

## Human Population Dynamics

### I. Introduction

#### A. Significance of topic

1. Human population dynamics essential part of ES
2. It is not enough to understand population *biology* because the population change of such incredibly social animals as *Homo sapiens* mandates the use of the *social* sciences too
3. Highly respected biologists have fostered serious and lasting misunderstandings among the public and decision-makers by making influential pronouncements about human population dynamics based on expertise in biology and ignorance of (or disregard for) social science.
  - a. Paul Erlich's *The Population Bomb* (slide 2 & note below)
  - b. Garrett Hardin's Tragedy of the Commons article (slide 3 & note below)
  - c. Recent example of legacy of these misunderstandings: HCN letter to the editor, 10/1/07 (slide 4)
  - d. What's wrong with these views? We will use social science to think critically about the views of human population dynamics that I will label "neo-Malthusian" (after the good parson, because it all started with him).

## B. Main points

1. The significance of population is not being ignored.
2. We are now well past the time for sounding the alarm.
3. Effective measures to deal with population growth from natural increase are in place all over the world.
4. The end to the population explosion is at hand.
5. The issues today relate to migration policy and how to achieve sustainability in the final phase of the demographic transition.

## C. Sequence of Topics

1. The legacy of Malthus
2. Human population change and distribution
3. Implications for environmental quality
4. Policy implications

### *NOTE:*

*From <http://www.stanford.edu/group/CCB/Staff/Ehrlich.html>:*

Paul R. Ehrlich (1932 – )

President, Center for Conservation Biology

Bing Professor of Population Studies, Stanford University

Paul R. Ehrlich received his Ph.D. from the University of Kansas. Co-founder with Peter H. Raven of the field of coevolution, he has pursued long-term studies of the structure, dynamics, and genetics of natural butterfly populations. He has also been a pioneer in alerting the public to the problems of overpopulation, and in raising issues of population, resources, and the environment as matters of public policy.

Professor Ehrlich's research group covers several areas. It continues to study the dynamics and genetics of natural populations of checkerspot

butterflies (*Euphydryas*). This research has applications to such problems as the control of insect pests and optimum designs for nature reserves. A central focus of his group is investigating ways that human-disturbed landscapes can be made more hospitable to biodiversity. This work in "countryside biogeography" is under the direction of Dr. Gretchen Daily, founder of the field. The Ehrlich group's policy research on the population-resource-environment crisis takes a broad overview of the world situation, but also works intensively in such areas of immediate legislative interests as endangered species and the preservation of genetic resources. A special interest of Ehrlich's is cultural evolution, especially with respect to environmental ethics.

Professor Ehrlich is a fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the American Philosophical Society, and a member of the National Academy of Sciences. Professor Ehrlich has received several honorary degrees, the John Muir Award of the Sierra Club, the Gold Medal Award of the World Wildlife Fund International, a MacArthur Prize Fellowship, the Crafoord Prize of the Royal Swedish Academy of Sciences (given in lieu of a Nobel Prize in areas where the Nobel is not given), in 1993 the Volvo Environmental Prize, in 1994 the United Nations' Sasakawa Environment Prize, in 1995 the Heinz Award for the Environment, in 1998 the Tyler Prize for Environmental Achievement and the Dr. A. H. Heineken Prize for Environmental Sciences, in 1999 the Blue Planet Prize, in 2001 the Eminent Ecologist Award of the Ecological Society of America and the Distinguished Scientist Award of the American Institute of Biological Sciences.

**NOTE:**

From [http://www.garretthardinsociety.org/gh/gh\\_cv.html](http://www.garretthardinsociety.org/gh/gh_cv.html):

Garrett Hardin (1915 – 2003)

1936 University of Chicago - B.S. Zoology

1941 Stanford University - Ph.D. Microbiology

Trained as an ecologist and microbiologist he is best known for his 1968 essay, *The Tragedy of the Commons*, *Science*, 162, now reprinted in over 100 anthologies and widely accepted as a fundamental contribution to ecology, population theory, economics and political science. The application of this essay to the problems of foreign aid and immigration was captured in his 1974 essay *Living on a Lifeboat*, *BioScience*, 24(10), and more recently elucidated in *The Tragedy of the Unmanaged Commons*, *Trends in Ecology and Evolution*, 9(5), 1994.

A common thread throughout his work is an interest in bioethics. Dr. Hardin views bioethics as more than just ethics applied to biological problems. He refers to "toughlove ethics" built on a biological foundation. Essential elements of such ethics are relative quantities, feedback processes, and the changes that time brings forth as unforeseen consequences of actions taken. In his book *Filters Against Folly*, 1985, he argues that ethical theory, to be useful, must employ three intellectual filters: literacy, concerned with the correct use of words, whether written or spoken; numeracy, involving the appreciation of quantities; and ecolacy, the study of relationships over time.

As a Professor of Human Ecology at the University of California for more than thirty years, Dr. Hardin publicly debated the issues of abortion, population control, foreign aid, nuclear power and immigration. He retired from the Santa Barbara campus in 1978, devoting himself to writing and speaking. His 1993 *Living Within Limits: Ecology, Economics and Population Taboos*, Oxford University Press, received the Award in Science by the honor fraternity Phi Beta Kappa.

Dr. Hardin's most recent books include *The Immigration Dilemma: Avoiding the Tragedy of the Commons*, Federation for American Immigration Reform (1995), *Stalking the Wild Taboo*, The Social Contract Press (1996), and *The Ostrich Factor: Our Population Myopia*, Oxford University Press (1999). Dr. Hardin was awarded the 1997 Constantine Panunzio Distinguished Emeriti Award, each year honoring one retired member of the nine-campus University of California system for continued scholarly productivity. Dr. Hardin has published over 350 articles and 27 books. Over 700,000 copies of his books have been sold.

## II. "An Essay on the Principle of Population" (1798, later revised)

- A. One of the most influential essays on human population ever to be written, published anonymously in 1798.
- B. Highly polemical debates have repeated themselves since then.
  - 1. Earth First! bumper sticker "Malthus Was Right!"

2. As you listen to this historical summary of debates about human population growth, try to find the roots of your own convictions on the subject.

C. Thomas Robert Malthus (1766-1834) – **slide 5**

1. Malthus the Grim Reaper?
  - a. It was his *Essay on Population* that earned economics the nickname of “The Dismal Science.”
  - b. In popular imagination, he is not far from the Grim Reaper; thought to have taught that famine, war and pestilence are nature’s way of dealing with overpopulation.
2. This is a distortion. He was really a friendly and mild-mannered English parson, political economist and mathematician who also had a talent for writing rather pessimistic assessments of the possibilities to eliminate suffering in the world.
3. It is true that his *Essay* was pretty sobering and his views on social policy were often harsh.
  - a. Observe, in graph, **when** he wrote *Essay*, i.e., at beginning of industrial revolution, when world population suddenly began to grow 10X faster than ever before (*though there were no reliable statistics on population at even national level then, let alone global*)

- b. Argued that growth in population would outstrip growth in food supply because one increases exponentially (e.g., 1, 2, 4, 8, 16 ...), the other arithmetically (e.g., 1, 2, 3, 4, 5 ...)
  - c. Predicted that, without voluntary restraints (*later marriage and celibacy until couple could support children*), the population would be reduced through famine, war and epidemics
  - d. Opposed existing form of government assistance for poor families because it was proportional to number of children, providing incentive for more, thus increasing the population of miserable people
4. But his sinister side has been distorted by his followers, who have turned out to be much more sinister, as we shall see.
- a. Softened 1798 *Essay on the Principle of Population* through six major revisions in the beginning of the 19<sup>th</sup> century
  - b. Argued for universal education, believing that schooling would help the poor more than financial assistance
  - c. Also advocated free medical care for the poor, state assistance to emigrants, direct relief to casual laborers or families with more than 6 children, and an extension of suffrage

- d. He opposed child labor in factories and he even opposed free trade when it was against the public interest.

#### D. Context of *Essay on the Principle of Population*

1. Turn of the 19<sup>th</sup> century in Europe a time for taking stock and looking forward
  - a. Intellectuals and radicals were optimistic about the possibility of perfecting humankind and its social systems
    - i. French revolution in 1789, when Malthus was 23
    - ii. Visions of Utopia were being published based on the Enlightenment belief in progress through science and reason
  - b. Malthus' father prided himself in being in the forefront of such intellectual discussions and he even associated with such leading thinkers as Rousseau (*who came to their house when T.R. was a baby*).
2. Stimulus and central objective
  - a. The *Essay* was written as result of on-going intellectual debate with his father about the perfectibility of humankind and human social systems.
    - i. Unlike his father, Robert (*never referred to as Thomas*) held that an egalitarian utopia is impossible because it would violate the laws of nature.

- ii. The issue was, and still is for many people, are the evils of the world, such as poverty and all its associated miseries, the result of defective social institutions, which might be improved? Or are they the inevitable result of natural laws, including something about human nature?
  - b. For Malthus, the animal urge to procreate was designed by God to conflict with the limitations of the environment for food and shelter. This was our stimulus to work and rise from savagery and sloth.
  - c. For him, contraception was immoral and population increase was good because it fulfilled the commandment to multiply and subdue the earth, but it was good only insofar as we were able to provide for our offspring
- E. Malthus' *Essay* tremendously influential in 18<sup>th</sup> & 19<sup>th</sup> centuries
- 1. The political Right used this as justification for their policies.
  - 2. The Left harshly attacked it for this *reason (justification of social inequality)*. Karl Marx (1818-1883) said cause of hunger and misery was capitalist exploitation, i.e., poor had fed themselves reasonably well as peasants and only became destitute when they became wage laborers, losing
    - a. **Means of production** (*land, tools, seeds, etc.*) and



- b. The ability to profit directly from what they produced with their own labor (*through consumption and sale*)
3. Effect on the science of ecology
- a. Worster: “Darwin’s reading of Malthus can make a good claim to being the single most important event in the history of Anglo-American ecological thought.” (*Nature’s Economy*, p. 149)
  - b. Both Charles Darwin and Alfred Wallace claimed to first entertain the idea that species evolve under natural selective pressure for survival in an environment with limited resources and intense competition because of their readings of *the Essay on Population*.
  - c. Today, this evolutionary perspective informs all of biology.
  - d. It is highly doubtful that the influence of Malthus was necessary but it was the spark because of the parallel logic in the analysis of both social and biological aspects of population growth.
  - e. This sort of parallel thinking is why Malthusian and Neo-Malthusian arguments make perfect sense to most biologists. Biology classes and publications and pronouncements by biologists on population were universally Neo-Malthusian until recently and many still are. Many of them have an excellent

understanding of biological population dynamics but a rudimentary comprehension of the social, political and ideological heritage of neo-Malthusian ideas.

- f. On the other hand, a significant block of social scientists tends toward the other extreme.
- g. Because of the way we have divided up the disciplinary turf in academia, and also because of the respect among the general public for natural and physical *scientists (as opposed to social scientists)*, neo-Malthusian ideas are extremely influential in the public mind.
- h. We must come out of the old polemical trenches and formulate some more nuanced and useful perspectives.

4. **Social Darwinism**, created in late 19<sup>th</sup> century by Herbert Spencer, applied the theory of natural selection to human society.

- a. Poor people were poor because they were less fit.
- b. Greater mortality among the poor strengthened the human race.
- c. Social institutions also evolve by natural selection, with the best surviving in the long run.
- d. Malthus was never that extreme.

F. Legacy in our times

1. Post WWII preoccupation with “development” and growing populations of “developing countries” as threat to international stability (*including economic stability*)
2. Concern with “Population Bomb” led to **Neo-Malthusian** perspectives, often couched in ecological concept of “**Carrying Capacity**”
  - a. New perspectives, compared to Malthus
  - b. Neo-Malthusians today see population explosion coupled with real declines in means of subsistence, whereas Malthus simply saw limited increases in means of subsistence AND he was thinking in terms of food and shelter, not minerals, energy, waste absorption capacity, fisheries, old-growth timber, etc..
  - c. Neo-Malthusians promote contraception and access to abortion, which were both sinful in Malthus’ view.
3. Legacy for 21<sup>st</sup> century
  - a. Today, as at turn of the 19<sup>th</sup> century in Europe, is a time for taking stock and looking forward
  - b. Neo-Malthusians were dominant until recently, at least in environmental circles. **They are much closer to Grim Reapers than Malthus ever was.**

- i. Neo-Malthusians have promoted the view that there is no alternative to forced birth control, as Hardin concluded in “The Tragedy of the Commons.”

*“No technical solution can rescue us from the misery of overpopulation. Freedom to breed will bring ruin to all.”*

- ii. Some neo-Malthusians oppose international aid for the poor

- (a) Paul Ehrlich took this position in *The Population Bomb*, but later moderated his stand.

- (b) An Earth First! leader once wrote, during a severe famine in Ethiopia:

*The worst thing we could do in Ethiopia is to give aid.*

*The best thing would be to just let nature seek its own balance, to let people there just starve.*

- (c) Extreme neo-Malthusians see AIDS as a natural population control mechanism

- (d) Basically, neo-Malthusians have this image in their heads (slide 6)

G. Opponents still operate under the assumption of the perfectibility of humans and human society through reason and science, which leads them to conclude that natural limits are in no way close to being reached, if they exist at all.

1. Left-leaning opponents argue that inequality (*in wealth, political power, education, etc.*) is the root cause (*of problems like poverty, disease, war, environmental destruction*) and that population growth is only a symptom (slide 7)
  - a. Poor have traditionally needed large families so children can increase family income and support elderly
  - b. Inequitable distribution of resources keeps them poor
  - c. Male privileges are obstacles to women's desires for smaller families, another example of how population is a symptom of inequalities.
2. Free-market conservatives and technological optimists
  - a. Argue that interference in free markets is the only obstacle to prosperity and environmental quality for all
  - b. Believe that science can always develop technological solutions to population-related problems, as it has in past
    - (1) Food supplies have increased faster than population since Malthus' time
    - (2) In all, technology has made it possible to support ~1,000x more people/unit area than was possible 10,000 years ago.
  - c. Population growth is seen as an asset because people are seen as resources

- (1) More minds to apply to solving problems
- (2) More workers
- (3) Larger markets

H. “Malthus was right,” says a popular bumper sticker. In fact, he was wrong about many things. Yet, over 200 years later, his thought, along with many extensions, modifications and distortions of it, is still in the center of debate over the future of the planet and of humanity in the coming millennium. **We are still engaged in the old debate, which preoccupied Robert and his father, over perfectibility of humankind and human social systems within the limitations of the natural environment.**

### III. Human Population Change & Distribution

#### A. World population explosion (slide 8)

- 1. For most of human history, the population was virtually stable (~1.5 million)
- 2. First of 3 growth periods: 8,000 B.C. to A.D. 1750
  - a. Pop. grew from 5 million to 800 million
  - b. Reason: the **agricultural revolution** (*plant and animal domestication*)
- 3. Second growth period: 1750 to 1950
  - a. Pop. grew to 2.5 billion

b. Reason: the **industrial revolution**

4. Third growth period: 1950 to present, caused by “**medical revolution**” (*spread of advanced medicine after WW II*)
5. Another way of looking at it is to count the time between reaching the billion marks on the graph (**slide 9**)
6. Graph levels off by the end of the next century based on a projection from the current decline in birth rates (*it takes that long because there are so many children in the world now who are growing up to be parents*)

B. The Demographic Transition (**slide 10**)

1. **Demographic transition** model is best known model of historical patterns of human population dynamics
  - a. Based on 4 stages of population growth followed in currently wealthiest countries during the course of their economic development
  - b. Originally suggested in 1945 as irreversible trajectory
  - c. Now seen as having some, but uncertain, predictive capability
  - d. Stage One
    - (1) High BR & DR
    - (2) Most of human history spent in stage 1 but now no stage 1 country remains
  - e. Stage Two

- (1) High BR but dramatic fall in DR
- (2) Therefore, high rate of natural increase
- (3) Came with industrial revolution in Europe & North America (late 18<sup>th</sup> to 19<sup>th</sup> centuries; public health improvements with increased wealth & improved technology)
- (4) Came in latter 20<sup>th</sup> century for former colonies (new technology for food production & disease control)
- (5) Things that often (not always) lead to higher birth rates
  - (a) Children as source of pleasure and pride
  - (b) Children as social security
  - (c) Children as family labor force
  - (d) High infant mortality requires high fertility
  - (e) High value placed on boys
  - (f) Large families may increase social status of parents, especially the father
  - (g) Social and cultural incentives
    - Religious prohibitions against artificial contraceptives and abortion (although not as effective as before, at least for Roman Catholics)
    - Governmental incentives

f. Stage Three



- (1) BR falls rapidly
- (2) Rate of natural increase decreases (but population still growing)
- (3) Came in first 1/2 of 20<sup>th</sup> century for Europe & N. America
- (4) All over the world now
  - (a) Use of family planning worldwide <10% of married women in 1960s; now ~60%
  - (b) Whereas shift to smaller families took 100-150 yrs. in U.S. & Europe, has already dropped almost as much in “developing” countries in only few decades.
  - (c) Including China, ¼ of pop. in developing world lives in countries with below-replacement fertility.
- (5) Things that can lead to declining birth rates
  - (a) Coercion only works in the short term (besides being unethical from the perspective of most people)
  - (b) Voluntary reduction in numbers of children
    - Reductions in infant mortality (*“There has never been a sustained drop in birth rates that was not first preceded by a sustained drop in infant and child mortality. ...saving 5 million children each year from*

*easily preventable communicable diseases would prevent 20 or 30 million extra births.” Cunningham)*

- Move from rural to urban setting changes children from assets to liabilities
- Entrance of women in labor force
- Increased power of women to make fertility choices
- Increased availability of birth control
- Evolving environmental ethics, increasingly biocentric, in which population reduction is a goal for some

g. Stage Four – return to balanced BR & DR, leading to stable population size (explaining the leveling of the graph of world population growth in your expected lifetimes)

2. Importance to pop. of the history of European colonialism

- a. Prior to the Industrial Revolution, all societies were basically agrarian.
- b. In Europe, Industrial Revolution brought:
  - (1) Medical advances (reducing infant mortality)
  - (2) Urbanization & industrialization
  - (3) Opportunities for emigration to the New World
- c. First two factors reduce BR & third also reduces pop.

- (1) In imperial countries, the decrease in birth rates came soon after and along with the decrease in death rates, so very rapid population growth never appeared.
    - (2) In former colonies, birth rates remained high longer, causing very rapid population growth.
  - d. Today's LDCs are largely former European colonies and were kept agrarian to supply cash crops to industrializing Europe.
  - e. Independence came as late as mid-20th century, so affects of urbanization and industrialization on birth rates came much later or still to come.
  - f. Medical revolution after WW II further lowered DR and pop. explosion resulted. **(slide 11)**
3. Problems with demographic transition model
- a. Does not allow predictions, only explanations after the fact
  - b. Unexpectedly sharp declines in fertility over last 2 decades in places not predicted by model **(slide 12)**
    - (1) TFR fell by nearly 2/3 in the 14 largest "developing" countries, including India and China
    - (2) These changing patterns not correlated (in regular, predictable pattern) with anything (such as economic growth, urbanization, reduction in poverty, cultural/social

change, distribution of land, religious belief, national policies, etc.) (slide 13)

4. Conclusions about how pop. patterns change over time
  - a. Human reproductive behavior is variable and difficult to predict from past patterns
  - b. Demographic transitions can only be understood as part of more general socioeconomic transitions which are complex and highly varied.

C. Future possibilities

1. BR declining worldwide (slide 14) ...
2. But **population momentum** will cause total population size to continue to grow rapidly for a few decades more
  - a. Definition - refers to population growth due to large # young people entering reproductive age (slide 15)
  - b. It's like putting the breaks on a supertanker at sea.
  - c. So, the issue is not whether the human population should grow but how to sustain our environments and our societies in a much more crowded world until the supertanker (Pop. Growth) comes to a halt or is even turned around.
3. How to slow population growth: recommendations of ICDP
  - a. International Conference on Population and Development in Cairo, September 1994

- b. Resulting “Program of Action” broadens population programs from looking at human numbers (i.e., just TFR, BR, DR) to looking at human beings and need to realize their human potential
- i. Empowerment of women, including education and access to resources
  - (a) In most countries, women have more limited access to education than men
  - (b) Women have limited access to influence and power
  - (c) Have narrower occupational choices than men
  - (d) Lower earnings than men
  - (e) Do a great deal of unpaid labor to support families
  - (f) Work longer hours than men in most countries
  - (g) Often have little or no voice in decisions made even within the household
  - (h) Often need husband’s consent to use contraception
  - (i) Subject to sexual harassment in the workplace
- ii. Universal, comprehensive reproductive health care, including family planning no later than 2015
- iii. Men should take responsibility for their sexual and reproductive behavior and for household obligations

#### IV. Implications for Environmental Quality (slide 16)

- A. It is said that  $I = P \times A \times T$ ; this simplified equation has the heuristic value of pointing out the need to work on all 3 at once:
1. Slow population growth (and reduce it over the long run)
  2. Reduce consumption per person
  3. Improve the efficiency of technology to meet our needs with lower environmental impacts
  4. If we say that population alone is the fundamental problem, we risk defeat by allowing the other two factors to go uncontrolled
    - a. Slower population growth can lead to higher income levels and increased consumption
    - b. Slower population growth + increased consumption => worse problems than at present
- B. Beyond the IPAT equation, we must remember many other complex variables correlated with environmental impact (poverty, inequality, economic policies, democratic rights, etc.)
- C. General conclusions (slides 17-24)
1. Avoid polarization - The debate about the relationship between population and the environment has progressed little in the past century, being largely polarized between extreme positions.

2. Avoid body counts - The number of living human bodies is not all that matters. What matters is what those humans DO with and to their environment. To understand that, we need to examine a long list of things having to do with both the natural and social systems that these humans are involved with.
3. There is no single root cause - The size of the human population is not the single most important cause of environmental degradation because it never acts alone in harming the environment. Its environmental impact is always mediated by many other direct and indirect factors that affect people's relationship with their environment. There is no single cause of environmental problems that is always more important than everything else.
4. Use multiple scales of analysis - The answers are best derived at multiple scales of analysis and not just the global. "How many people can the Earth support?" is a question that we are unable to answer with much confidence but "How many people can Nigeria or Spain or the southwestern U.S. support?" is a more reasonable (though still very complicated) question.

5. Use multidisciplinary studies - The answers to such questions can only be found by studying the linkages between local ecological conditions and their social, political and economic contexts. Instead of asking “How much environmental damage does the addition of a new person add?”, we should ask, “What social, political, or economic factors shape how that person uses and manages natural resources?”
6. Work hard to clean up our own act - Overconsumption and excessive waste production are the most serious threats as population rises. They are also the most difficult to combat. When we focus all our attention on slowing population growth in developing countries, we fail to assume the blame we deserve and to shoulder the burden of changing our ways while, at the same time, we blame poor Third World women for global environmental problems and expect them to bear the costs of solving these problems for us.
7. Practical, effective and positive solutions are in place
  - a. With massive effort to increase education, health care, family planning and women’s status around the world, TFR can fall below 2 and stay there.
  - b. In that case, the world’s population would peak in the middle of the next century and start to fall after that.



- c. It would fall to 5.6 billion by the year 2150.
- d. Lower and higher results are also possible. The actual totals depend upon continuing actions to improve the lives of people and the status of women the world over.