POPULATION AND ENVIRONMENT

In the popular press, population growth is not often seen as an environmental problem. On a regular basis, we are warned about global warming, ozone depletion, rainforest destruction, groundwater contamination, toxic waste proliferation, shrinking animal habitat, endangered animal species, shrinking petroleum reserves, and a loss of biodiversity. Occasionally stories about these topics make connections with other topics, but usually they are dealt with singularly. A host of responses have been proposed to combat these signs of man's impact on the natural world, but seemingly only those that are convenient are implemented. According to those who have studied the burgeoning population, all attempts to deal with environmental degradation will fail because they deal with the symptoms of the problem, not the problem itself. The problem, they clearly state, is overpopulation. None would argue that the population is growing. Statistics show that for every person who was alive in 1830, there are now six people consuming the earth's resources. Where there were one billion mouths to feed, there are now six billion. The earth hasn't grown any larger, and many argue that it's capacity to sustain human life, through such developments as a decrease in topsoil, increase in desertification, pollution of groundwater and other factors, has actually decreased during this period. Many have theorized what the actual carrying capacity[1] of the earth is, with estimates ranging from less than the current population to as high as 50 billion. Such wide-ranging estimates, purported by experts, are one reason the population problem goes largely unnoticed. This paper will examine the problem of population growth, both as it was viewed historically and how it is seen today.

Throughout history, there seems to have always been one or two people who were able to see and understand the effects of population growth on an environmental, social, and economic level. The first modern writer to deal with the idea of overpopulation was Robert Thomas Malthus, an Englishman who lived from 1766-1834. He was an ordained priest in the Church of England, as well as a professor of history and political economy at the East India College at Hertfordshire. In 1798 Malthus wrote An Essay on the Principle of Population. In it he examined the future of mankind, and pondered whether expanding human numbers would eventually outstrip the capacity of the land to provide for them. At the time he wrote his famous essay, the prevailing

[1] Carrying Capacity has been defined by the Carrying Capacity Network as the number of individuals who can be supported without degrading the physical, ecological, cultural, and social environment, i.e. without reducing the ability of the environment to sustain the desired quality of life over the long term. The Carrying Capacity Network (CCN) is a nonprofit organization in Washington D.C.

ideas of the time reflected upon the perfectibility of mankind. It was believed that man had been progressing with the increasing population, and that rapid increases in population were not only desirable, but they would ensure that man would attain a state of perfection much sooner than if population grew more slowly. Malthus had different ideas as to what such an increase in population would bring. First, he believed that human fertility could increase human numbers beyond the land's capacity to sustain them. The crossing of this threshold came to be known as the Malthusian Crunch. Technological advances in the past two centuries, such as fertilizer, irrigation, hybrid crops, and others have extended the number of people the earth can feed. These advancements, which have enabled man to push back the limits placed on him by nature, have come to be known as the Malthusian Shuffle. Malthus also understood the geometric quality of population growth. Population growth is explained by a growth rate, symbolized by the percent the population is growing. The geometric factor resides in a growing base. For example, two percent of a hundred is two, while two percent of six billion is one hundred twenty million. That one hundred twenty million would be added to the original six billion, and the base upon which the percentage of growth would be calculated the following year would be six billion, one hundred twenty million. Eventually, Malthus wrote, the growing number of people would use up the available resources. This became known as the Malthusian Trap. Malthus wrote that it was inevitable that the human population would someday exceed those limits, and as a result the human population would be brought under control by vice and misery. As defined by Malthus, vice referred to human intervention, such as war, while misery referred to non-human intervention, such as starvation and/or disease.

While the validity of Malthus' essay has been argued by both sides since it was written, the lasting value of his work may be much more basic. He was the first to write that there were finite limits of material goods the earth could produce. Before his essay made its appearance, the earth and its resources were seen as inexhaustible. The belief was that man had been given the earth by divine providence, and that his duty was to "go forth and multiply". Even though that is what we, as a species, have done, Malthus' essay has given us a historical cause for thought regarding our future.

In 1968, Dr. Paul Ehrlich sounded the Malthusian horn to a new era with his book The Population Bomb. Like the earlier work of Malthus, Ehrlich's book received a mixed reaction from the public. For some, it served as an alert to the growing problems brought on by the expanding population. For others, it was criticized as an unprovable hypothesis generated by the

new environmentalism movement. In the book, Dr. Ehrlich reasoned that the future of an overpopulated earth was soon to be a reality, and that future was grim. He prophesized great famines, resource wars, polluted oceans, the atmospheric greenhouse effect, and the general degradation of the natural environment. As a professor of population studies at Stanford University, Dr. Ehrlich has made the study of population his life's work.

In 1990 Dr. Ehrlich teamed up with his wife Anne, a senior research associate in the biological sciences at Stanford, to write a follow up to The Population Bomb titled The Population Explosion. In it, they discussed the predictions he had made in 1968 and compared them to what had actually transpired. Similar to Malthus, a large number of his predictions had been accurate. The Ehrlichs open their book with a discussion of the technological advances of the late twentieth century that have allowed the population to grow so large. They state clearly that this Malthusian Shuffle comes with a price; unsustainability. They document the increased productivity brought about by the green revolution, and show that the productivity for this type of industrialized agriculture peaked in the mid-80's. Since then, yields have fallen each year, while population has continued to grow. They also explain how these types of farming practices, with their reliance on chemical fertilizers and by their monocropping ideology, have resulted in a net reduction of topsoil by as much as half. Also, they discuss the effects of over fishing on fish stocks, whose tattered remains are at the brink of being unable to reproduce their numbers due to younger, pre-breeding age fish being targeted as a result of the older fish having already been caught and sold.

Next the Ehrlichs examine the geometric properties of population growth. Similar to the arguments of Malthus, they state that it is a cycle that can not go on much longer. They discuss the lag time between action being taken to control the population and those actions having any real effects, and call this population momentum. Simply put, barring any plunge in the birth rate that take family averages well below the reproduction rate of 2.1 children per female, and barring any substantial rises in the death rate, it will take between fifty or sixty years after a population reaches replacement reproduction to achieve zero population growth. This is so because there is a high population of young people in the world right now. Births usually take place among the young, while deaths usually take place among the old. Thus if a population has a high percentage of young people, the average age of the population must increase before death rates catch up with birth rates. What this means is that if population were suddenly viewed as the specter it is in early December of 1998, and by January 1, 1999, all people of the world had no more than 2.1 children

on average, the population would continue to rise until the middle of the next century before leveling off.

When discussing population growth, the argument is often made in industrialized nations that the problem lies in the third world, where the most explosive growth exists. Many of the populations of industrialized nations are at or near zero growth. If we had a pure population problem, where there were simply too many people, they would have a valid argument. But the population dilemma we face is as much a problem of resources and consumption as it is of population. The Ehrlichs address this problem with possibly the most important idea of their book. They state that the impact of humans on the environment can be understood as the product of three separate factors. "*The first is the number of people. The second is some measure of the average person's consumption of resources (which is also an index of affluence). Finally, the product of those two factors—the population and its per-capita consumption—is multiplied by an index of the environmental disruptiveness of the technologies that provide the goods consumed. The last factor can also be viewed as the environmental impact per quantity of consumption. In short, Impact = Population x Affluence x Technology, or I=PAT.*"[2] Using this equation, we can see that population does not act alone in its effect on the environment. Similarly, the argument of many in developed nations with low birth rates that they are not the problem is clearly bunk when it is understood that they use a much greater percentage of the world's resources. In effect, this equation levels the playing field between the first and third world, negating the validity of finger pointing by both sides. It clearly shows that both the developed and the developing world have contributed to the negative environmental impacts of the growing population.

The Ehrlichs expend considerable effort detailing the effects of population growth on agriculture, global ecosystems, and public health. In their lucid manner, they explain three possible futures for humanity: the bang, the whimper, and the alternative. The bang, they explain, is a nuclear war. Growing population will put an excessive strain on the world's resources, leading ultimately to increased tensions and a resource war. This possibility, they wrote in 1990, was becoming more unlikely due to the events of the time. But, they maintain, it is still a possibility. The whimper would be a result of the life support systems of the earth ultimately becoming over stressed and ceasing to function in a way that could be manipulated by man to produce the

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[2] Ehrlich, Paul R. and Anne H. Ehrlich. The Population Explosion. New York: Simon and Schuster, 1990, p.58.

mountains of food now being produced. Simply put, it would mean the end of the world as we know it, and possibly the end of civilization as we know it. The specialization of labor would breakdown when food was no longer being supplied from somewhere else, and the results, in addition to widespread starvation, could be riots and/or epidemics. Economies would become localized, and food production would be the chief job of the much smaller population. The alternative would be to simultaneously halt population growth and begin population shrinkage, convert the economic system from one of growthism to one of sustainability while decreasing per-capita consumption, and convert to more environmentally friendly technologies. In short, simultaneously reduce the three multipliers in the I=PAT equation (population, affluence, technology). Interestingly, both the bang and the whimper are directly in line with what Malthus wrote two centuries prior, corresponding to vice and misery, respectively. The Ehrlichs firmly believe that we are living on borrowed time, and that the population will decrease in the coming years. Whether that is by a voluntary decrease in the birth rate or by an involuntary rise in the death rate is the only question.

In his book Living Within Limits, Garrett Hardin, professor emeritus of human ecology at the University of California at Santa Barbara, addresses many of the same questions examined by the Ehrlichs. He also comes to many of the same conclusions. Early in the book Hardin quotes Herodotus, who reported that there had been a time when a person could walk across North Africa from the Atlantic to the Indian Ocean always in the shade of trees. Next, he quotes a tenth century Samanid prince who identified the four earthly paradises as being the regions of Samakand, southern Persia, southern Iraq, and Damascus. Clearly these regions today are known for their sand, not for their similarity to earthly paradises. He uses this idea to introduce his theory that throughout human history man's trend of exploitation of the earth's resources has been colonize, destroy, then move on. He makes a solid case for his theory, going so far as to introduce the plan of science (fiction) to colonize the stars once we have plundered the earth. Explaining this idea using real numbers, he quickly exposes it as a ludicrous dream ungrounded in reality. Hardin blames the ignorance about population issues on innumeracy. Innumeracy, he explains, is the numerical equivalent of illiteracy. It is the inability to read and comprehend numbers. The evidence, he states, is clear. It is the interpretation, or lack thereof, which constitutes the problem.

In the seventh chapter, titled Cowboy Economics and Spaceship Ecology, Hardin discusses the irreconcilable chasm between the thought systems driving economics and ecology. Economics, he states, is driven by the cowboy ideals of independence and inexhaustible resources stretching to

the horizon. This line of reasoning is horribly outdated, explains Hardin. In reality, we are quickly diminishing the resources that drive our economy. Hardin uses the concept of a spaceship with clearly defined finite limits on its available resources to describe the earth. While traditional economic theory describes the economy in terms of growth and GNP (gross national product), it ignores the basic realities of production. Economic theory recognizes the concepts of source (source of raw materials) and production, but ignores what happens after production. In the real world, there are three steps: Source - Production - Sink. Sink may be defined as that part of nature that has to absorb the unwanted, so-called by-products of production, or pollution. As ours is a growth-based economy which has been growing ever larger with the expanding population, the prognosis for the future when taking this type of oversight into account is grim. Essentially what he is saying is that economic theory ignores the T in the I=PAT equation, which as the Ehrlichs demonstrated is an important factor in environmental impact. With two such opposing ideologies, Hardin questions if there is any hope for reconciliation in the face of a growing population and increasing use of resources.

Hardin writes that Malthus was ninety five percent correct in his predictions. Throughout the book, he restates Malthus' ideas using modern facts and figures to support them. He shows that birth rates have not dramatically changed over the last few centuries, but death rates have decreased rapidly. Life expectancy, therefore, has grown considerably. Hardin predicts that this decrease in death rates, or rise in life expectancy, will be short lived. He believes that as a species we are out of equilibrium, and that equilibrium will be restored by a sharp increase in the death rate in the years to come.

In his book A Bicentennial Malthusian Essay, attorney and mechanical engineer John F. Rohe revisits principles found in Malthus' essay in order to determine whether their root causes are applicable in 1998. The book is broken up into five sections: Malthus himself, population growth, economic growth, the effects of population growth on the land, and the next two hundred years. In the section on Malthus, Rohe biographies Malthus and explains how he came to write his famous essay as a reaction to the conventional optimism of the times. Rohe discusses the influence of Malthus' work on Charles Darwin, and how it helped Darwin to formulate his understanding of the results of excess reproduction contained in his theories of evolution and natural selection. Finally, we see how Malthus' divergent ideas ranged far from his Utopian peers of the late 18th century.

In the section on population, Rohe looks at human evolution as a possible explanation for our inability to grasp large problems. He states that throughout man's evolution we have been concerned with small, localized problems in order to survive. When hungry, procure food; when cold, build a fire or a shelter. If the climate in the region we live changes, either adapt or move on in search of greener pastures. After all, prehistoric man had not the hubris to believe he could have been responsible for changes in the climate. It was too large, and he too small. There was no advantage to understanding large, slowly developing problems. Many believe that our nervous systems developed with this inability to grasp larger issues, being more focused on aiding us in the day to day survival activities we faced.

The section on economic growth is especially poignant. Like Hardin, Rohe points out innumeracy as a major problem. He writes that "*during the 1996 presidential campaign, vice presidential candidate Jack Kemp professed he would like to see our GNP grow at a rate of five percent per year. That's a doubling time of fourteen years. In a healthy lifetime of ninety-eight years, that's seven doublings! The progression of seven doublings is: 2, 4, 8, 16, 32, 64, 128. Does he really think the annual GNP can be 128 times as big in a single year sometime later in the lifetime of a child born today? In 98 years? That's 128 times as many new homes in a single year, 128 times as many new roads in a single year, 128 times as many new cars, planes, boats, skyscrapers, and televisions all in a single year… An affinity for growth reduces to an absurdity. Let's assume we maintain a steady growth rate of six percent per year. This is close to the U.S. rate of growth in the early 1980s and less than the present rate in some Asian countries. If we can maintain this rate of growth, the economy will be 339 times as big in a period of 100 years. It is even more daunting to think that in just an additional fifty years we will be reproducing 100% of all items having economic value today in a single twenty-four hour period! In other words, every road, house, car, television, and other item of existing value today will then be manufactured in a single day!*"[3] Clearly, when growth is explained in such terms, it leaves little room for belief in sustained economic development. But, if the population is to continue growing at an exponential rate, such economic growth would be necessary in order to employ the masses. Any rational person can easily see that such growth simply isn't sustainable for anything but the short term, regardless of the rhetoric employed by politicians seeking office.

The effects of population growth on the environment could eventually bring about the implementation of policies which could be seen as anti-American. In addition to documenting the

[3] Rohe, p.46.

devastating effects population growth has had on the global ecosystem, Rohe states that continued population growth could spell disaster for that most cherished American ideal; private property. As the environment continues to decay, public outcry will most likely turn the tide of lawmakers from that of protecting the individual's right to pollute to protecting the masses right to a clean environment. Although in direct conflict with entrenched American values, Rohe believes that the mystique of the American frontier, and the ability of the individual to live as an individual, will be usurped by a growing populace.

Rohe sees the next two hundred years as being pivotal on whether man can change or not. If not, then the future is anything but rosy. If we are able to change, he lists three specifics which will need to be at the forefront of that change in order to forestall the demise of man. First, he feels that there needs to be a growth in numeracy, or an understanding of numbers. Not only in terms of human populations, but in understanding the problems we will face in the future. Second, he feels that a shift in values will be necessary. The consumptive ways of late twentieth century man must go the way of the carrier pigeon, and as a species we must embrace an ethical and ecological balance that is in tune with nature and out of tune with merchandisers. Simply put, we must live our lives in recognition of the fact that there will be generations coming after us, and that we don't have the right to use all the resources and pollute the earth. Lastly, he believes that we must be willing to make ethical compromises. Somehow we must infuse in our collective mentality that the tenets of capitalism, such as maximizing profits at any cost, are not in the best interests of our species or our planet.

With the new millennium just over a year away, the popular press has been examining issues pertinent to our well being in the twenty-first century. Many articles have appeared of late on the topic of population, but few have made the connection between overpopulation and ecological crisis. Written in 1978, Bartlett's Forgotten Fundamentals of the Energy Crisis is one whose omission in a paper such as this would be conspicuous. The article itself is about energy use in relation to the lessons learned during the oil crisis of the early 1970s. With this as his impetus, Bartlett examined the future of oil as a commodity for energy production. He concluded that per-capita energy consumption was rising in 1978. To the layman, it would seem that per-capita energy consumption continues to rise. Couple that with explosive growth in population and the result is a short future for oil and the plethora of products derived from it. Bartlett calculated how much oil the earth would hold were it completely hollow and full of oil, then using the concept of exponential growth figured out how long those hypothetical reserves would last. The

significance of this article in our oil-based economy is great; it put a definite, if unrealistically large, amount of time our present society could exist without undergoing significant change.

The sources researched for this paper have a somewhat redundant quality to them. Each of the books was written to stand alone, thus they repeat much of the same information. As much of the information is contrary to the prevailing attitudes of our time, that information must be read several times for it to sink in. The authors are quick to point out that it can be difficult to grasp the fact that there is a world population problem when you live in America. After all, the grocery store is filled to the brim with food, never before in history have there been more goods available to so many people, and the standard of living for most of us here is high. But the problem remains. To the field of environmental history, these books add a definitive answer as to why the environment is breaking down. If one person has x impact, then six billion people have 6,000,000,000x impact. They serve to put the causes of the environmental problems of the era, often made out to be nebulous and ethereal, into a tangible equation that can be easily grasped and understood. Their main addition to the field, though, is to alert people to the impending consequences of our collective actions.

The core issue of overpopulation and its many negative effects on the earth, which are seen as individual environmental problems, is one of limits. Throughout nature, the evidence that actual limits exist regarding how many of a certain species a region can support is clear. For example, snowshoe hare populations in Alaska are on a twelve year cycle. Their population grows exponentially for twelve years, until there are too many hares for the limited food supply to feed. As a result, they die off in such large numbers that it takes them another twelve years to generate a population of similar numbers. But when they do, they face the same fate as their predecessors. Can we, as rational beings, recognize that we will face a similar fate if we allow our population to continue to grow unchecked? Edward O. Wilson, of Harvard University, points to a lily pond as an example of exponential growth: *"At first there is only one lily pad in the pond, but the next day it doubles, and thereafter, each of its descendants doubles. The pond completely fills with lily pads in 30 days. When is the pond exactly half-full? Answer: On the twenty-ninth day.*"[4] Had the lily pads been capable of rational thinking, would the majority of them have loudly proclaimed that there was no population problem at midnight on the twenty-ninth day? Two hundred years ago Malthus foresaw the demise of mankind, and the vehicle was the disregard of limits in the form of overpopulation. The authors of the works discussed in this paper predict a

similar fate if we don't change our ways and stop living as if, because we are human, we can disregard the laws of nature. As we enter the new millennium, those limits written about by Malthus loom on the not too distant horizon. It took all of history up to 1830 for mankind to generate a billion people living on the planet at the same time. We now add a billion new people in just over twelve years.[5] There is an old saying that states if you don't change your direction, you'll end up where you're headed. The question, then, is whether mankind will change direction. The answer remains to be seen.

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Written by Tim Smith

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[5] Lutz, Wolfgang, National Geographic, October 1998, p.4-5.