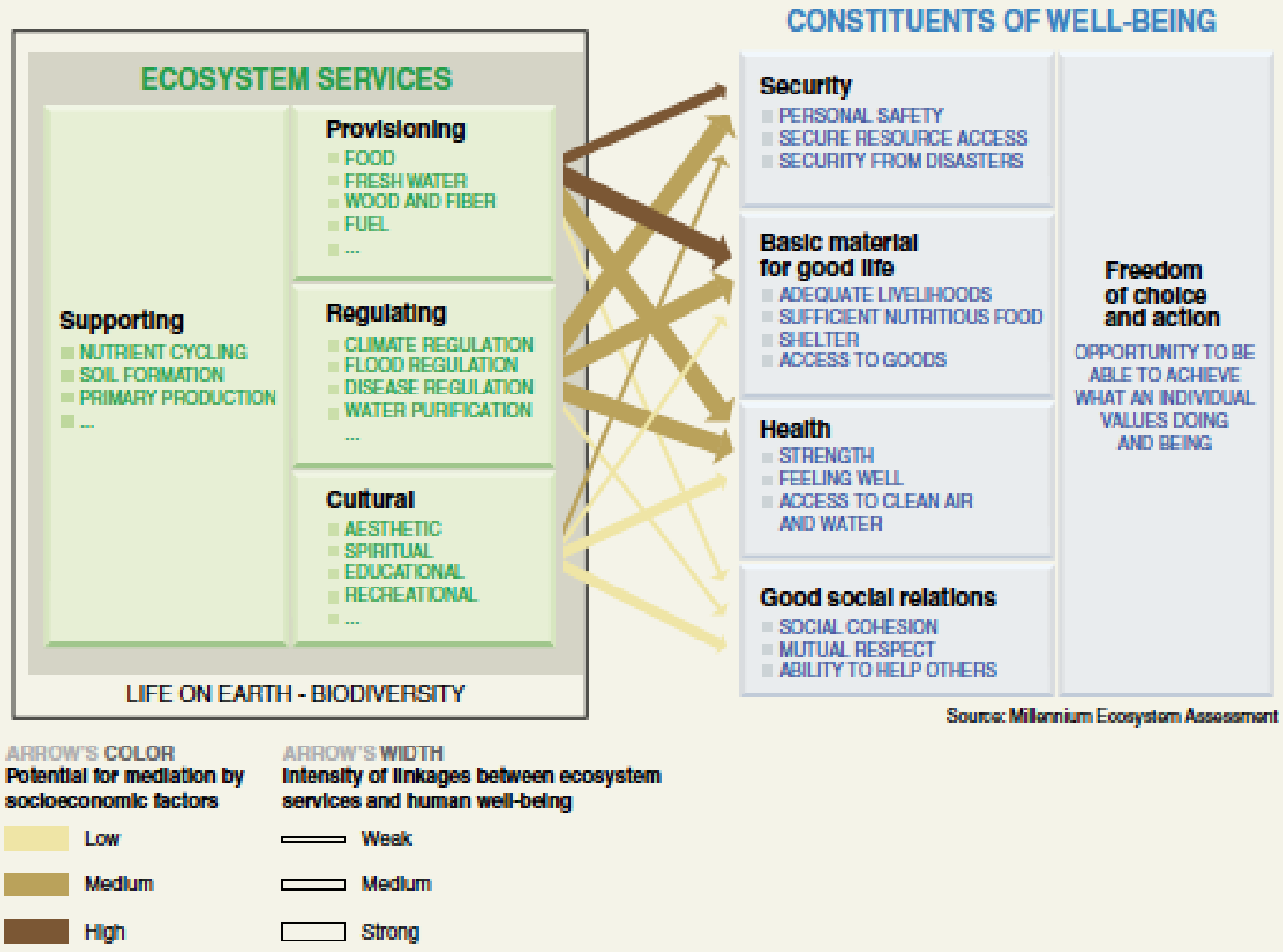
2005

ecosystem services:

the benefits people obtain from ecosystems

Figure A. Linkages between Ecosystem Services and Human Well-being

This Figure depicts the strength of linkages between categories of ecosystem services and components of human well-being that are commonly encountered, and includes indications of the extent to which it is possible for socioeconomic factors to mediate the linkage. (For example, if it is possible to purchase a substitute for a degraded ecosystem service, then there is a high potential for mediation.) The strength of the linkages and the potential for mediation differ in different ecosystems and regions. In addition to the influence of ecosystem services on human well-being depicted here, other factors—including other environmental factors as well as economic, social, technological, and cultural factors—influence human well-being, and ecosystems are in turn affected by changes in human well-being. (See Figure B.)



Source: Millennium Ecosystem Assessment

ELSEVIER

Ecological Economics 25 (1998) 3–15

ECOLOGICAL ECONOMICS

The value of the world's ecosystem services and natural capital[1]

Robert Costanza [a,b,*], Ralph d'Arge [c], Rudolf de Groot [d], Stephen Farber [e], Monica Grasso [b], Bruce Hannon [f], Karin Limburg [g], Shahid Naeem [h], Robert V. O'Neill [i], Jose Paruelo [j], Robert G. Raskin [k], Paul Sutton [l], Marjan van den Belt [m]

For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US$16–54 trillion ($10^{12}$) per year, with an average of US$33 trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate.

NATURE'S FORTUNE

HOW BUSINESS AND SOCIETY THRIVE BY INVESTING IN NATURE

MARK R. TERCEK AND JONATHAN S. ADAMS

The Nature Conservancy through 2011

The Nature Conservancy beginning 2012

Protecting nature, for people today and future generations.

JILL AND KEN ISCOL DISTINGUISHED ENVIRONMENTAL LECTURE

OVERCOMING DOGMA and Prophecies of DOOM TO SAVE NATURE

MONDAY APRIL 22 | 2013 | 5:00 PM

David L. Call Alumni Auditorium, Kennedy Hall

FEATURING

Peter Kareiva

Chief Scientist
The Nature Conservancy

For a full schedule of activities, please visit
acsf.cornell.edu/iscol

Presented by
Atkinson Center for a Sustainable Future

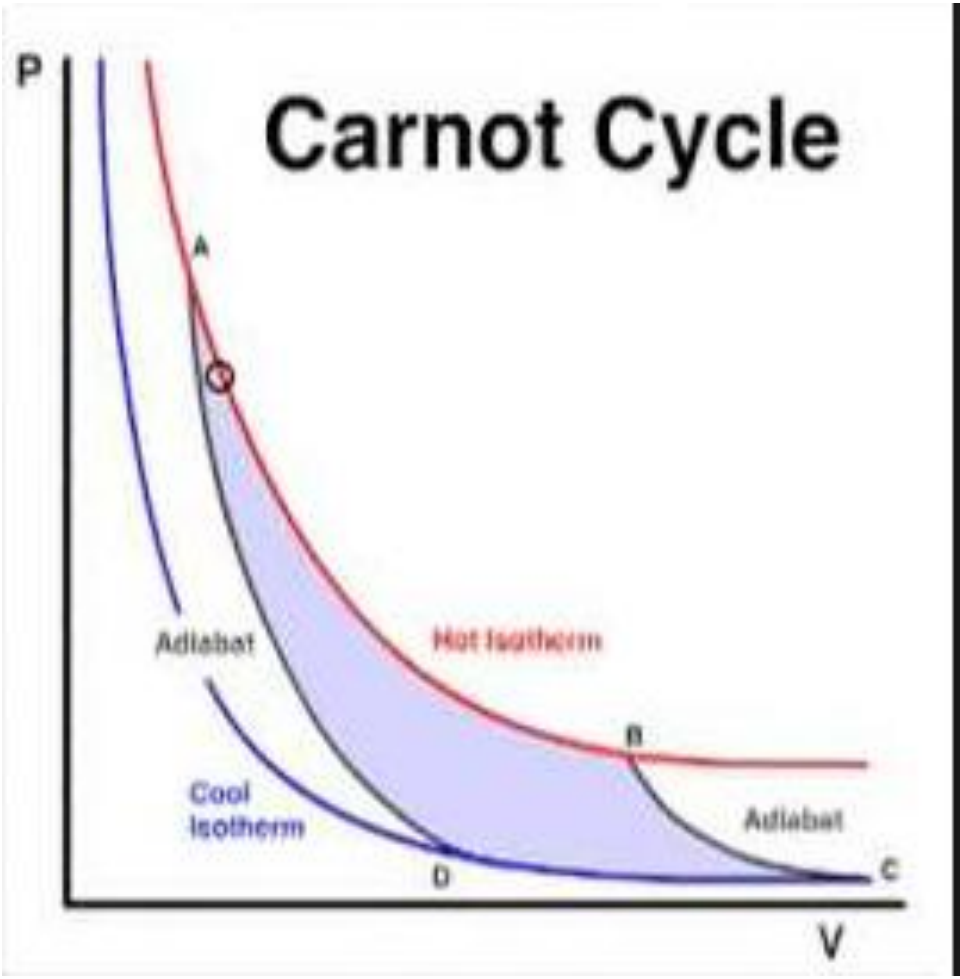
“Because of the expanding human footprint, these infested and novel ecosystems will be valued, and not shunned as somehow unworthy” (Kareiva in R. Lalasz, 2011, p. 8).

Peter Kareiva:

Peter Kareiva:

Alas, there are limits to growth…..

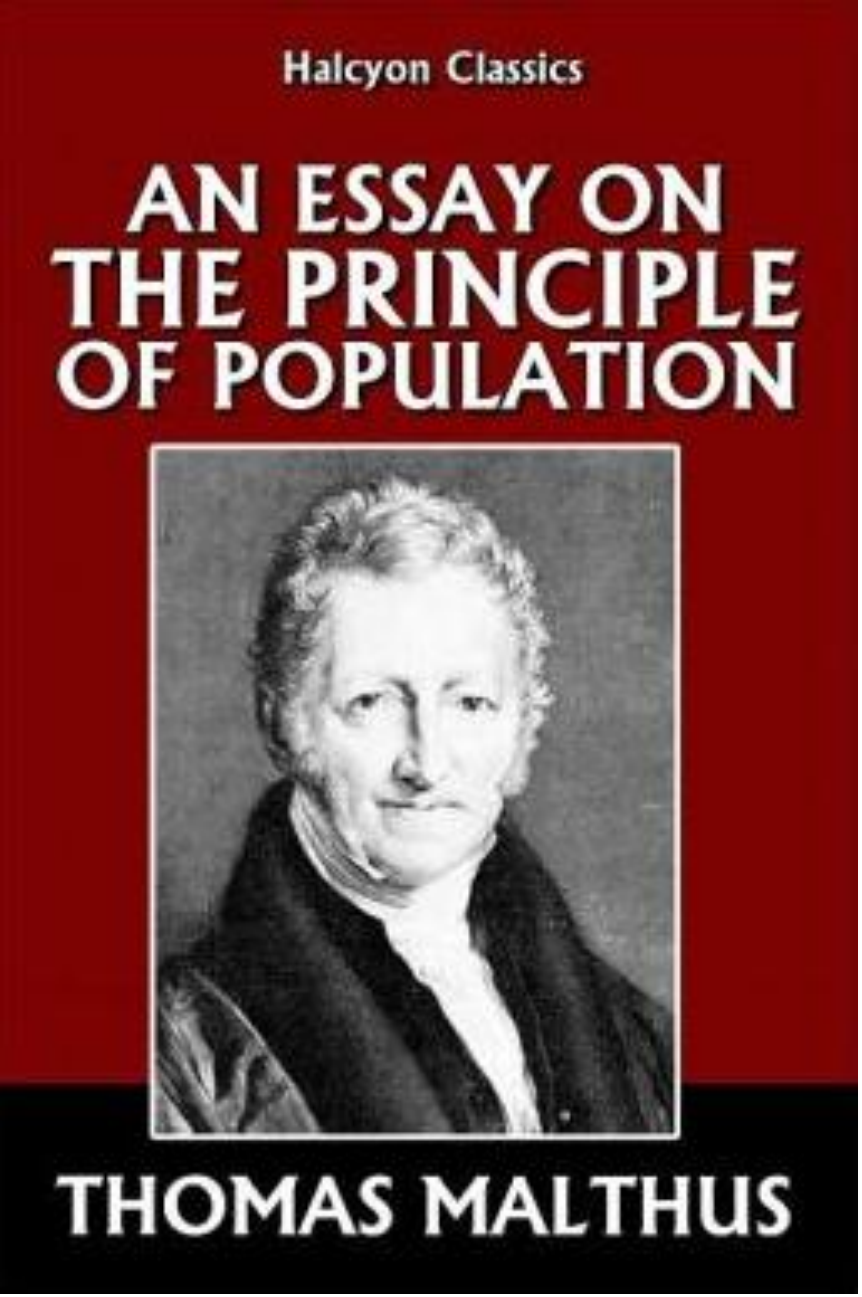
Sadi Carnot 1796- 1832



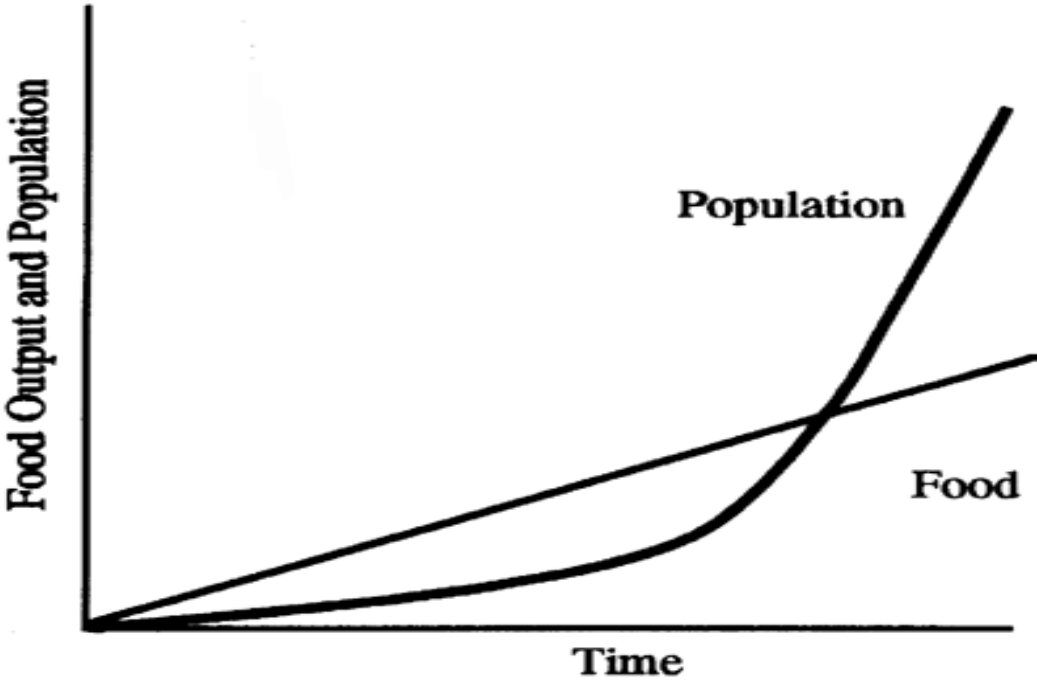
Rudolf Clausius version of the 2nd law of thermodynamics:

"Heat can never pass from a colder to a warmer body without some other change, connected therewith, occurring at the same time."

Planck's version: "Every process occurring in nature proceeds in the sense in which the sum of the entropies of all bodies taking part in the process is increased."



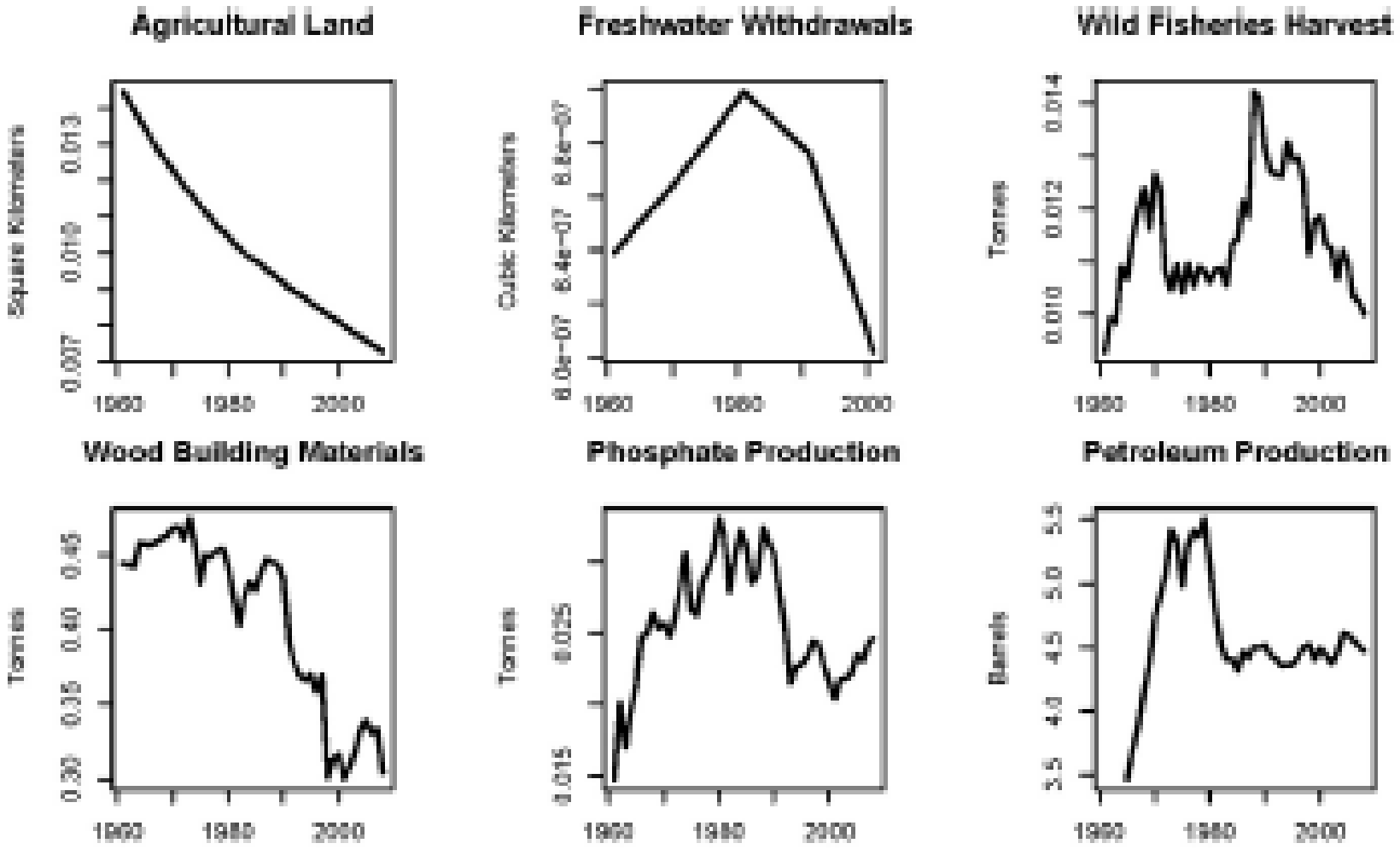
1766-1834

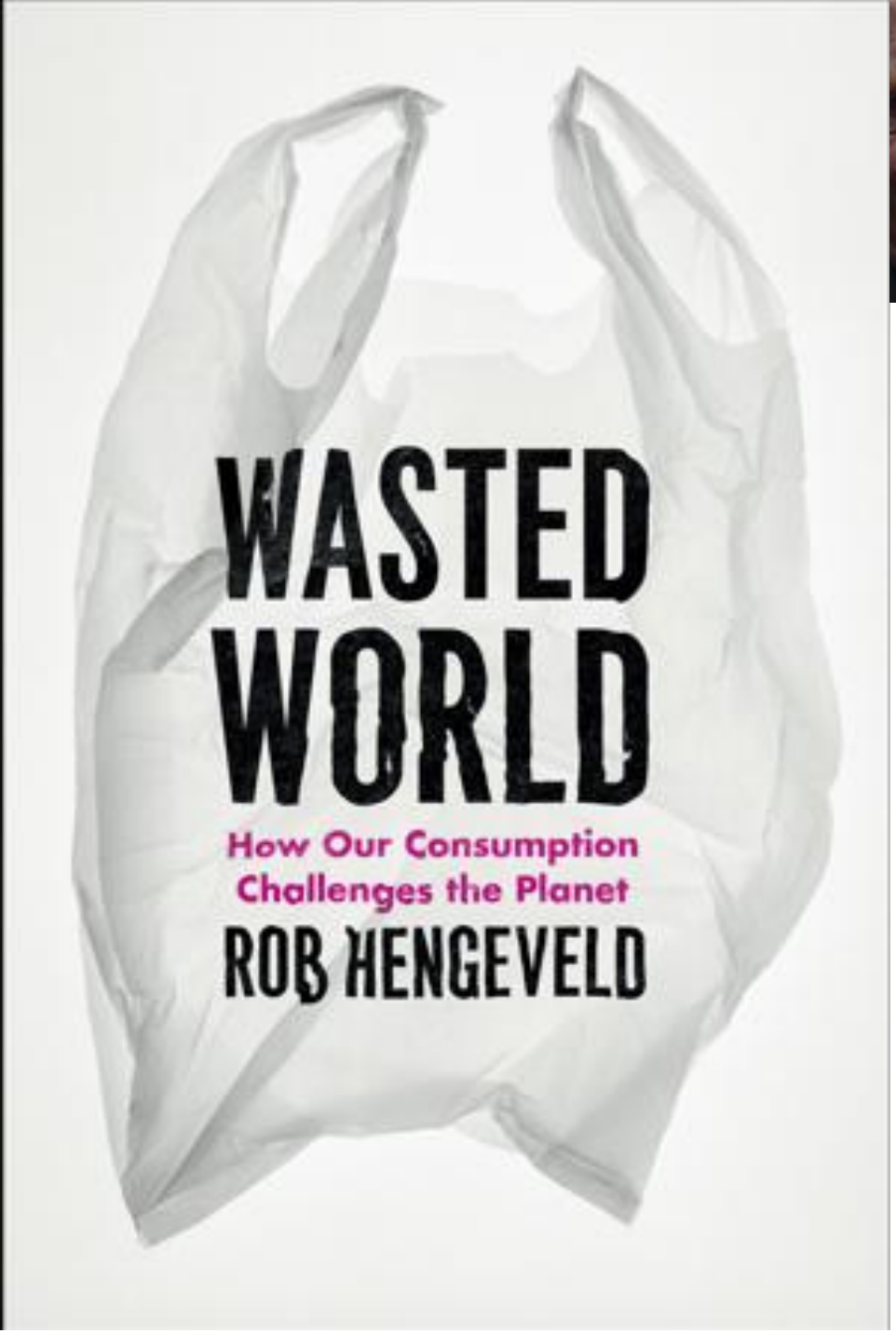


"That the increase of population is necessarily limited by the means of subsistence,

That population does invariably increase when the means of subsistence increase, and,

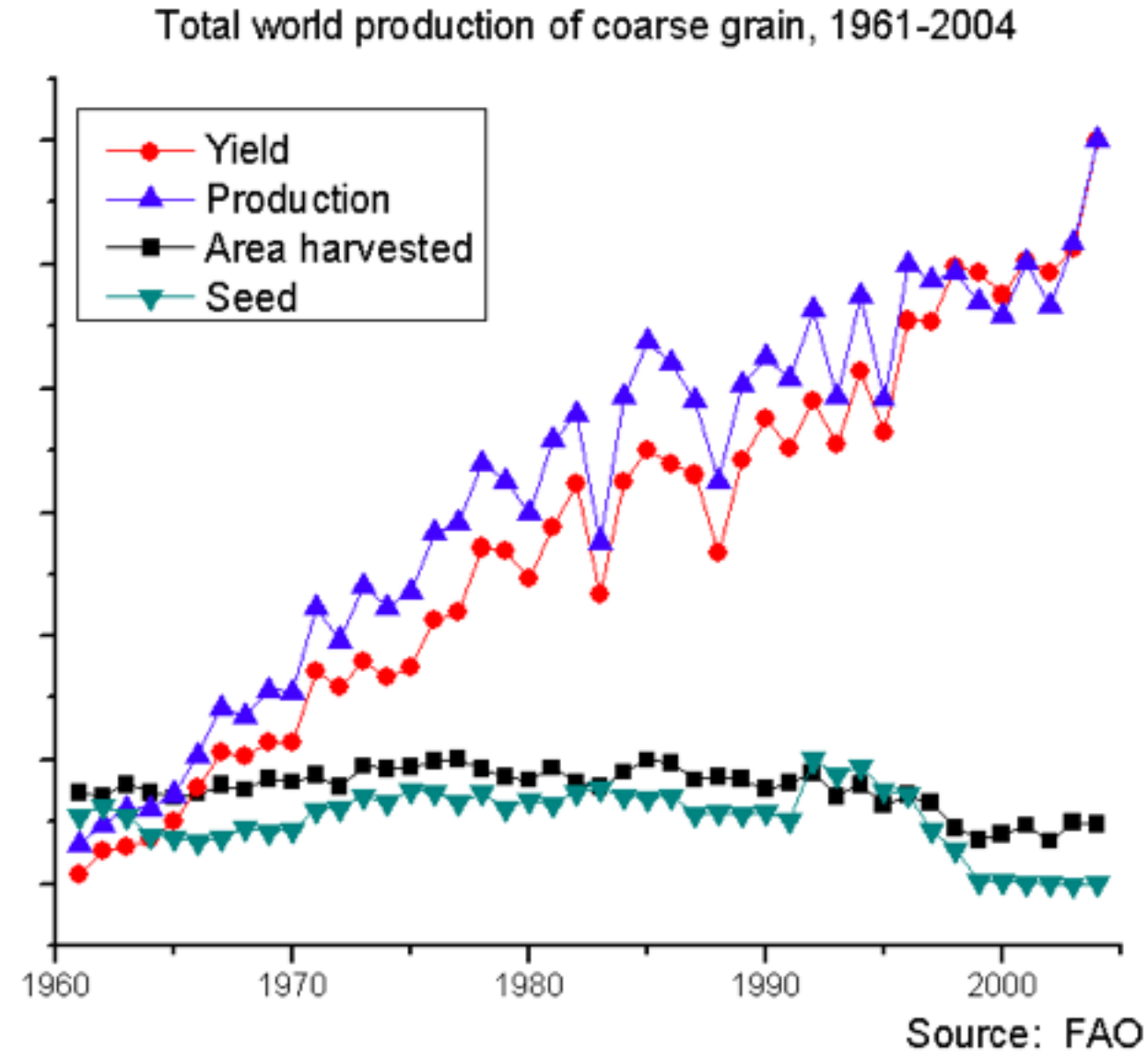
That the superior power of population is repressed, and the actual population kept equal to the means of subsistence, by misery and vice."


Agricultural Land
Square Kilometers
0.007
0.010
0.013
1960
1980
2000
Freshwater Withdrawals
Cubic Kilometers
6.0e−07
6.4e−07
6.8e−07
1960
1980
2000
Wild Fisheries Harvest
Tonnes
0.010
0.012
0.014
1960
1980
2000
Wood Building Materials
Tonnes
0.30
0.35
0.40
0.45
1960
1980
2000
Phosphate Production
Tonnes
0.015
0.025
1960
1980
2000
Petroleum Production
Barrels
3.5
4.0
4.5
5.0
5.5
1960
1980
2000

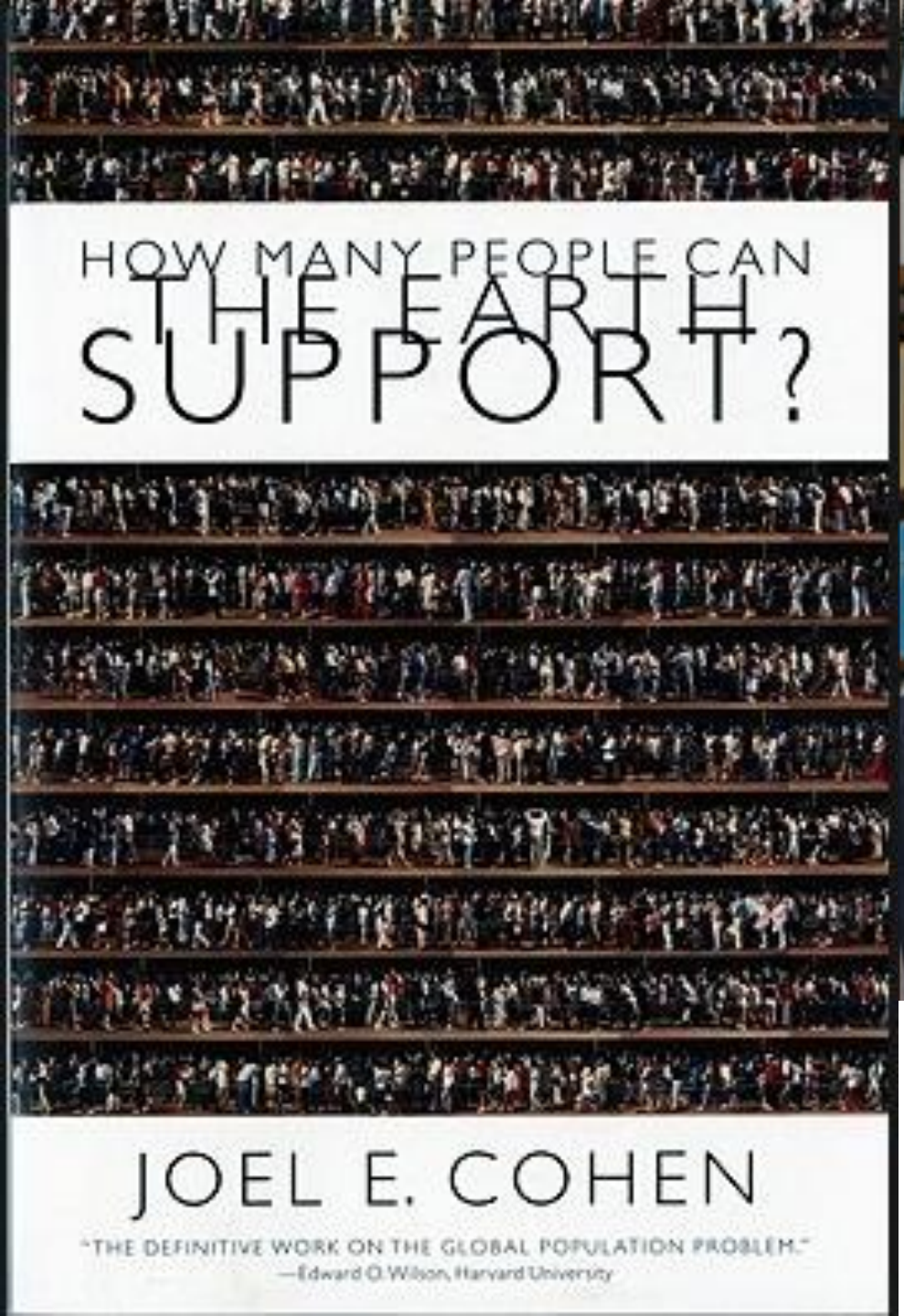


For instance, humans extract massive amounts of energy from burning, usually converting chemical energy to heat energy and then to mechanical energy, each step causing enormous losses of material and energy, much of it to the atmosphere (e.g., CO_2), with up to 60% lost at each step.

E.g. – incandescent light bulb – only 5% of energy is used as light; other 95% lost as heat.

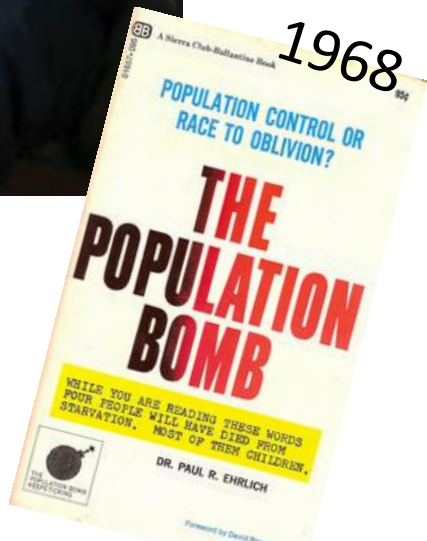


Norman Borlaug, "father of the Green Revolution"


HOW MANY PEOPLE CAN THE EARTH SUPPORT?
JOEL E. COHEN
"THE DEFINITIVE WORK ON THE GLOBAL POPULATION PROBLEM."
—Edward O. Wilson, Harvard University

1995

1968

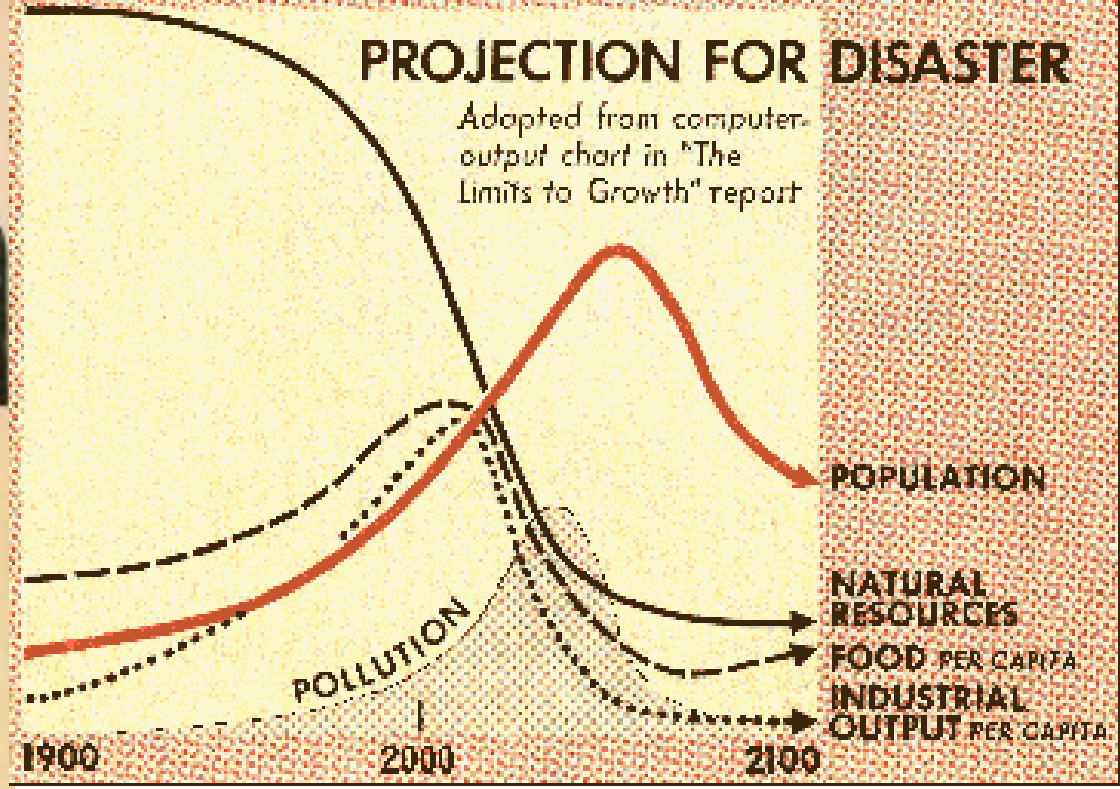

A Sierra Club-Ballantine Book
POPULATION CONTROL OR RACE TO OBLIVION?
THE POPULATION BOMB
WHILE YOU ARE READING THESE WORDS FOUR PEOPLE WILL HAVE DIED FROM STARVATION. MOST OF THEM CHILDREN.
DR. PAUL R. EHRLICH

THE LIMITS TO growth

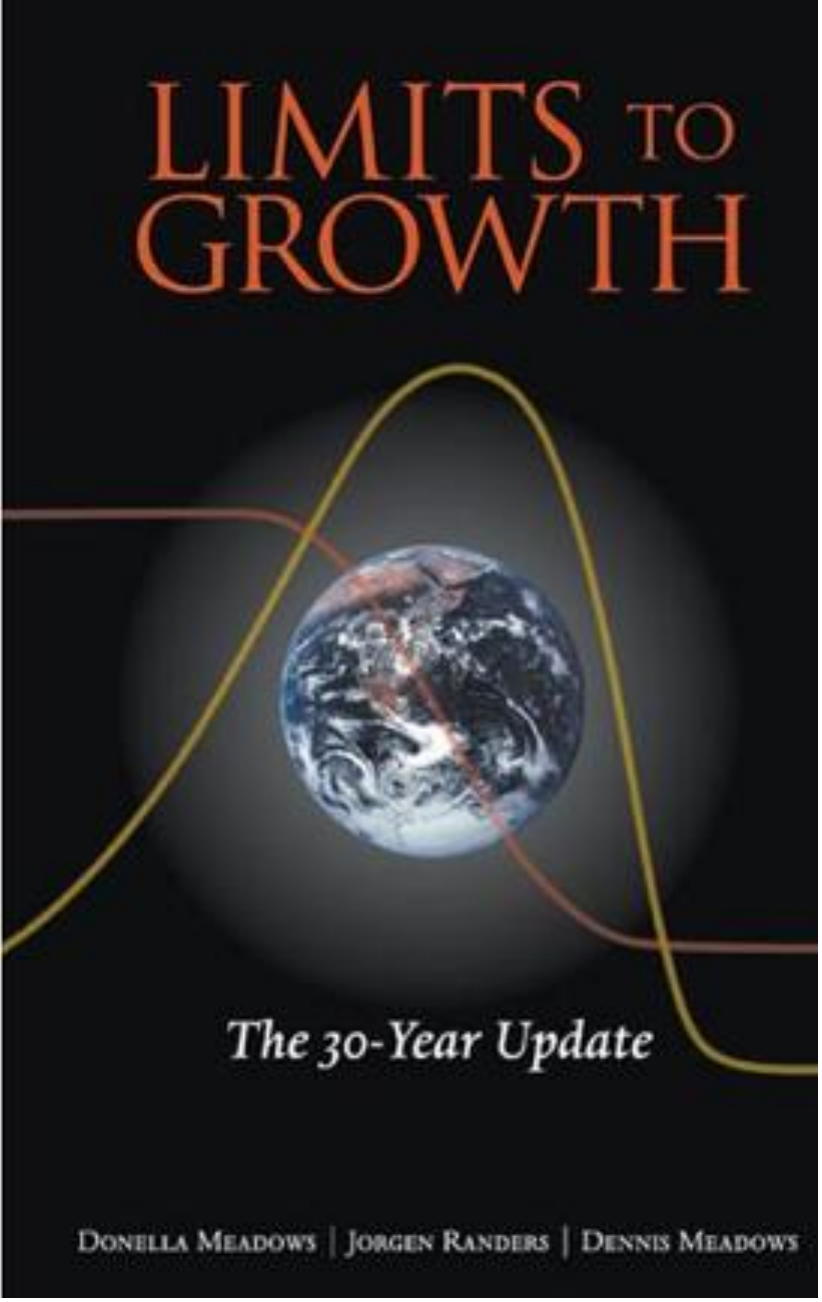
Donella H. Meadows
Dennis L. Meadows
Jørgen Randers
William W. Behrens III

A Report for THE CLUB OF ROME'S Project on the Predicament of Mankind

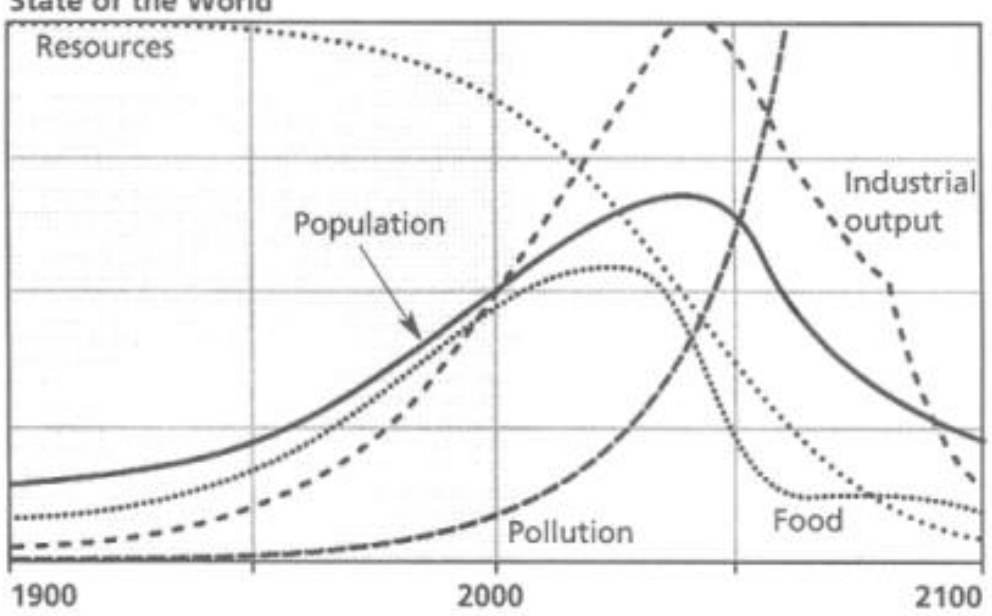
A POTOMAC ASSOCIATES BOOK $2.75

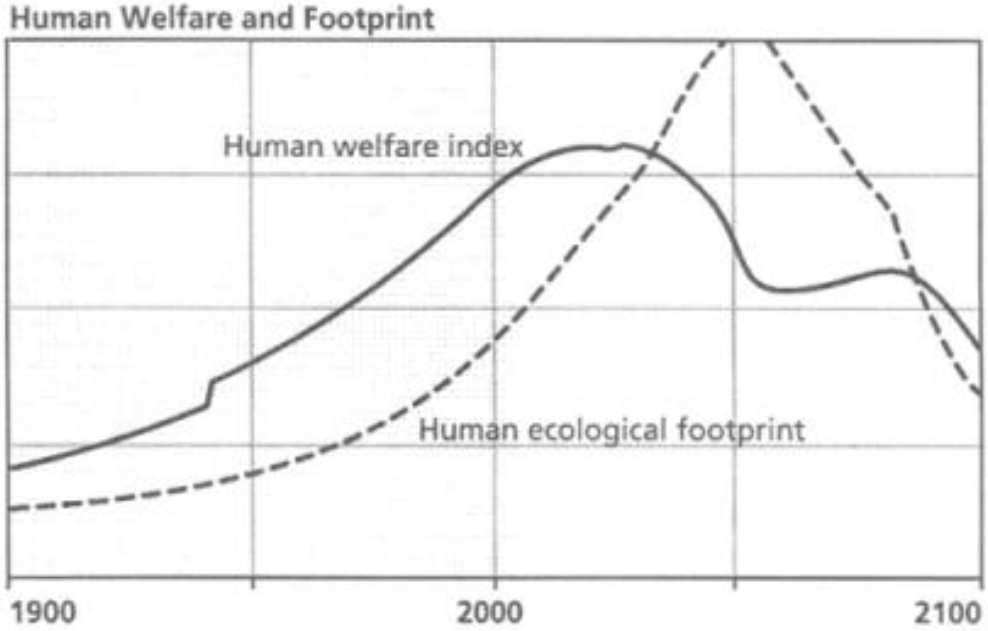


1972

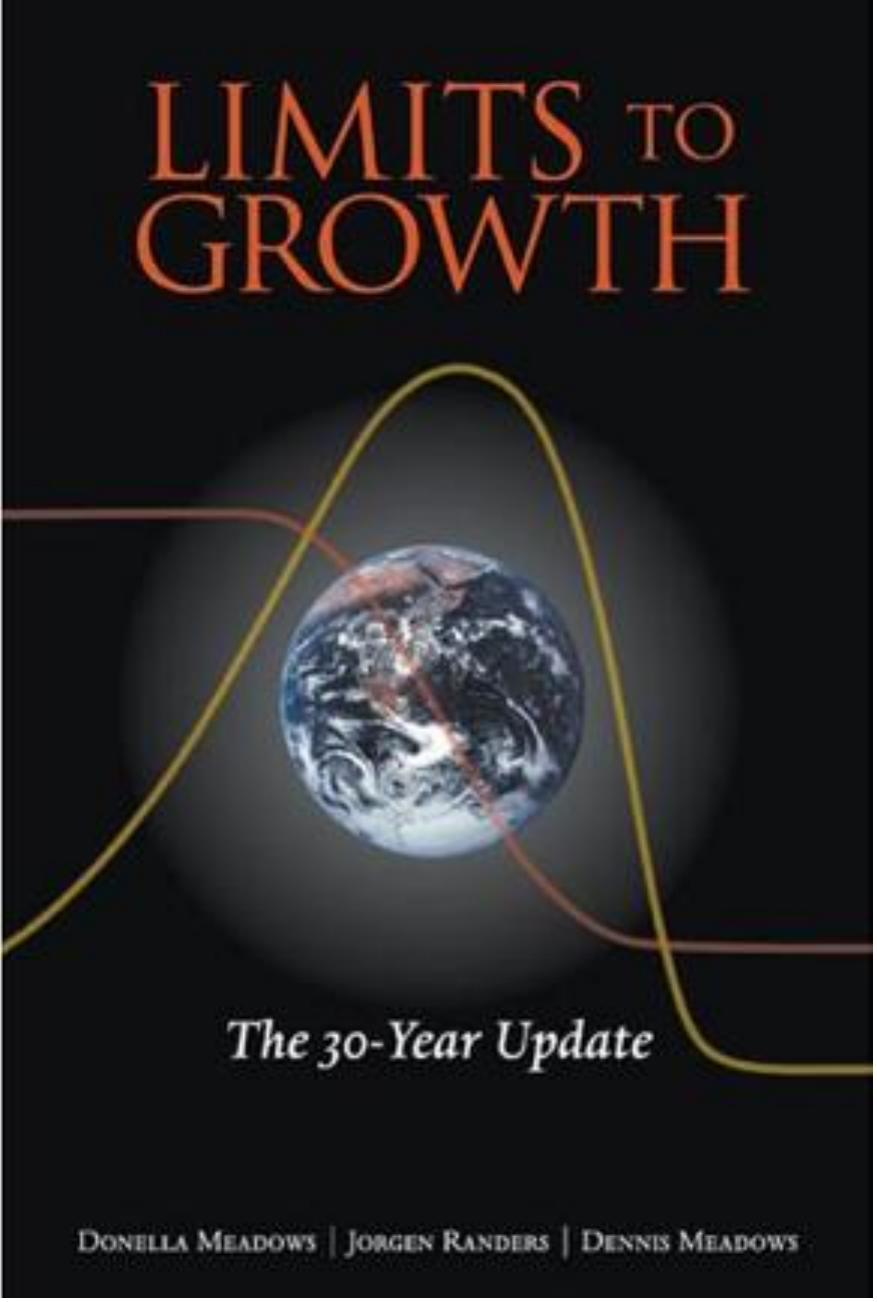


2004

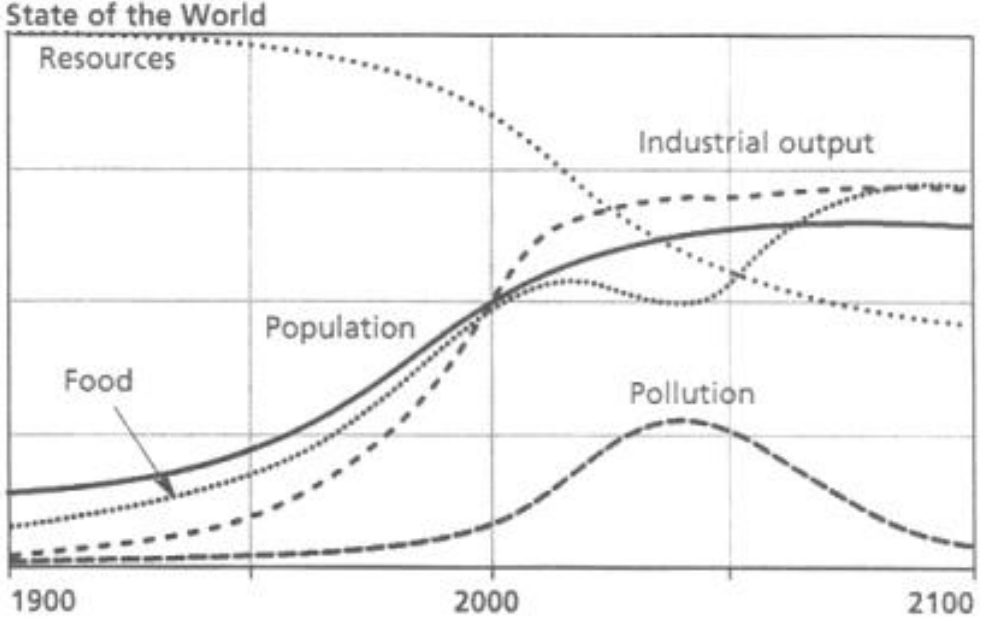


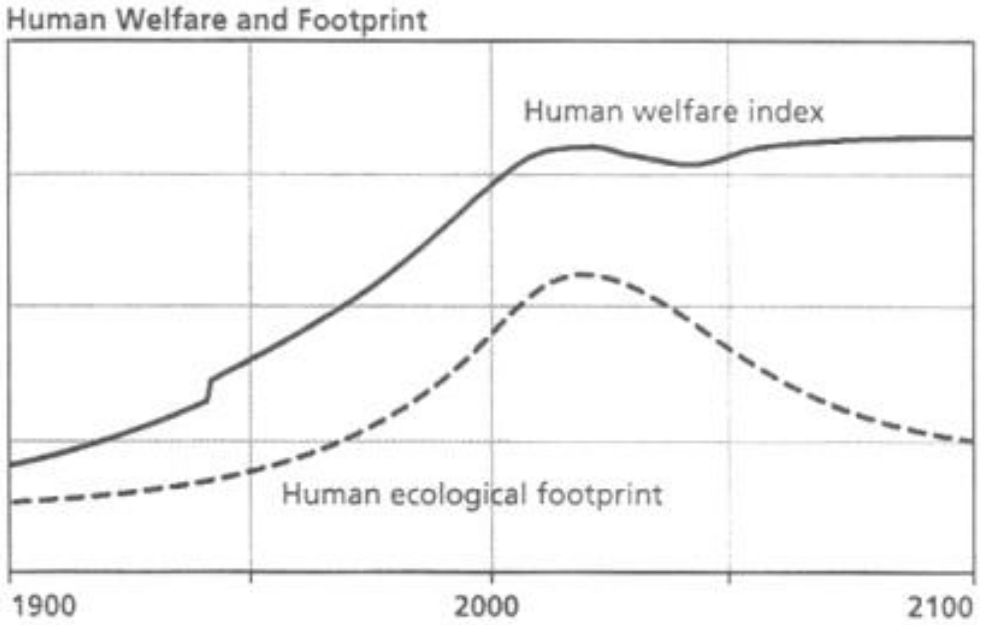


More abundant non-renewable resources

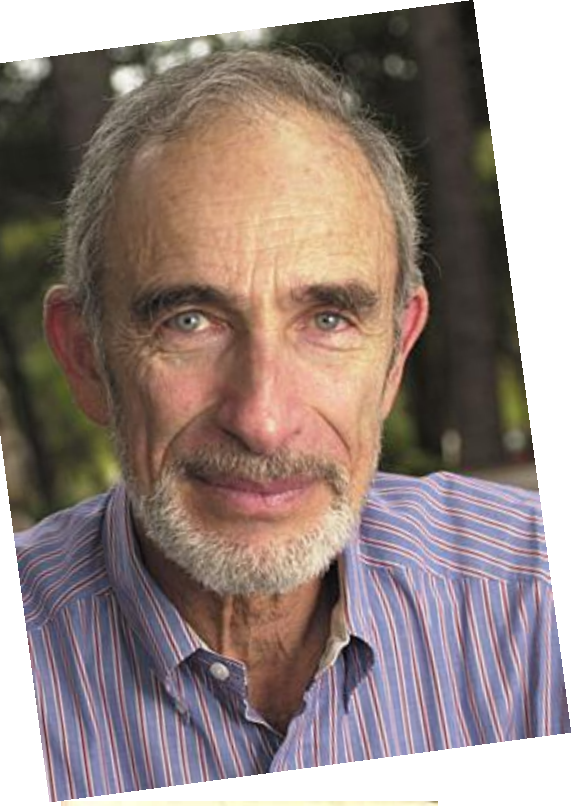


2004





World seeks stable population and stable industrial output per person, plus improved technologies



THE BET

Paul Ehrlich, Julian Simon, and
Our Gamble over Earth's Future

PAUL SABIN

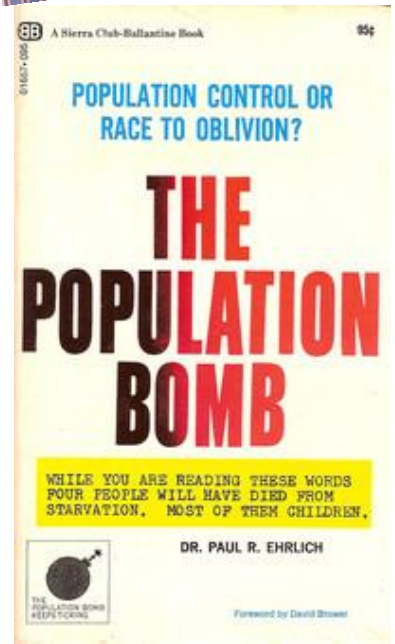
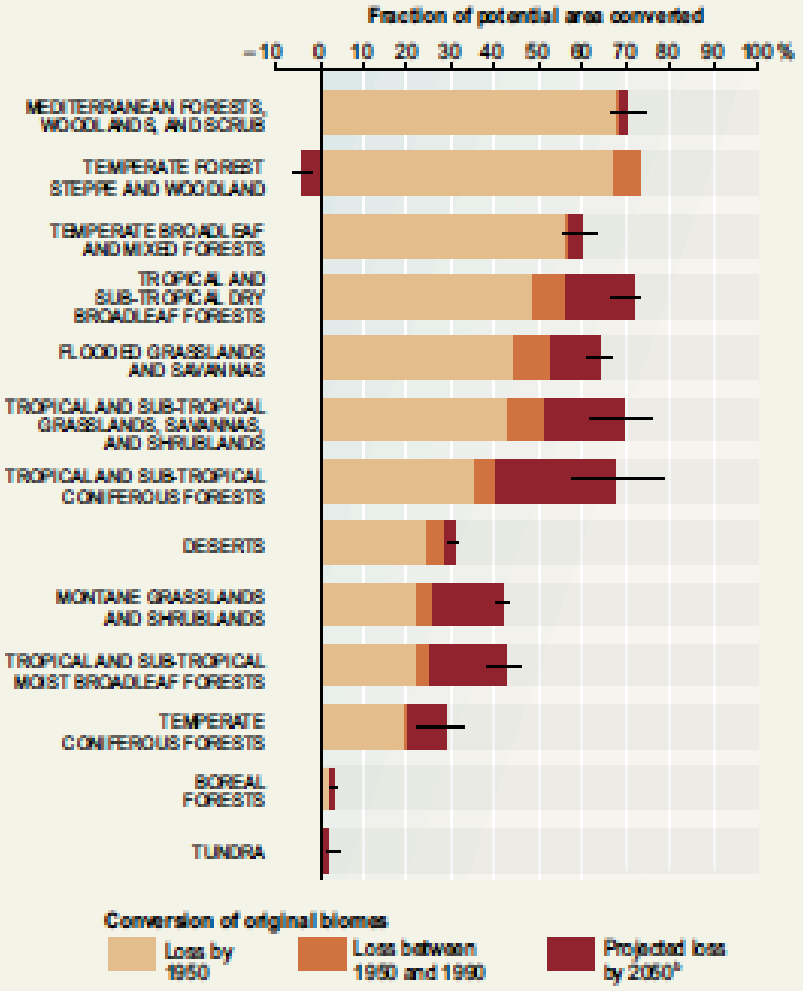


Figure 3. Conversion of Terrestrial Biomes[a]
(Adapted from C4, S10)

It is not possible to estimate accurately the extent of different biomes prior to significant human impact, but it is possible to determine the "potential" area of biomes based on soil and climatic conditions. This Figure shows how much of that potential area is estimated to have been converted by 1950 (medium certainty), how much was converted between 1950 and 1990 (medium certainty), and how much would be converted under the four MA scenarios (low certainty) between 1990 and 2050. Mangroves are not included here because the area was too small to be accurately assessed. Most of the conversion of these biomes is to cultivated systems.

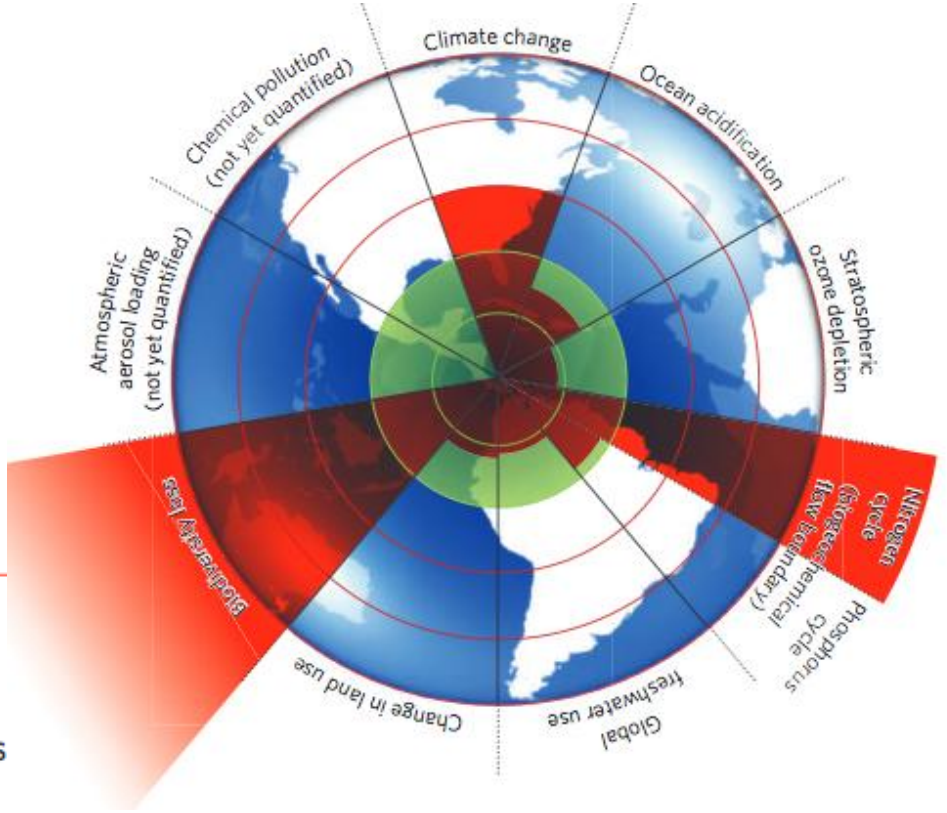


Millennium Ecosystem Assessment

FEATURE

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue **Johan Rockström** and colleagues.

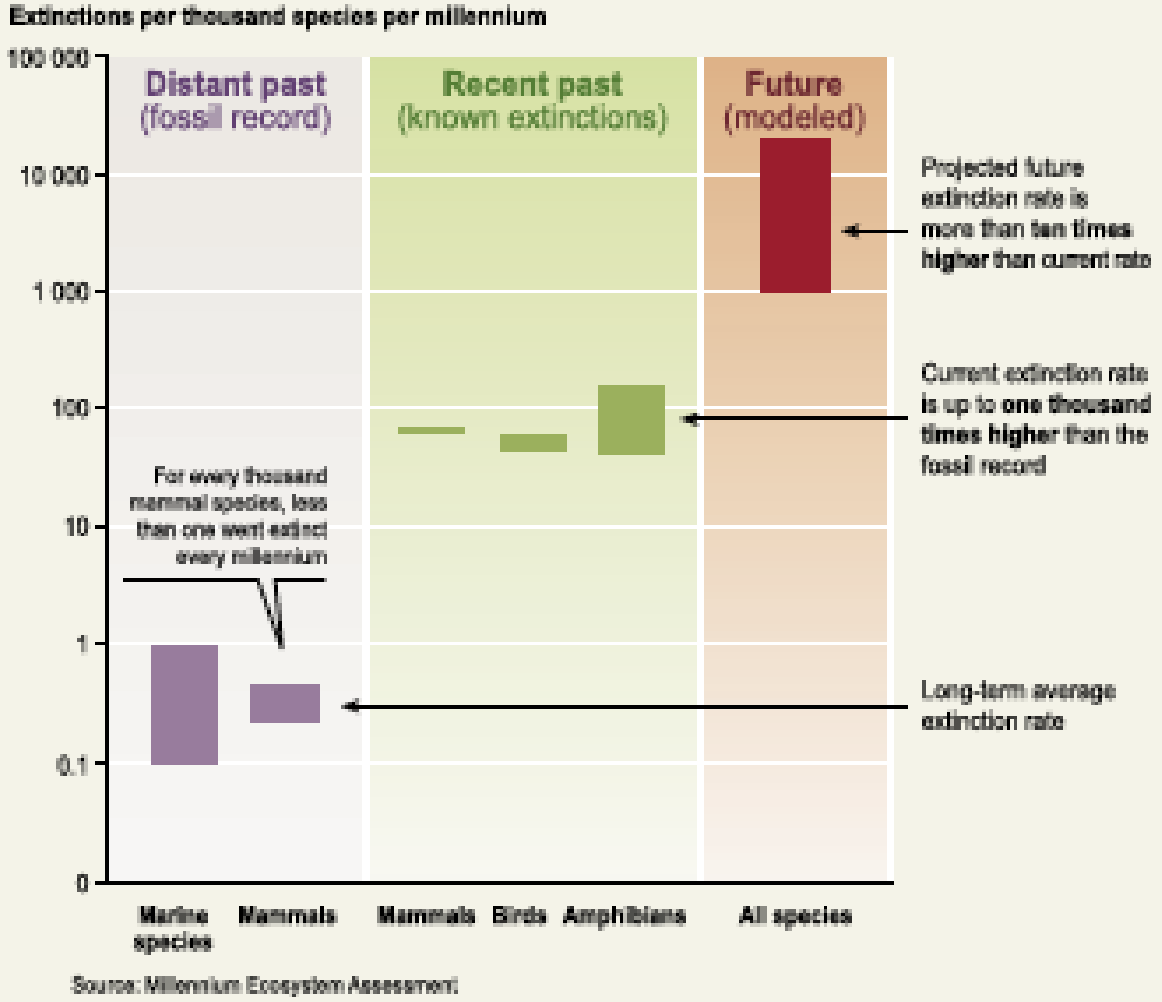


SUMMARY

- New approach proposed for defining preconditions for human development
- Crossing certain biophysical thresholds could have disastrous consequences for humanity
- Three of nine interlinked planetary boundaries have already been overstepped

Figure 4. Species Extinction Rates (Adapted from C4 Fig 4.22)

"Distant past" refers to average extinction rates as estimated from the fossil record. "Recent past" refers to extinction rates calculated from known extinctions of species (lower estimate) or known extinctions plus "possibly extinct" species (upper bound). A species is considered to be "possibly extinct" if it is believed by experts to be extinct but extensive surveys have not yet been undertaken to confirm its disappearance. "Future" extinctions are model-derived estimates using a variety of techniques, including species-area models, rates at which species are shifting to increasingly more threatened categories, extinction probabilities associated with the IUCN categories of threat, impacts of projected habitat loss on species currently threatened with habitat loss, and correlation of species loss with energy consumption. The time frame and species groups involved differ among the "future" estimates, but in general refer to either future loss of species based on the level of threat that exists today or current and future loss of species as a result of habitat changes taking place over the period of roughly 1970 to 2050. Estimates based on the fossil record are low certainty; lower-bound estimates for known extinctions are high certainty and upper-bound estimates are medium certainty; lower-bound estimates for modeled extinctions are low certainty and upper-bound estimates are speculative. The rate of known extinctions of species in the past century is roughly 50–500 times greater than the extinction rate calculated from the fossil record of 0.1–1 extinctions per 1,000 species per 1,000 years. The rate is up to 1,000 times higher than the background extinction rates if possibly extinct species are included.

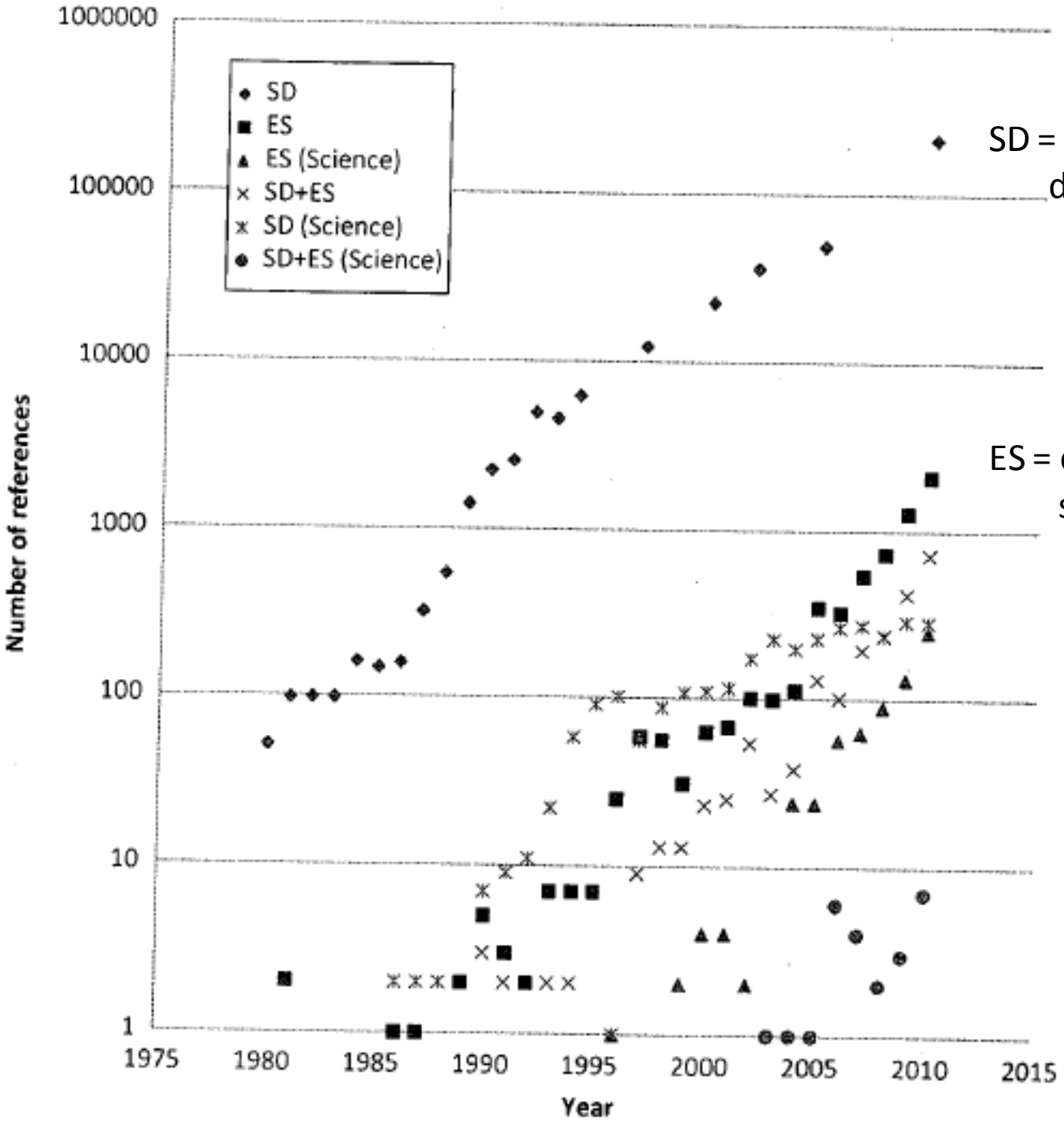


Millennium Ecosystem Assessment

2013

Chapter 25
Ecosystem Services: Is a Planet Servicing One Species Likely to Function?

Shahid Naeem



SD = sustainable development

ES = ecosystem services

Naeem 2013

Table 1. Global Status of Provisioning, Regulating, and Cultural Ecosystem Services Evaluated in the MA

Status indicates whether the condition of the service globally has been enhanced (if the productive capacity of the service has been increased, for example) or degraded in the recent past. Definitions of "enhanced" and "degraded" are provided in the note below. A fourth category, supporting services, is not included here as they are not used directly by people.

Service	Sub-category	Status	Notes
Provisioning Services			
Food	crops	▲	substantial production increase
	livestock	▲	substantial production increase
	capture fisheries	▼	declining production due to overharvest
	aquaculture	▲	substantial production increase
	wild foods	▼	declining production
Fiber	timber	+/–	forest loss in some regions, growth in others
	cotton, hemp, silk	+/–	declining production of some fibers, growth in others
	wood fuel	▼	declining production
Genetic resources		▼	lost through extinction and crop genetic resource loss
Biochemicals, natural medicines, pharmaceuticals		▼	lost through extinction, overharvest
Fresh water		▼	unsustainable use for drinking, industry, and irrigation; amount of hydro energy unchanged, but dams increase ability to use that energy
Regulating Services			
Air quality regulation		▼	decline in ability of atmosphere to cleanse itself
Climate regulation	global	▲	net source of carbon sequestration since mid-century
	regional and local	▼	preponderance of negative impacts
Water regulation		+/–	varies depending on ecosystem change and location
Erosion regulation		▼	increased soil degradation
Water purification and waste treatment		▼	declining water quality
Disease regulation		+/–	varies depending on ecosystem change
Pest regulation		▼	natural control degraded through pesticide use
Pollination		▼*	apparent global decline in abundance of pollinators
Natural hazard regulation		▼	loss of natural buffers (wetlands, mangroves)
Cultural Services			
Spiritual and religious values		▼	rapid decline in sacred groves and species
Aesthetic values		▼	decline in quantity and quality of natural lands
Recreation and ecotourism		+/–	more areas accessible but many degraded

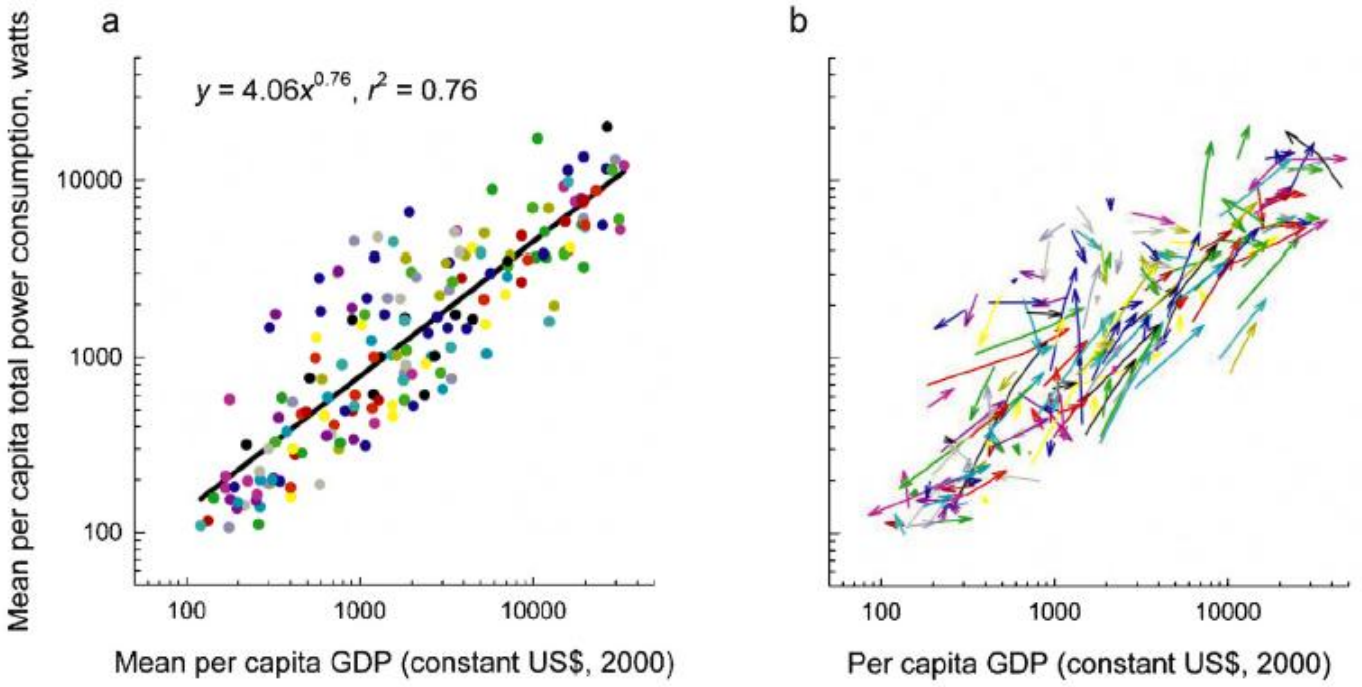


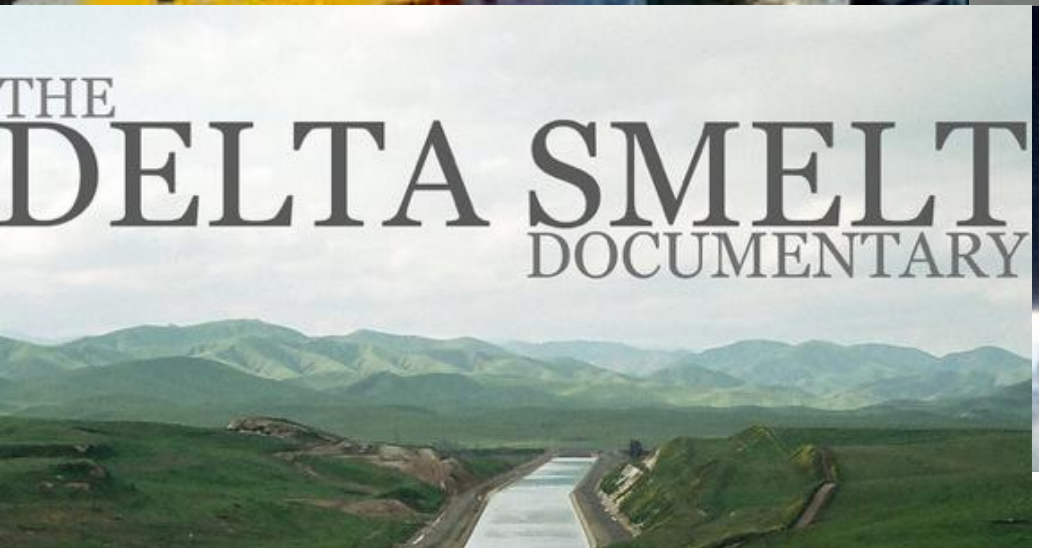
Fig. 1. Relationships between per capita energy use and per capita GDP: (a) Across countries, with each point representing the average energy consumption and the average GDP from 1980 to 2005; (b) over time, with each arrow showing the net change from 1980 to 2005. Note that per capita energy consumption scales as the 0.76 power of GDP (a), and the changes in energy consumption over the 25 years (b) parallels this scaling relationship. Replotted using data compiled by Brown et al. (2011).


AGUA E
NUEST
NO
PEOPLE
ARE MORE
IMPORTANT
THAN FISH!


"SAVE A LOGGER"
"EAT AN OWL"


DISMANTLE
EMPIRE!
I WANT
A
FUTURE
FOR ALL
LIFE!


NO WATER=
HIGHER
FOOD
COST!
CALIFORNIA

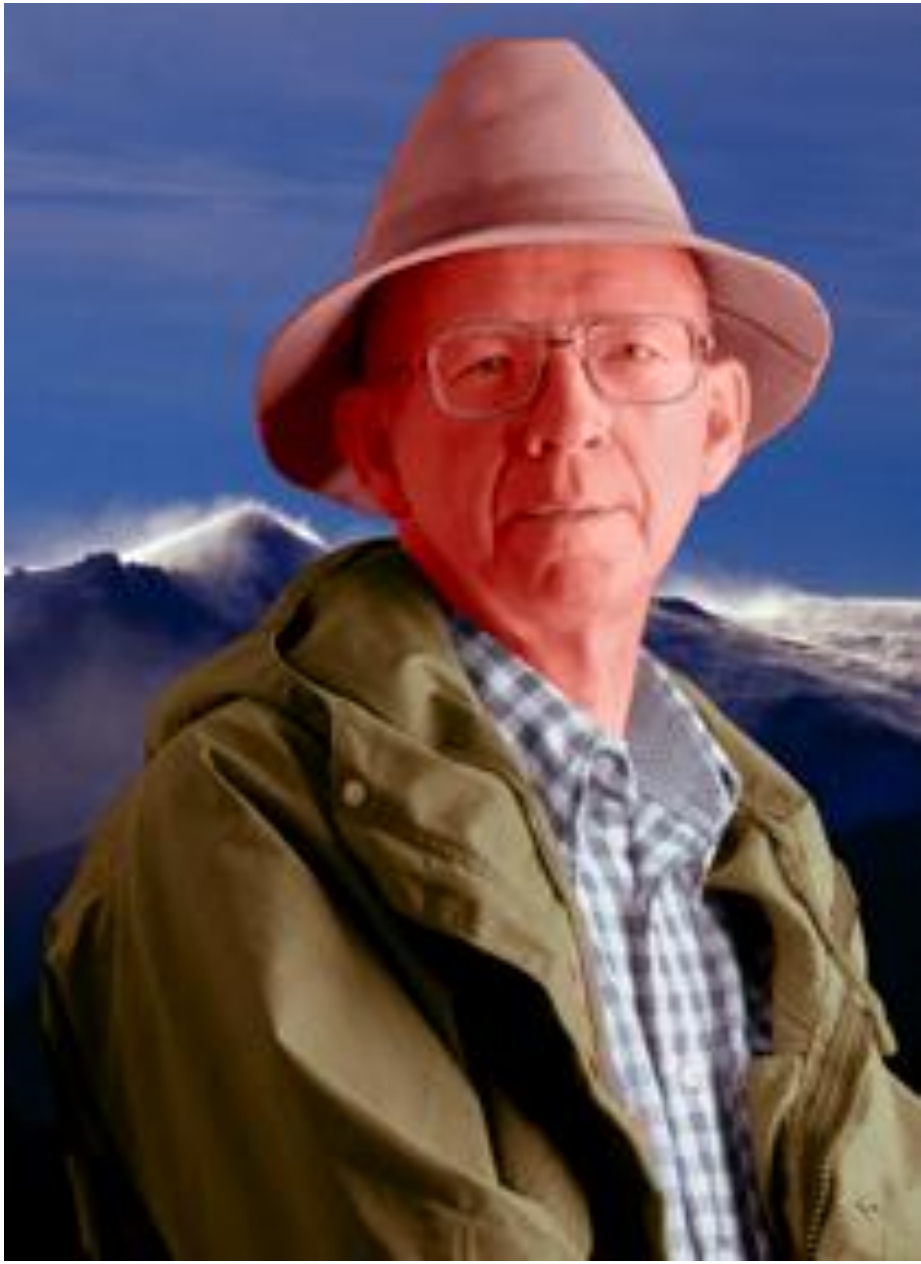

THE
DELTA SMELT
DOCUMENTARY

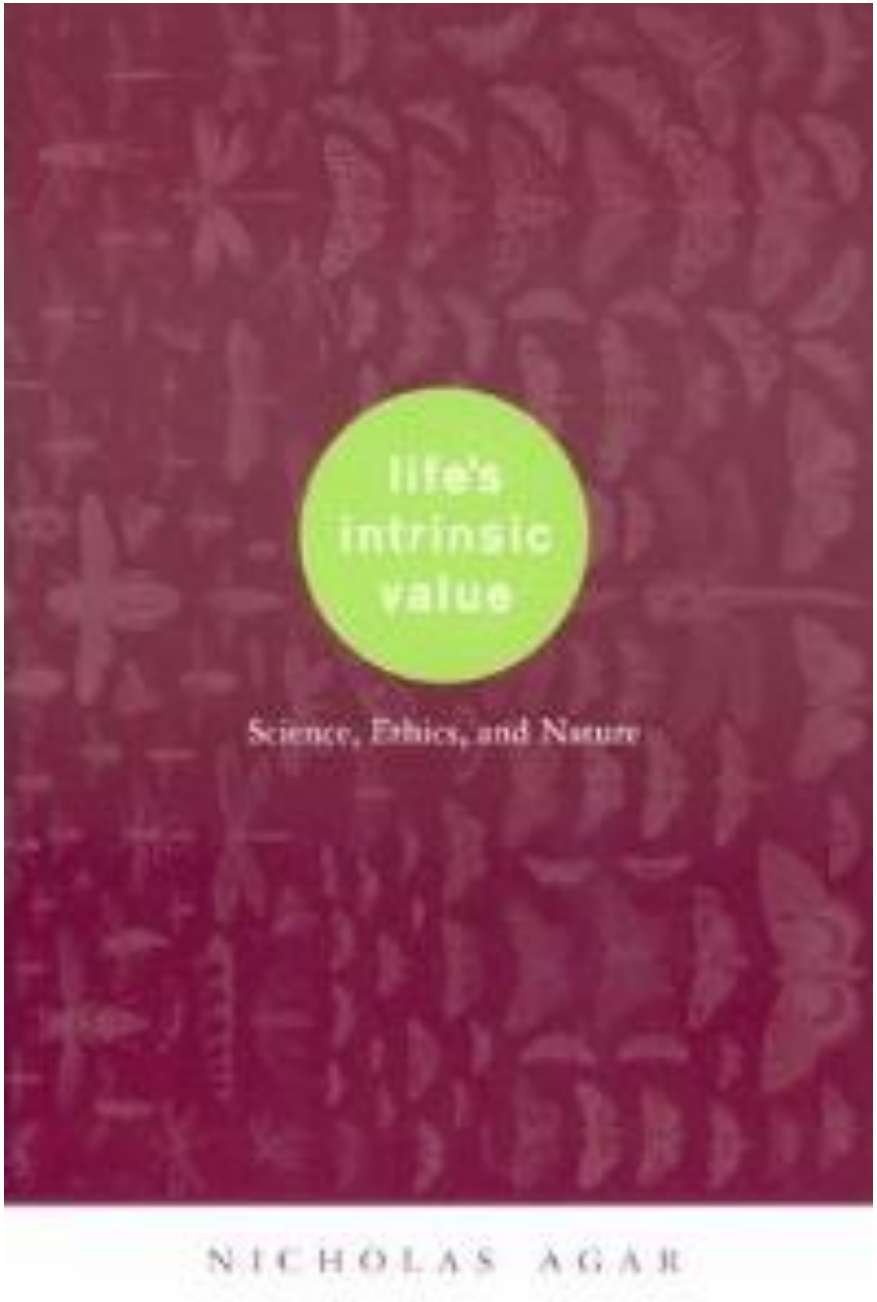

DISMANTLE
EMPIRE!
I WANT
A
FUTURE
FOR ALL
LIFE!

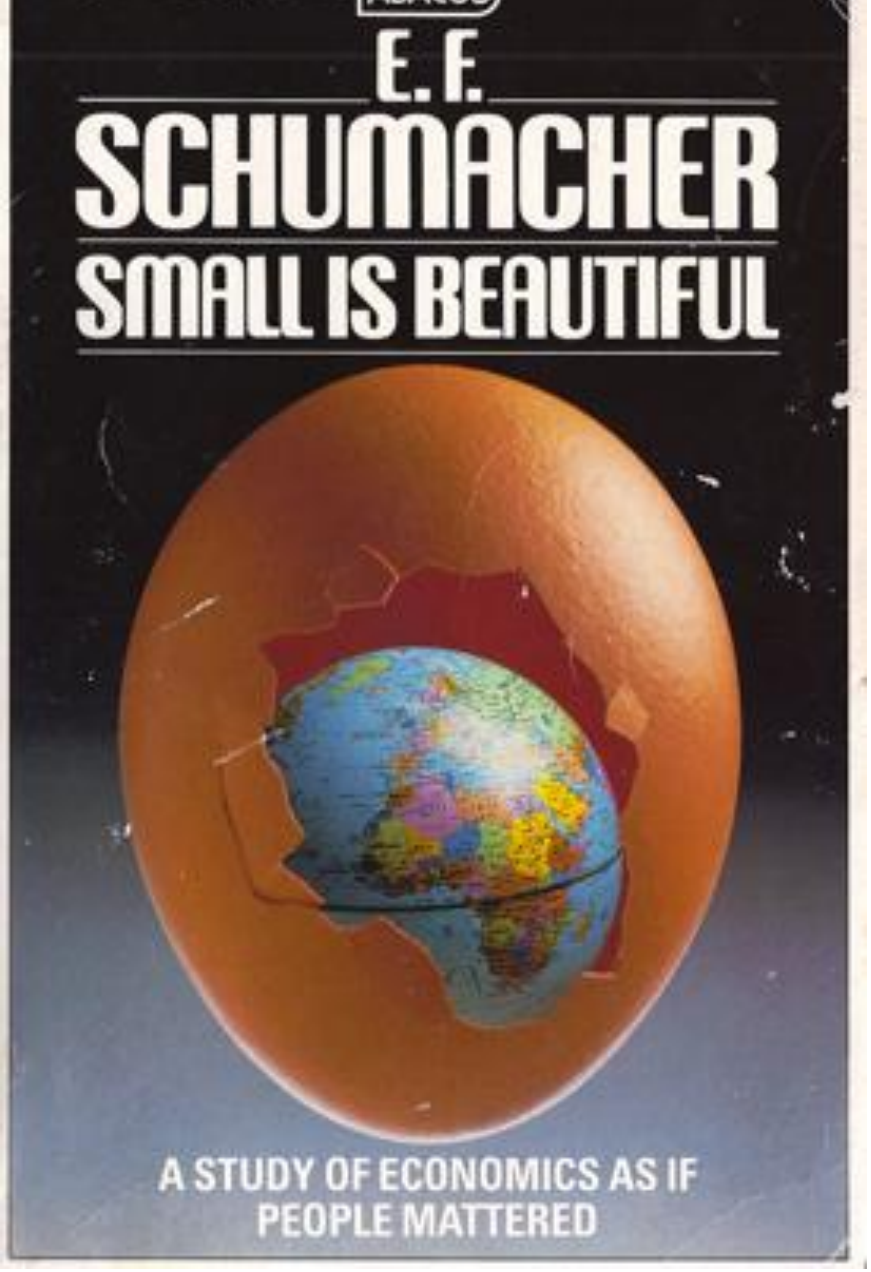
Environmental Ethics

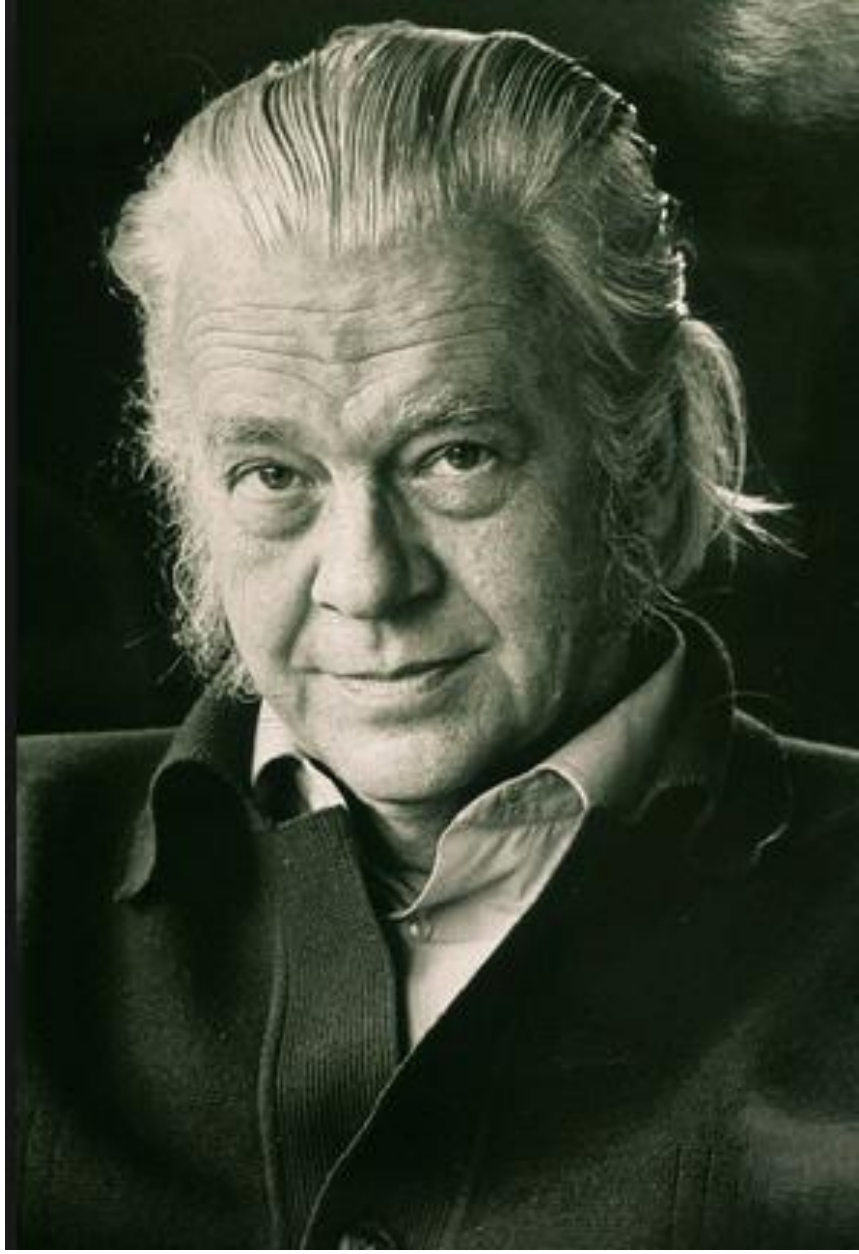
Duties to and Values in The Natural World

HOLMES ROLSTON, III

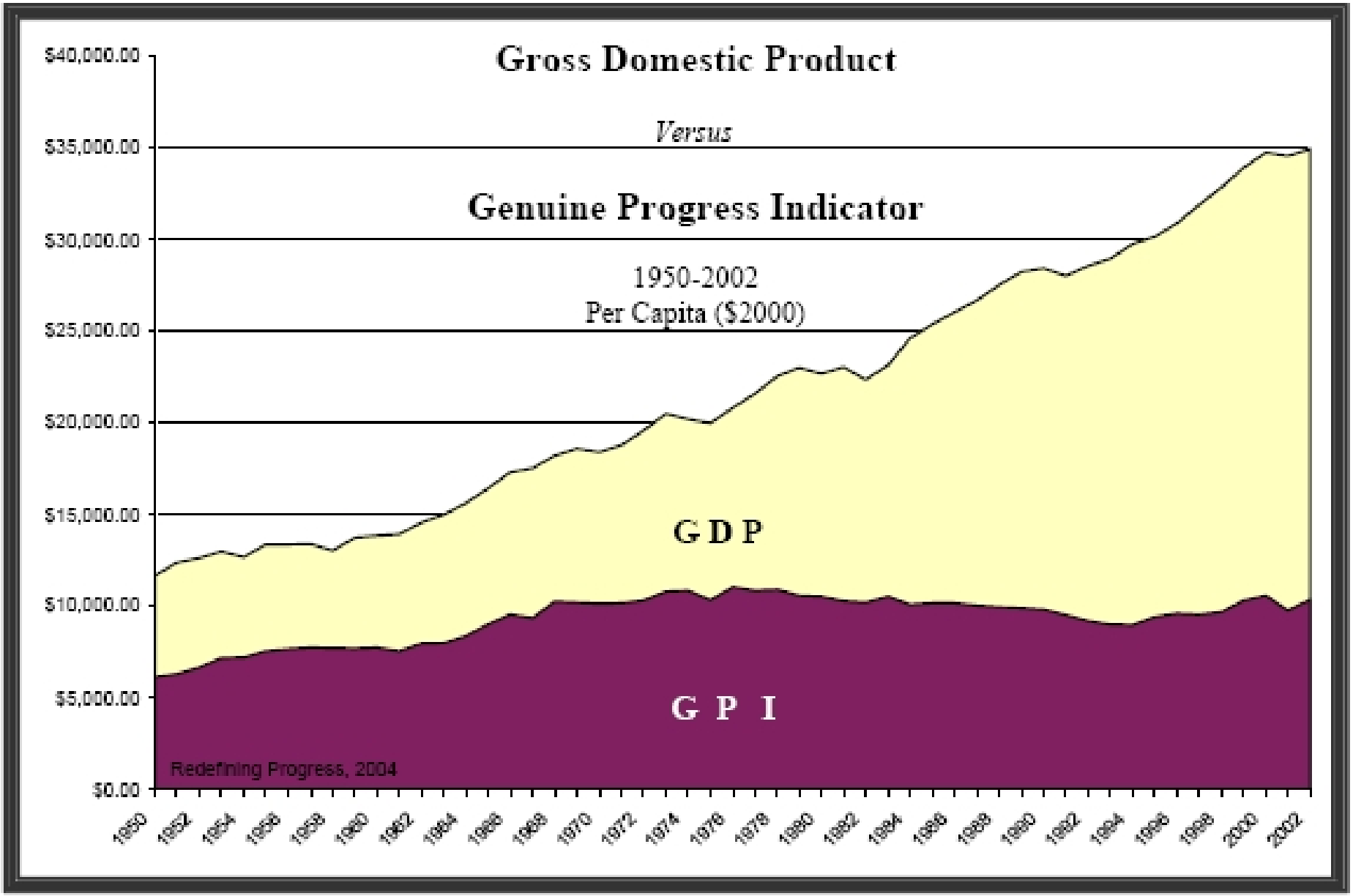



life's
intrinsic
value
Science, Ethics, and Nature
NICHOLAS AGAR


E. F.
SCHUMACHER
SMALL IS BEAUTIFUL
A STUDY OF ECONOMICS AS IF
PEOPLE MATTERED

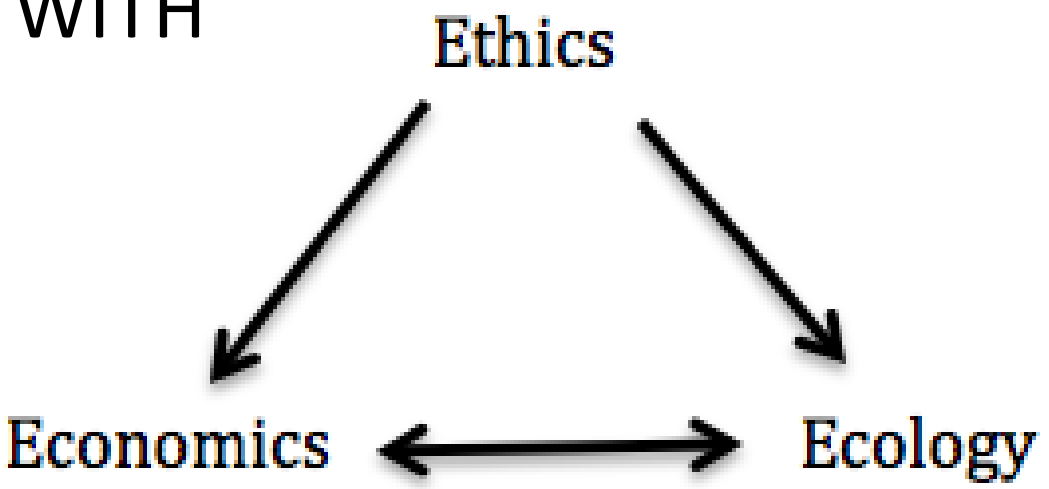


1973

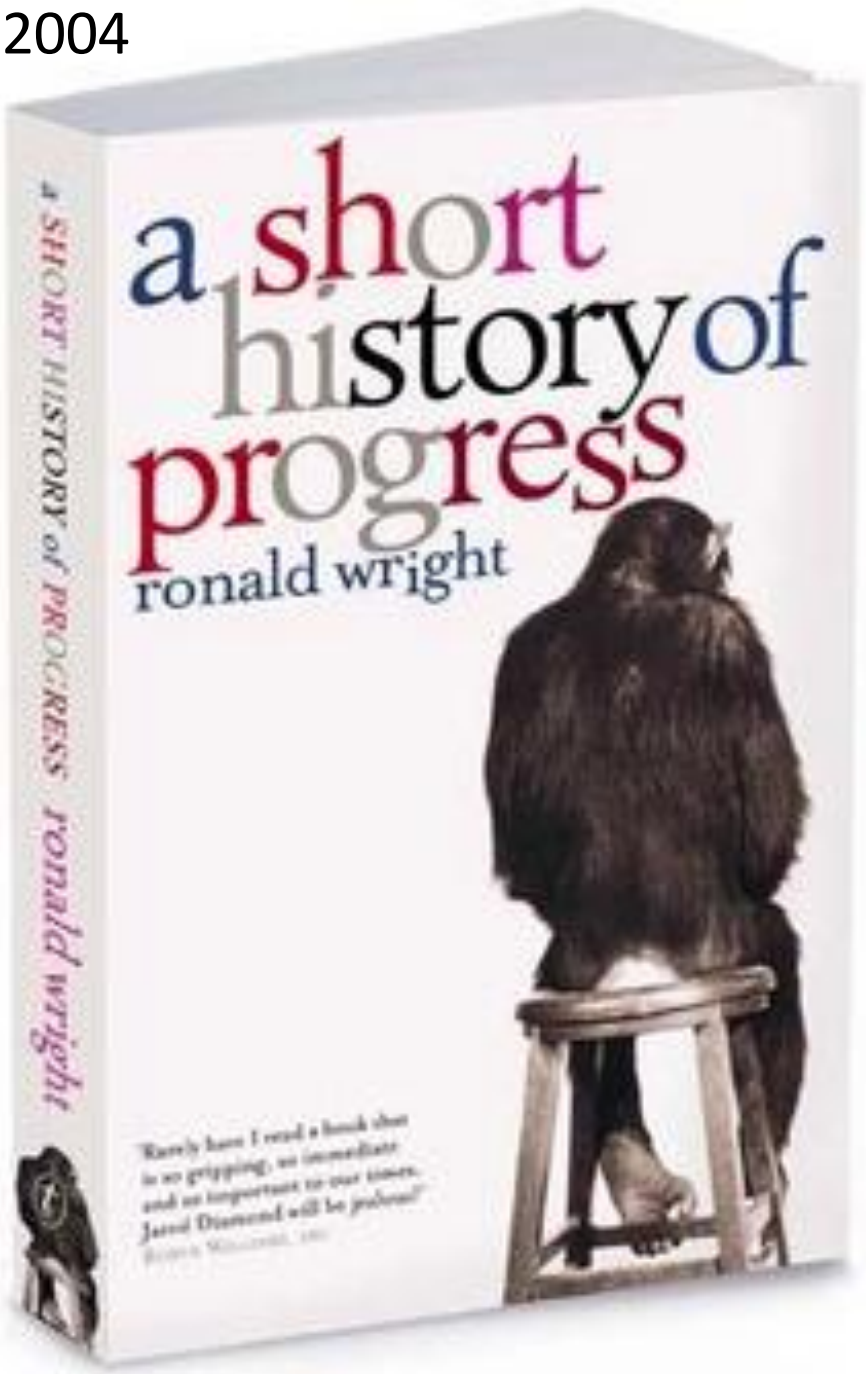

Gross Domestic Product
Versus
Genuine Progress Indicator
1950-2002
Per Capita ($2000)
$40,000.00
$35,000.00
$30,000.00
$25,000.00
$20,000.00
$15,000.00
$10,000.00
$5,000.00
$0.00
G D P
G P I
Redefining Progress, 2004
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

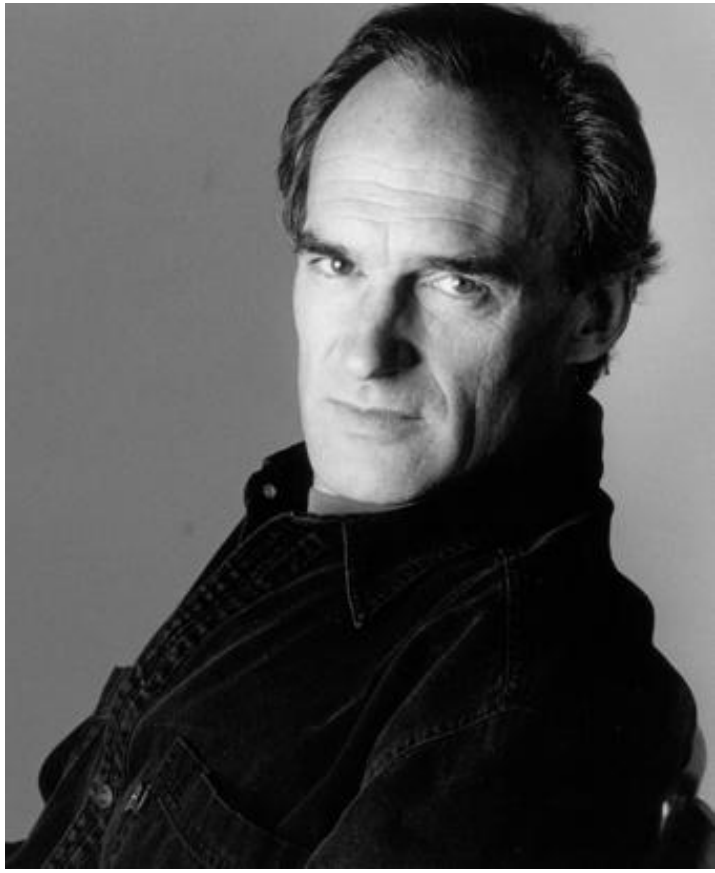
REPLACE

WITH

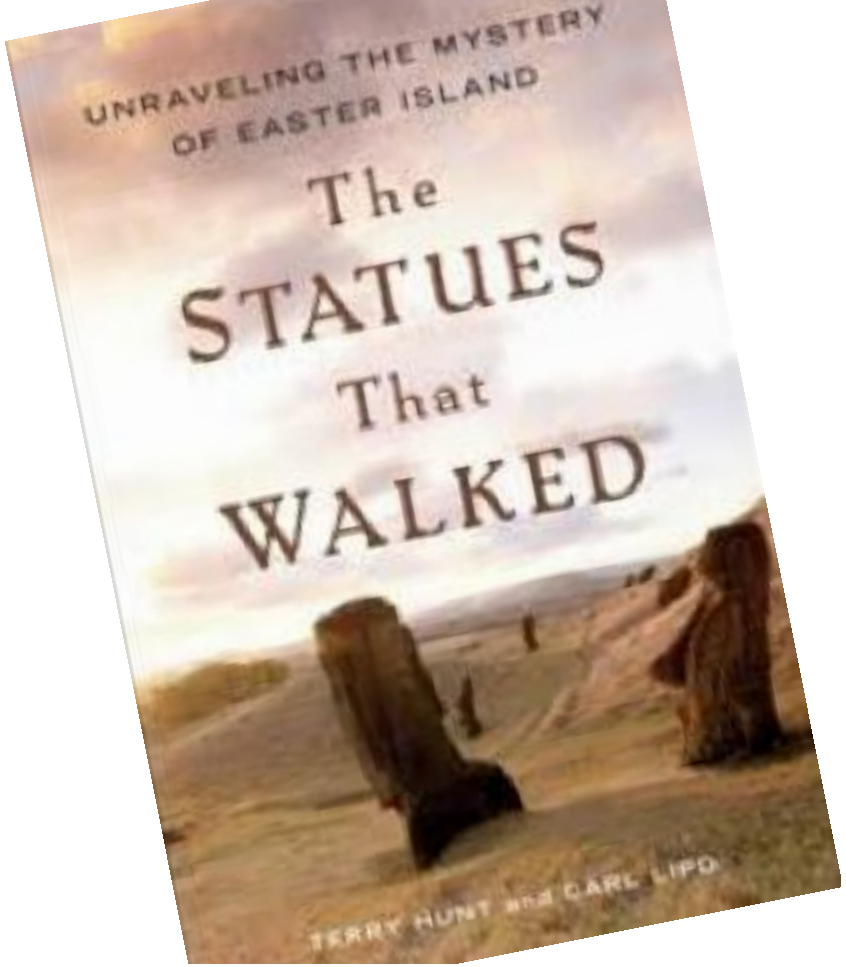


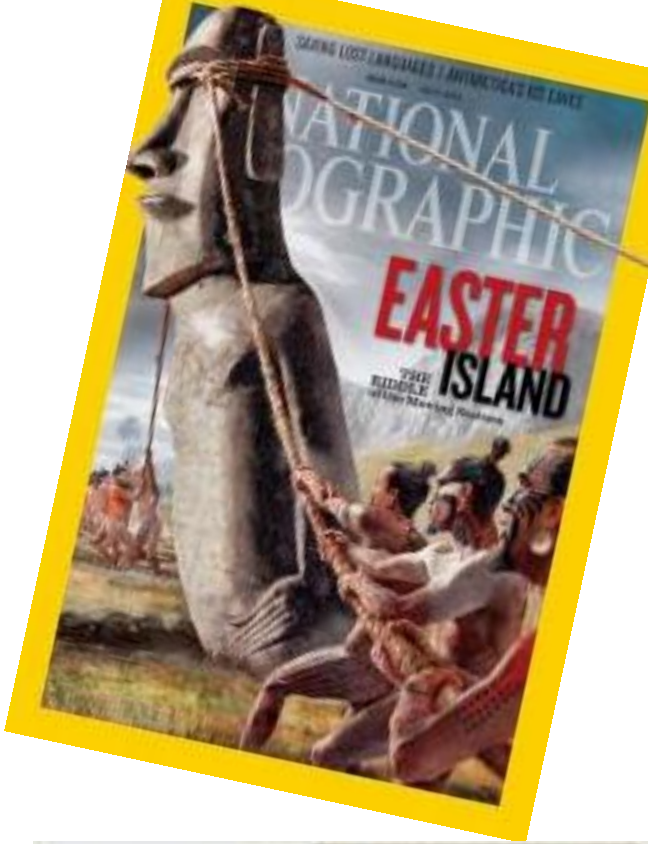
2004





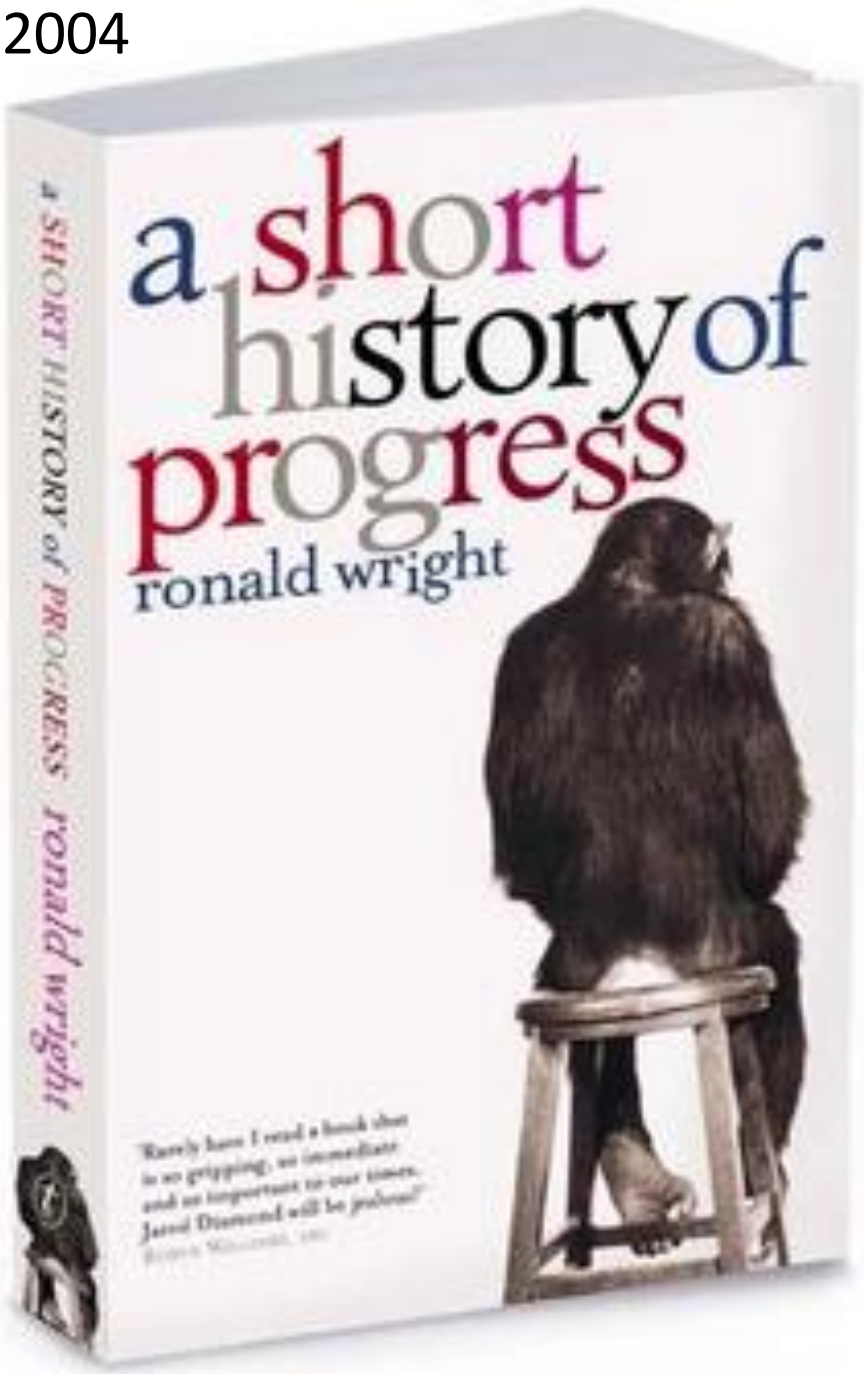
“progress trap”

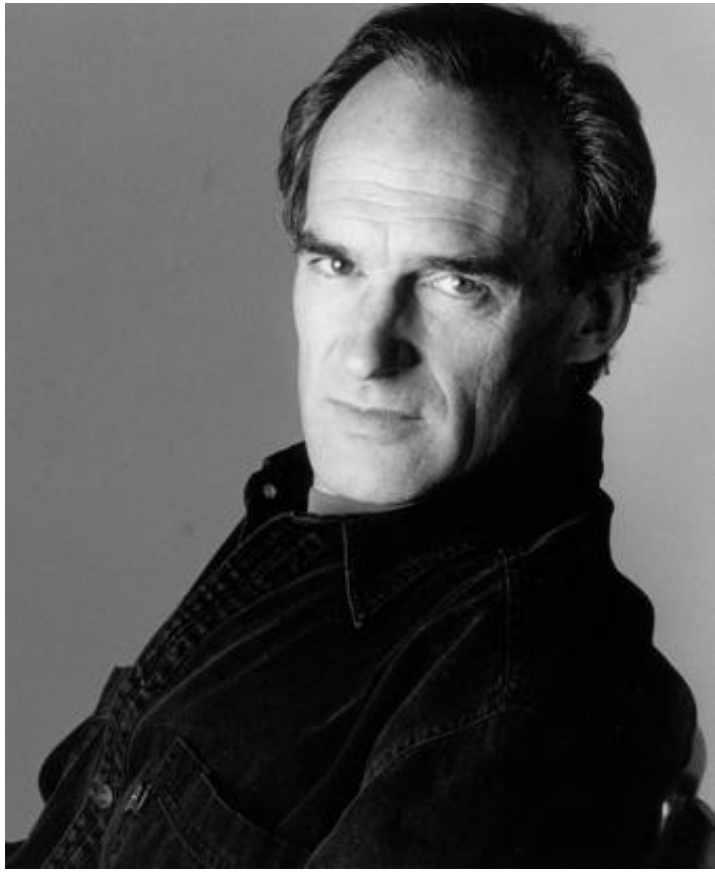




RATTUS EXULANS

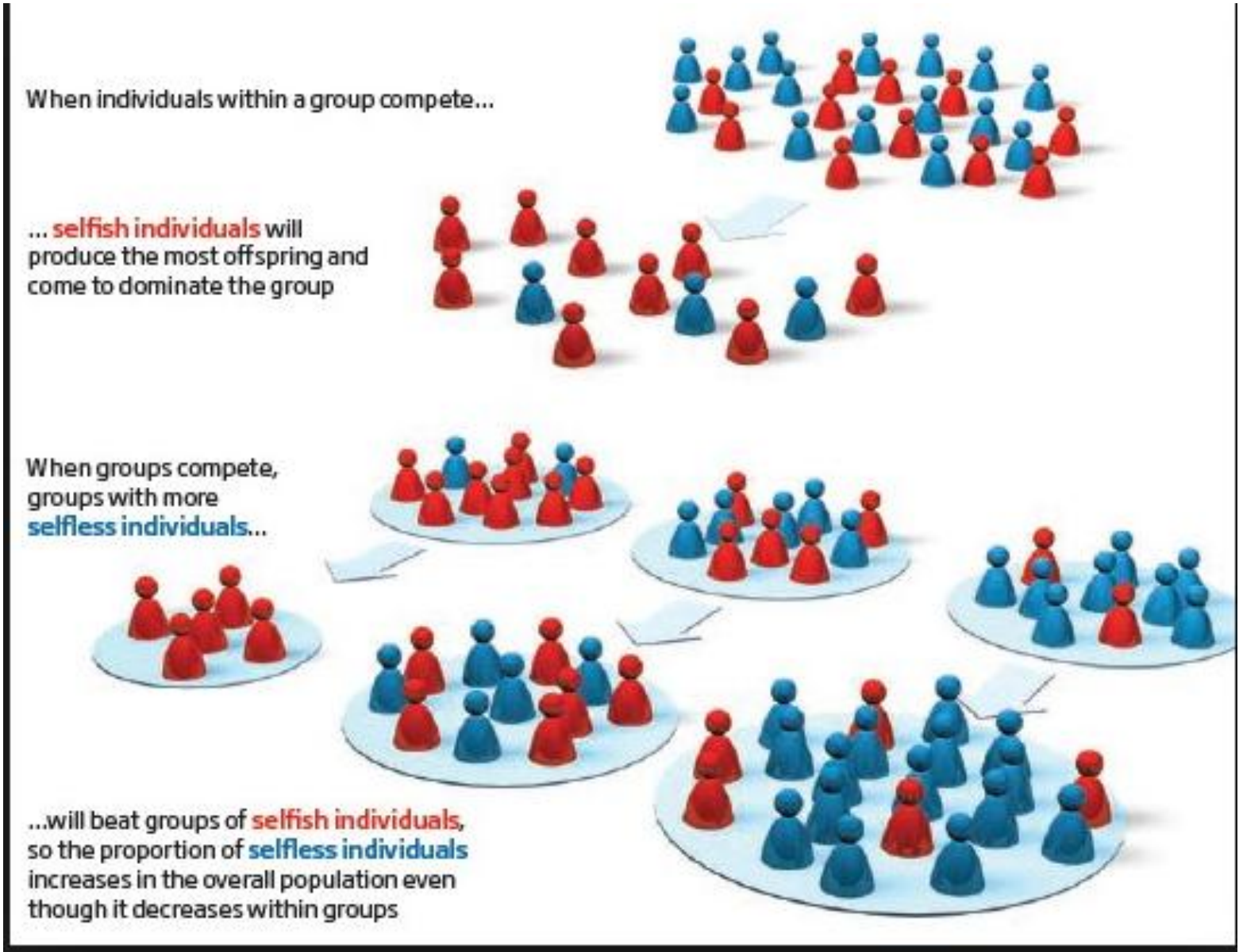
2004





“progress trap”

Natural selection: individual or group-level?



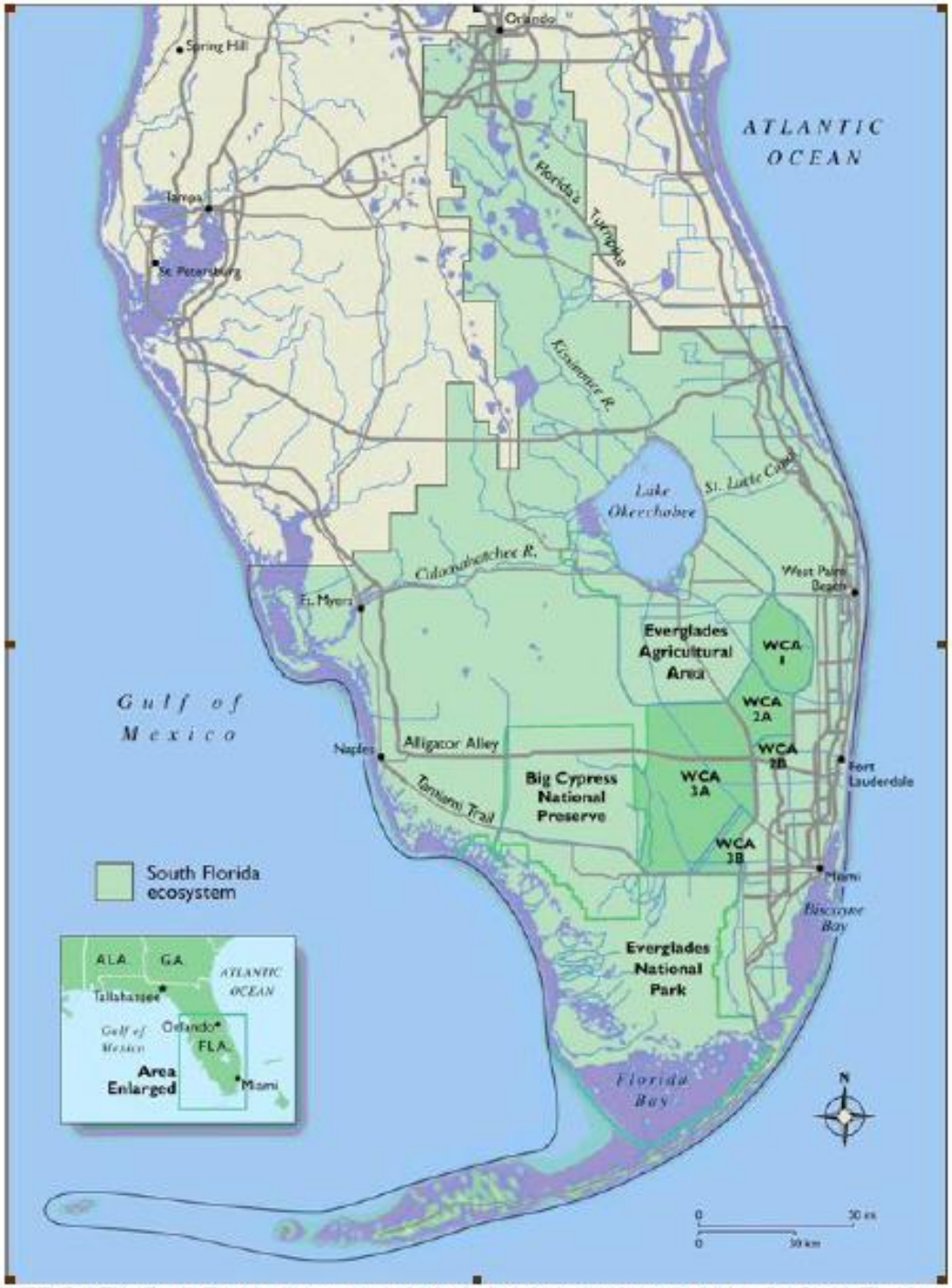


FIGURE S-1 The South Florida ecosystem, which shares the same boundaries as the South Florida

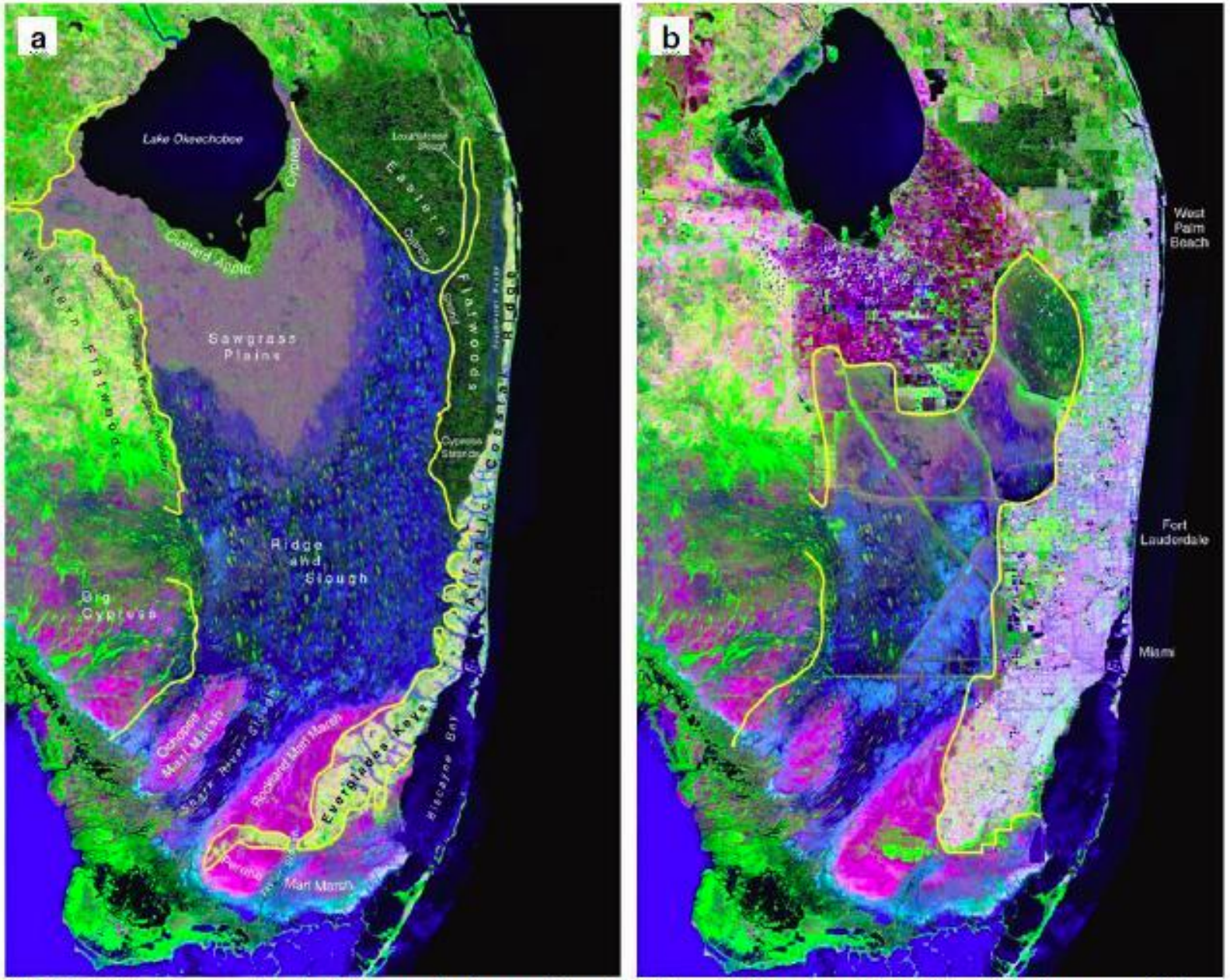


FIGURE 1-1 Reconstructed (a) pre-drainage (circa 1850) and (b) current (1994) satellite images of the Everglades ecosystem.
NOTE: The yellow line in (a) outlines the historical Everglades ecosystem, and the yellow line in (b) outlines the remnant Everglades ecosystem as of 1994.

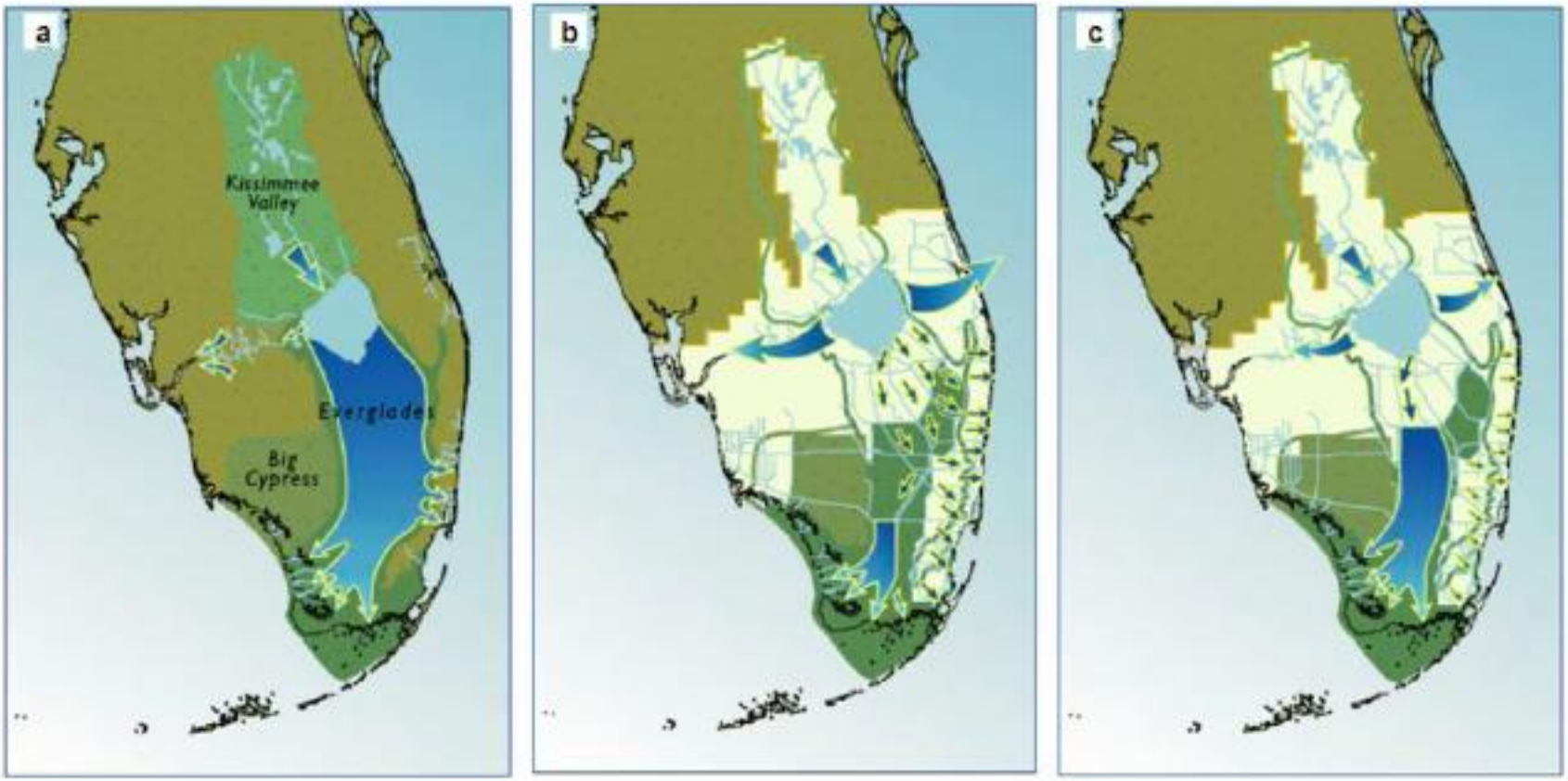


FIGURE 2-1 Water flow in the Everglades under (a) historical conditions, (b) current conditions, and (c) conditions envisioned upon completion of the Comprehensive Everglades Restoration Plan (CERP).

2014

CLIMATE CHANGE
EVIDENCE & CAUSES

An overview from the Royal Society and the US National Academy of Sciences

NATIONAL ACADEMY OF SCIENCES

THE ROYAL SOCIETY

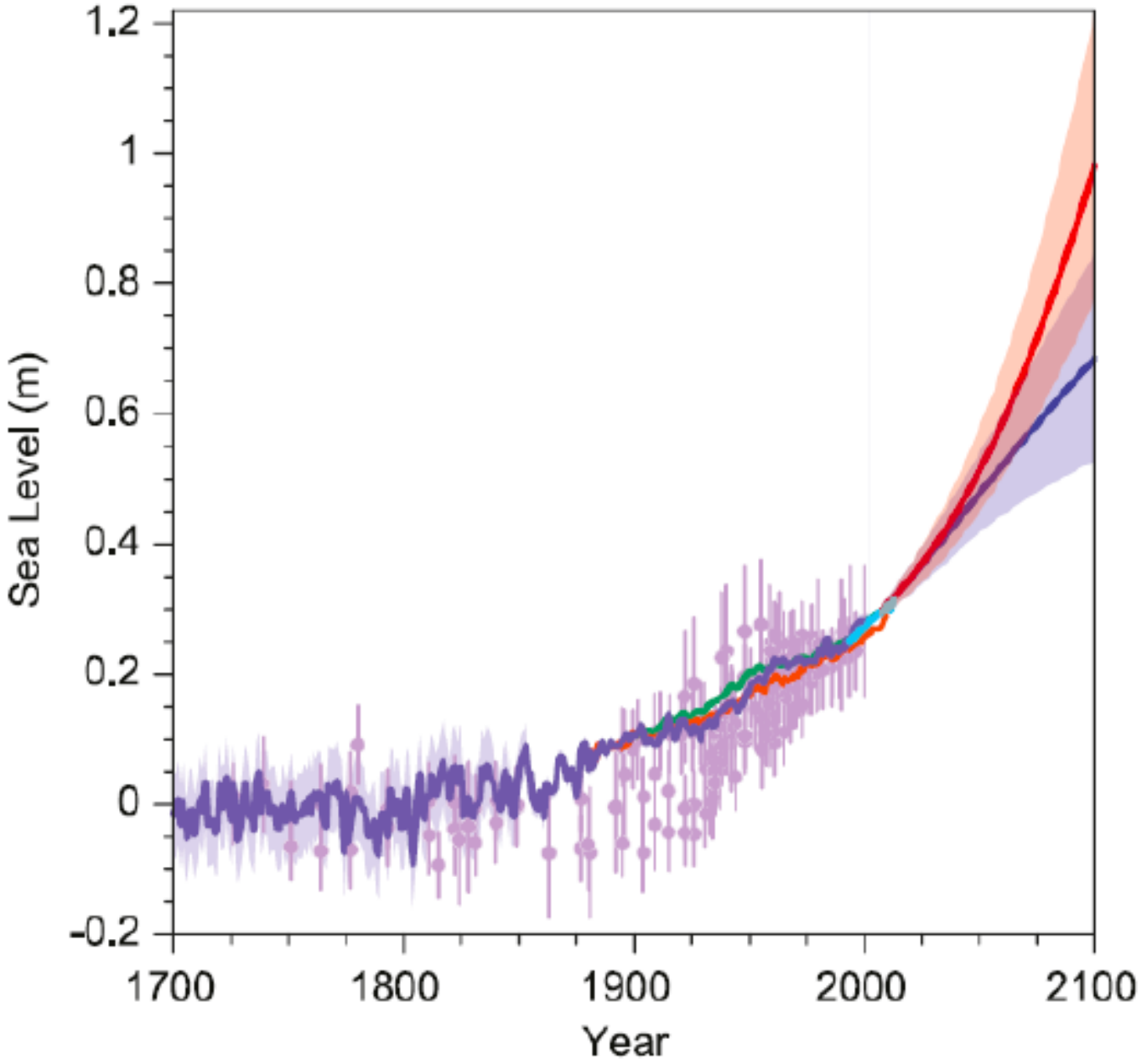


Figure 5-1: Projected global rise in sea level in comparison with historical records. The future projections show median estimates and likely ranges for future sea level rise for the low emissions scenario (RCP2.6; blue) and the high emissions scenario (RCP8.5; red).

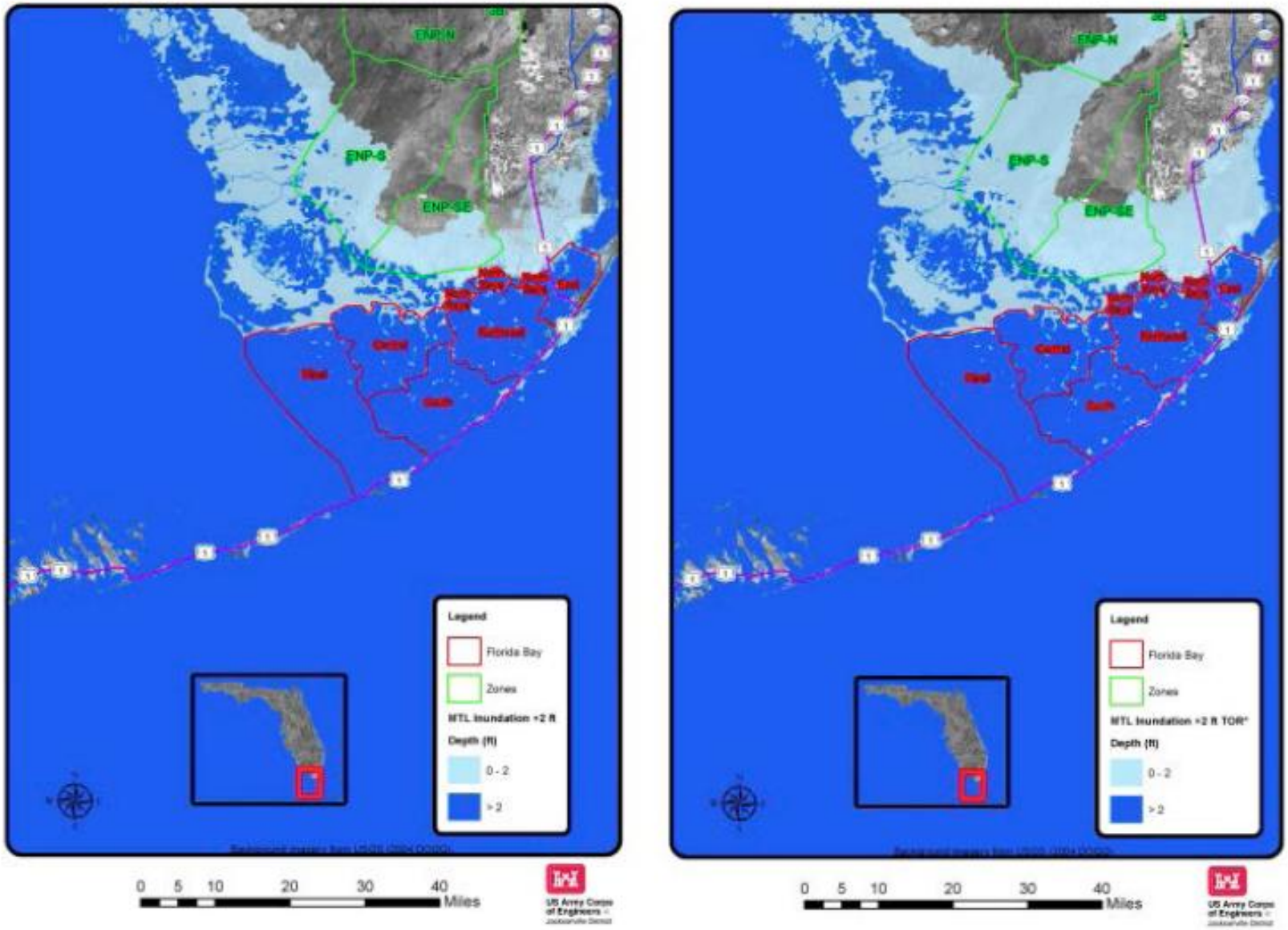


Figure 5-5. Land loss in Everglades National Park based on two feet of sea-level rise (the intermediate scenario for 2100 in Figure 5-4), (a) assuming existing topography and (b) assuming complete loss of peat soils, which leads to substantially greater land loss. Neither scenario considers new sediment accretion.

Scenes of street flooding, like this one on Alton Road in Miami Beach in November, are becoming increasingly common.

Angel Valentin for The New York Times

New York Times, yesterday, May 8, 2014

But three prominent Florida Republicans — Senator Marco Rubio, former Gov. Jeb Bush and the current governor, Rick Scott — declined repeated requests to be interviewed on the subject. Mr. Rubio and Mr. Bush are viewed as potential presidential candidates. Political analysts say the reluctance of the three men to speak publicly on the issue reflects an increasingly difficult political reality for Republicans grappling with the issue of climate change, particularly for the party's lawmakers from Florida. In acknowledging the problem, politicians must endorse a solution, but the only major policy solutions to climate change — taxing or regulating the oil, gas and coal industries — are anathema to the base of the Republican Party. Thus,

New York Times, yesterday, May 8, 2014

Figure 6-5. Old World climbing fern completely blanketing a tree island in the Arthur R. Marshall Loxahatchee Wildlife Refuge.

Figure 6-7. A Burmese python in Everglades National Park.

Figure 6-8. Approximate distribution of Burmese pythons in South Florida from the 1990s to 2010, indicating rapid spread throughout the area.

Figure 6-1. Laurel wilt damage to swampbay trees on an Everglades tree island (left), which is caused by the redbay ambrosia beetle (right). Note the scale; the adult insect is less than 3 mm long.

Figure 6-9. Argentine black-and-white tegu.

Figure 6-10. A wild hog in the Everglades.

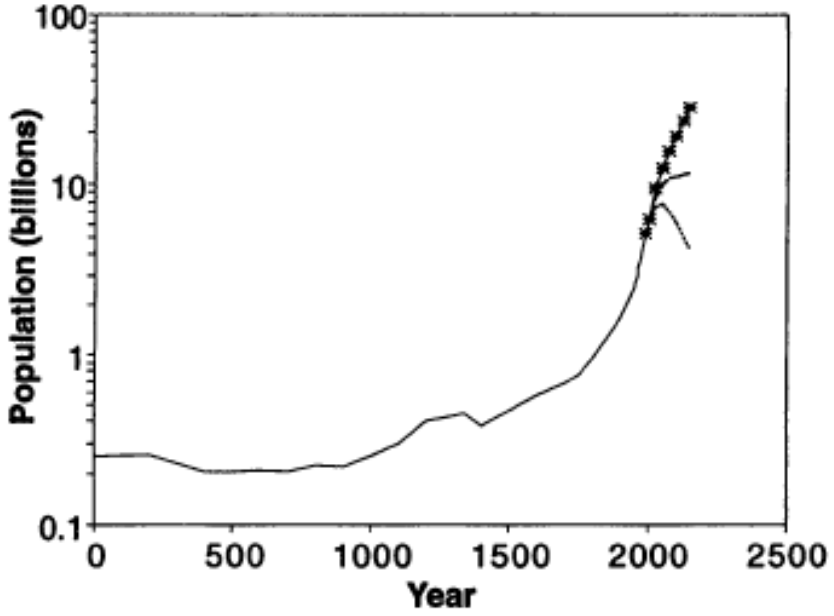


Fig. 1. Recent world population history A.D. 1 to 1990 (solid line) (*53*) and 1992 population projections of the UN (*11*) from 1990 to 2150: high (solid line with asterisks); medium (dashed line); and low (dotted line). Population growth was faster than exponential from about 1400 to 1970.

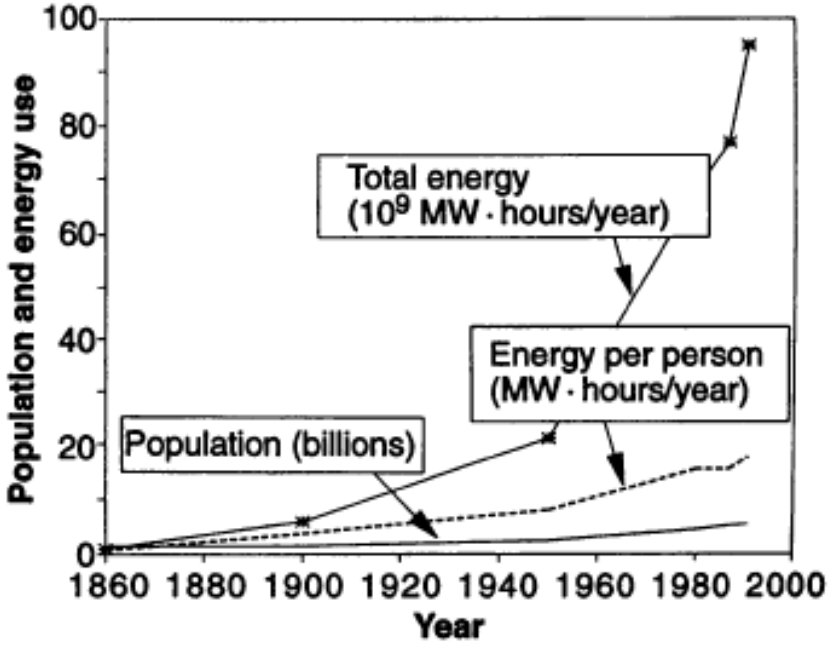


Fig. 2. Inanimate energy use from all sources from 1860 to 1991: aggregate (solid line with asterisks) (*54*) and per person (dashed line). Global population size is indicated by the solid line.

Joel Cohen

Group Selection

- 1962: Wynne-Edwards
- Free-rider problem
- 1972: Williams and Dawkins criticism
- 1990's: Resurrection based on new mechanisms