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Submissions

The journal aims to publish papers exploring all aspects of the relationship between human numbers and environmental issues. It is truly interdisciplinary and invites contributions from the social sciences, humanities, environmental and natural sciences including those concerned with family planning and reproductive health. We also invite contributions from those working for NGOs with interests in population and environmental issues. It is intended that the journal act as an interdisciplinary hub facilitating collaboration and furthering the development of the field. We are interested in publishing original research papers, reviews of already published research and book reviews. For submission details please see our website (**www.populationmatters.org**) or contact the editor: **journal.editor@populationmatters.org**

The journal is available free of charge at **www.populationmatters.org** and is published by Population Matters, a membership charity that addresses population size and environmental sustainability. We believe population growth contributes to environmental degradation, resource depletion and other problems. We conduct research, inform the public and advocate improved family planning and sex education, women's empowerment, smaller families and moderate consumption. We are a company limited by guarantee (3019081) and a registered charity (1114109).

Sustainability Insights

Population Matters has prepared a set of short papers on various subjects relating to the overall issue of population and sustainability. The index page **https://www.populationmatters.org/resources/sustainability-insights/** together with links between the papers can be used to navigate between topics to show how the various pieces of the jigsaw fit together. Whereas these papers are intended to be accessible to readers without specialist knowledge of the topics, we hope they will also prompt dialogue between experts in different specialisms, thereby furthering development of the integrated subject as a discipline in its own right.

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Editorial Introduction

DAVID SAMWAYS – EDITOR

To some extent, environmentalism has always been concerned with shifting orientations, values and attitudes. Whether it is discouraging littering, encouraging recycling or energy conservation or tackling more fundamental issues such as consumerism or family size, then a change in values and attitudes is likely to be involved. It follows that all of the papers in this issue of the *Journal of Population and Sustainability* (JP&S) can be seen as in some sense being concerned with behaviour change or the consequences of a lack thereof. Three of the papers in this issue touch on the question of our orientation toward nature and the wellbeing of other species, and this reflects the wider concerns in the mainstream environmental literature regarding the 'anthropocene' and questions around the primacy of short-term human interests in contrast with the health and sustainability of the biosphere. In the latter part of this editorial introduction I want to take the opportunity to examine a particular attitudinal and value orientation which is somewhat pertinent to these papers (and in particular to the IPAT identity), and which from the beginning of the modern environmental movement has been a source of great concern: anthropocentrism or human-centredness.

I begin with a brief overview of the contributions to this issue. Our first paper, Ugo Bardi's *A Seneca Collapse for the World's Human Population?*, examines the concept of the 'Seneca Effect' (as developed in his 2017 book of the same name), in respect of human numbers. A Seneca Collapse is typified by a slow growth of one or more of the elements of a system leading to a rapid collapse. Starting with well-documented accounts of collapses in animal populations, Bardi shows how, due to a number of factors, animal populations can follow a typical Seneca curve. Applying the same analysis to historical data relating to human population declines driven by food supply collapse, migration, disease, and active lowering of birthrates – all attended by overdetermining sociological and political

factors -, Bardi shows how similar Seneca Collapses can be observed in human numbers. Bardi concludes that in broad terms the global human population is subject to the same constraints as non-human populations i.e. overshoot of the food-supply, predation (by disease organisms in the human case), and lowering of the birth rate. It is possible that global population could rapidly collapse due to predation by a disease organism, but Bardi thinks this much less likely than overshoot caused by the inability of the global economic system to deliver food worldwide. The attendant misery of this scenario is extremely objectionable, and Bardi speculates that it would be centuries before the system would recover. Finally, the most desirable possibility of a population collapse is one under our own control. Bardi is cautiously optimistic that economic, technical and social factors may lead to an active choice to reduce human numbers before disease and overshoot impose a tragic and dreadful collapse upon us.

Doug Booth's paper *Postmaterial Experience: Economics, Population, and Environmental Sustainablity* considers the environmental potential of the emerging 'postmaterial' culture in mature economies. Booth argues that a mostly young, urban demographic, raised in an era of prosperity, experiencing little or no material hardship and engaged in a new, and often creative, service economy has great potential for environmental sustainability. This demographic displays reduced interest in material possessions and an emphasis on consuming individual and shared experiences such as concerts, theatre, travel, extreme sports etc. Usually living and working in the regenerated commercial centres of cities, they are typically more energy efficient and have a greatly reduced reliance on the private car.

Postmaterialism is also positively correlated with concern about the environment. Booth argues that an expansion in postmaterialism globally could have a direct positive effect on environmental sustainability, especially if the environmental values with which it is often associated have an impact on government policies. Booth speculates that postmaterialism might also foster a reduction in human fertility over and above that experienced with conventional 'demographic transition'. He observes that postmaterial values and reduced fertility are correlated but that correlation is not cause, and whether postmaterial values will lead to a reduction in the desire to have children is a question for future research.

Bill Ryerson's paper, *The Hidden Gem of the Cairo Consensus*, looks at the UN's 1994 Programme of Action of the International Conference on Population and Development. He argues that while the document it produced (known as the Cairo Consensus) was both anthropocentric and failed to hold the goal of lowering population growth at the same status as reproductive health and rights, the encouragement to use entertainment media as a means to help achieve gender equality has been a powerful tactic.

Ryerson shows how through the use of soap operas and other dramatic formats broadcast on both television and radio, the Population Media Centre (PMC), of which Ryerson is the President, has successfully and effectively engaged and challenged social norms and attitudes which underpin the social status of women, attitudes toward contraception and norms around family size. All of these factors are significant drivers in population growth in developing countries, and Ryerson demonstrates how, through a variety of dramatic devices underpinned by sound psychological and psychosocial theory, the audience is taken on a journey which challenges established practices and attitudes, whilst also showing the personal benefits for them and their families of family planning and fewer children.

This issue also carries a review by Paul Ehrlich of Tobias and Gray's *Anthrozoology*. As an appendix to Ehrlich's review we have a previously unpublished paper by John P. Holdren on the history of IPAT. Those readers familiar with the IPAT equation (impact=population x affluence x technology) will be aware that the identity was first developed by Ehrlich and Holdren in the early 70s, and the paper published here leads us through the development of the equation and defends it against later critiques and misinterpretations. The first publication of the IPAT equation, along with a response from Commoner took place in the *Bulletin Of The Atomic Scientists* in 1972. Holdren argues that his and Ehrlich's position has since been caricatured as asserting population growth as the only important factor. He goes on to show that, in all of the various iterations of their thesis, their emphasis has been on the interconnectedness of population, affluence, technology, and various socioeconomic factors in the environmental impact of humankind.

Anthropocentrism – the origin of environmental degradation?

The 1960s and early 1970s were the crucible of the modern environmental movement. The Ehrlich, Holdren and Commoner debate (1972) exemplifies the enormous appetite for attempting to understand the 'origin' and driving forces of environmental problems. The exchange centred around Commoner's claim that population increase and growing affluence was largely irrelevant to the massive growth of pollution. The actual origin of ecological problems, he argued, was the adoption of inappropriate and destructive technologies in the post war period, and that the solution lay in switching to environmentally friendly production. Ehrlich and Holdren countered that an analysis that focused on technology alone was totally inadequate and misleading, but more importantly did not address fundamental ecological issues like species extinction. They began their critique by pointing out that well before the advent of modern technology people had had a significant impact on the environment.

> ... serious ecological harm has accompanied man's activities ever since the agricultural revolution some 10,000 years ago. In fact, it may date from even earlier; in the period of intensive hunting and food gathering preceding the advent of agriculture, men may have contributed to a dramatic reduction in the number of species of large mammals inhabiting the earth. (1972 p. 16)

They went on to list examples of ancient environmental degradation including the desertification of the Tigress and Euphrates Valleys beginning around 2000 BCE, deforestation by prehistoric peoples (including hunter gatherers), and the impact of pastoral peoples in North America through overgrazing. Ehrlich and Holdren argued that in most of these examples population had played an important part. It is interesting to note that in his response Commoner did not address any of these points.

While their disagreements were stark, what Ehrlich and Holdren's approach and that of Commoner share is a scientific analysis of the issue, and an attempt to understand the dynamics of technological and economic change and its relationship to environmental degradation. While it was clear that these 'material' factors where the immediate cause of environmental degradation, some argued

that origin of the ecological crisis itself lay deep in the philosophical orientation toward nature at the core of western civilisation.

Anthropocentrism and environmental impact

In 1962 Rachel Carson's *Silent Spring* (1962) not only alerted the public to the catastrophic consequences of pollution as a side-effect of scientific and technical 'progress', but also warned of the inherent danger of the view "that nature exists for the convenience of man" (p. 297). However it was Lyne White Jnr's *The Historical Roots of Our Ecologic Crisis* (1967) that brought the concept of *anthropocentrism* to the attention of the emerging environmental movement. White argued: "what people do about their ecology depends upon what they think about themselves in relation to things around them" (p. 1205). For White, while the enormous power over nature of science and technology was the proximate cause of environmental degradation, science and technology themselves were the product of the Judeo-Christian tradition which placed human beings firmly at the centre of both the moral and natural world. According to White, the pagan animism that Christianity replaced regulated the interchange between human beings and nature and limited negative human impacts:

> Before one cut a tree, mined a mountain, or dammed a brook, it was important to placate the spirit in charge of that particular situation, and to keep it placated. By destroying pagan animism, Christianity made it possible to exploit nature in a mood of indifference to the feelings of natural objects. (ibid.)

White's thesis met a number of criticisms, the most important of which pointed out that his interpretation of the Judeo-Christian tradition was very narrow and lacked an account of the notion of *stewardship* present in biblical discourses (see Passmore 1974/1980). In the second edition of *Man's Responsibility for Nature* (1980) John Passmore was doubtful that attitudinal change would have the impact that many environmental writers have supposed (for examples see: Callicott, 1989, 1994, 2012; Callicott and Ames, 1989; Naess (1973); Devall and Sessions (1985); Berry (1988, 1993, 1999); Oelschlaeger (1991); Crist and Kopnina (2014); Washington et al (2017)).

In contrast to Passmore's scepticism regarding a change in values, in a recent UNESCO interview environmental philosopher J. Baird Callicott has argued:

> As a philosopher, I am committed to the belief that all our actions are situated in and framed by a worldview... In the last analysis, the only way to protect the environment or make sustainable use of natural resources is an essentially philosophical revolution, a shift in our ideas of Nature, of human nature, and the relationship between humans and Nature, naturally accompanied by a shift in our values from a narrow anthropocentrism to a wider circle of concern. (2012, p. 2)

A connection between ecocentrism, or at least the absence of anthropocentrism, is common to almost all of those who subscribe to the idea that a change in values is essential to diverting humanity from ecological catastrophe. The identification of primal peoples or small scale preindustrial peoples with ecocentrism and environmental sustainability is also common. For thinkers who follow White's general thesis, the values and lifestyles of preindustrial, and especially primal peoples, represent the gold standard in low environmental impact. But what evidence is there to support this? Do societies who have non-anthropocentric values always have a sustainable relationship with nature?

Preindustrial ecological impact

Ehrlich and Holdren had not been the first to point out that significant ecological degradation predated the industrial era. Tuan Yi Fu (1968) was one of the earliest writers to cast doubt on the connection between anthropocentric attitudes and environmental impact by pointing to the considerable deforestation undertaken in European pagan antiquity and in Confucian classical China.

Evidence from anthropological and archeological sources also casts doubt on the idea that non-anthropocentric orientations make any real difference to ecological outcomes. In the anthropological literature for instance, there is little to support the idea that hunter-gatherer societies practice any kind of conservation (see Smith and Wishnie, 2000; Hames, 2007). Rambo's (1985) study of the Semang Orang Asli people of Peninsular Malaysia showed that at the local level air pollution from fires, pollution of water and soil was not quantitatively less significant than industrial society. While no equivalence can be drawn between

the environmental impact of modern society and that of the Semang, Rambo argued that most of the impacts are qualitatively comparable. He concluded that it is not a fundamental difference in orientation to nature that limits the Semang's impact but the limited size and power of their social system.

Krech's (1999) highly respected examination of the ecological practices of Native Americans – possibly the most celebrated bearers of an ecocentric sensibility – shows that contrary to conserving many of the species on which they relied, in many instances they decimated them. Indeed many Native American beliefs may have actually militated against conservation since the idea of reincarnation of animal spirits promoted a belief in fecundity without limits – a conception of limitlessness not dissimilar to those in anthropocentric western discourses.

Furthermore, a wealth of archaeological evidence also attests to the frequently not inconsiderable impact of pre-industrial and often pre-agricultural human beings on every continent. In particular, the migration of people to regions that had been previously uninhabited resulted in species extinctions and or ecological disruption. (see Martin 1967; Johnson et al., 2013; Araujo et al., 2017; Worthy and Holdaway, 2002; Perry et al., 2014; Bahn and Flenley, 1992; Flenley and Bahn, 2003; Diamond 2005; Middleton, 2012)

Attitudes, values and action: conflict and contradiction

Despite the extensive evidence against it, more than five decades on from White's article, the idea that "what people do about their ecology depends upon what they think about themselves in relation to things around them" (op. cit. p. 1205) has lost none of its attraction. Part of its appeal lies in our everyday intuition that values and actions are connected in a straightforward and consistent way. Responding to the evidence of anthropogenic Quaternary extinctions and Tuan's (op. cit.) observations regarding ancient Asian environmental impact Callicott asks:

> Do our natural (and social) attitudes and values direct our behavior or, on the contrary, are they a sort of muzak of the mind[?]... Behavior does not flow exclusively from attitudes and values; but neither are attitudes and values simply irrelevant to what people do and how they live (Callicott and Ames, 1989 p. 285).

His last observation is undoubtedly true, but it does somewhat appear to assume that behaviour must be consistent with *all* the attitudes and values held by agents and that all these attitudes and values are consistent and compatible. Yet from a sociological perspective there are good reasons to believe that this is a simplistic conception of the agent.

While there is insufficient space to explore the sociological concept of agency and the self in any depth here, Anthony Giddens' (1979, 1984, 1993) stratification model of the agent might prove a good starting point. The details of this model are not important to us here except to note that it attempts to analyse the motivational sources of action in terms of layers of consciousness, moving from the unconscious, through to practical consciousness (the tacitly held knowledge of everyday life) and discursive consciousness (being able to give reasons for one's actions). Giddens notes that although agents are often very knowledgeable about the conditions under which they act this knowledge is not exhaustive. Action is always bounded by unacknowledged conditions and unintended consequences.

Embracing the idea of layers of consciousness, the concept of the self as a unified and rationally coherent entity must be at least partially suspended in recognition that individuals often hold mutually incompatible beliefs and attitudes, and a hierarchy of desires and wants (see Craib 1992; Stones 2005). A connection between the incompatibility of one motivation/action and another may never be reflectively experienced as incompatible and conflicting, and hence no cognitive dissonance may be experienced.

In practical terms this means that it is perfectly possible for individuals in any society to, at some level, hold ecocentric values but nonetheless engage in practices which contradict these values. The example of 'bison (or buffalo) jumps', found in the North American archaeological record and recorded as late as the early 19th century (Krech 1999), where hundreds of animals were driven to their deaths, and where most of the meat was left to rot, may well be an example of a people holding an ecocentric worldview[1], but being motivated by the immediate

1. As with all prehistoric peoples the values and attitudes that they held are unknown and unknowable, we can only offer speculations based upon the interpretation of artifacts and extrapolation from what we know from the earliest historical accounts of their distant descendants – see Hutton 1991 for an account in respect of prehistoric Britain.

need to provide food by the easiest and most reliable method.[2] The same conflict of values might also be true of all of the archaeological cases above, but without hard evidence for the values of the people in question this can be no more than speculation.

The postmaterialist demographic identified by Booth in his paper published in this issue might serve as a contemporary hypothetical illustration of value conflict and ranking of desires. As Booth shows, there is a strong correlation between postmaterialist values and concern about the environment. It is clear that some aspects of postmaterialist lifestyles have a lower environmental impact due to reduced energy consumption in domestic heating and local transport.

While this demographic is relatively uninterested in personal possessions they are interested in travel. However, if our hypothetical postmaterialist subject enjoys taking-in far flung exotic cultures, landscapes, flora and fauna, their carbon footprint alone from international flights might well far outweigh all of their reduced emissions from domestic heating and local travel (see Berners-Lee 2010 for relative figures). Moreover it's not just the carbon footprint of travel that is environmentally problematic: hotel construction, water usage, erosion and so on all have significant impacts. Our theoretical postmaterialist subject may well be extremely concerned about climate change, the destruction of natural habitats, mass extinction and so on, and part of their motivation for travel might be due to a deep love of nature. It may be that they never consider their desire to travel and their environmental concerns together, and if they do they may underestimate the environmental impact, or perhaps they simply rank the desire to travel higher than their environmental values. This theoretical speculation might find empirical support in recent research by Alcock et al. (2017) using UK survey data, which shows that while there is a strong correlation between environmental concern and routine pro-environmental behaviour (being energy conscious, using less packaging, recycling etc), no correlation was found with the propensity to take flights.

Booth argues that it may well be that the postmaterialist demographic has a lower birth-rate than average, which according to Wynes and Nicholas (2017) would have a greater positive impact than any other action, greatly outweighing the negative

2. Another reading of such events might also point to the known evidence regarding reincarnation of animal spirits as shown in Krech's (1999) study.

impact of air travel. However, it is unlikely that the choice to have fewer children would be directly motivated by environmental concerns rather than the result of other social factors such as female career choices. Thus, the environmental benefits of this choice would be an unintended consequence of action.

The social context of environmental impact

Beyond attempting to understand possible disjunctions between values and action, we can say something about the social context and the unintended consequences of action. Many have commented on the ecological knowledge of indigenous peoples (for an overview see Inglis 1993). However, this often extensive knowledge does not preclude the possibility of unacknowledged conditions of action and the production of unintended environmental consequences. As we have seen, the archaeological and anthropological evidence clearly shows that small-scale societies with low technology can have significant environmental impacts that are the unintended consequences of their socio-technical practices in everyday life.

Ehrlich and Holdren's IPAT identity provides far greater explanatory power for the environmental impact of a society, whatever its philosophical orientation to nature might be. Thus, in the case of the Native American use of bison jumps, although the technique was extremely effective at killing a large number of animals in one go, Indian populations were simply too small to make a real difference to buffalo numbers. It took a population influx of Europeans for whom the buffalo were an impediment to cattle ranching etc., a high demand for buffalo hides, and new technology in the form of guns and railways to devastate their numbers.

The fact that individual agents are themselves participants in social systems represents another dimension in the ability of any individual to act on all of their values and attitudes without conflict. The participation in a social-technical system not only structurally constrains the actions of individuals by limiting the resources available to them such as their source of energy, but also in terms of the normal expectations of life. Adam Smith noted in 1776 that:

> A linen shirt, for example, is, strictly speaking, not a necessary of life. But... a creditable day-labourer would be ashamed to appear in public without a linen shirt, the want of which would be supposed to denote

> that disgraceful degree of poverty which, it is presumed, nobody can well fall into without extreme bad conduct. (2007 [1776] p. 676)

In affluent contemporary societies the world-over the range of 'necessities' would extend well beyond decent clothing. Sen (1998) noted that to "live a life without shame" a range goods and services is necessary, and at the present time these might include, a mobile 'phone, broadband, central heating, frequent showers, eating out, consuming out-of-season produce, eating meat every day, foreign holidays, and so on. Affluence has not only driven our consumption of resources in terms of being better able to meet our needs, wants and desires, but has redefined what is required to properly participate in society – all of which has increased our environmental footprint. Combine this affluence with fossil fuel technology and a large population and the environmental problems are inevitable. As Ehrlich and Holdren showed us, this is not merely a problem of technology: transitioning to renewable energy technologies might be mitigate climate change, but, following Commoner (1971), environmentally there's no such thing as a free lunch and if issues such as population growth along with a business-as-usual approach to economic growth remain unaddressed then so too will other potentially catastrophic ecological problems.

Conclusion: rehabilitating anthropocentrism

Given the evidence that attitudes to nature make little difference to actual environmental impact, it would seem that the replacement of anthropocentrism with ecocentrism, at least at the level of the individual, would make little difference to behaviour and hence environmental impact. As participants in particular societal and technical systems, the environmental consequences of everyday action are largely out of the conscious control of individuals no matter what their orientation toward the natural world.

Many have pointed out that in the weakest sense all values are anthropocentric i.e. it is only human beings that engage in the act of valuing. Over and above this very weak sense, is there anything in the discourse of anthropocentrism that is worth defending or that might have some utility in our attempt to deal with anthropogenic environmental change? The idea that only human beings have moral value and are the only objects of moral consideration, contained in the strongest version of anthropocentrism, is to many people, including myself,

morally objectionable. However, attempts to demonstrate intrinsic value in nature are not only difficult, but largely entirely unconvincing. In contrast, weaker versions of anthropocentrism that attempt to avoid speciesism and the denial of moral standing to abstract entities such as habitats and ecosystems have been cogently articulated. In these weaker versions of anthropocentrism, by virtue of a discourse of obligation or through philosophical relationalism, human beings are seen as the source of value but not the only object of moral consideration (see Norton 1984; O'Neill 1997; Chan et al. 2016). Those who advocate these weaker anthropocentric approaches argue that they can potentially achieve all that ecocentrism aspires to without the complex and usually laboured attempts to show intrinsic value. However, given the conclusion that the valuing of the natural world by individuals has made little difference to actual environmental impact, are these approaches of any practical use?

While I have made the case that individual value change is not likely to significantly alter individual behaviour, at a governmental and international regulatory level the drafting of policies which are strongly anthropocentric, as indicated by Ryerson in respect of the Cairo Consensus (see Ryerson's paper in this issue), will undoubtedly have outcomes which ignore the balance between human interests and ecological sustainability. However, the adoption of an approach which attenuates human-centredness, such as that outlined in the UN 'Harmony With Nature' project (again see Ryerson's paper), may well produce outcomes which consider the value of the natural world in its own right. The 'Harmony With Nature' project clearly owes much more to the approach taken by weaker anthropocentrist approaches than it does to intrinsic value or ecocentric perspectives.

Policies committed to a model of ever-increasing economic and population growth without consideration of the effects on the biosphere are clearly anthropocentric in the narrowest and strongest sense. However, it is clear that such human-centeredness has significant potential to undermine the conditions not only for human existence but also for flourishing (see Kidner 2014 for a thought-provoking discussion). It is in the sphere of domestic and international regulatory policy that a decentering of narrow human interests in favour of a broader sense of the dependence of humankind on the ecological diversity of the natural world can have the greatest impact. By changing the social-structural conditions of everyday life governments and international agencies can moderate excessive

consumption, create conditions for the development and adoption of sustainable technology, and importantly, enable and encourage people to make decisions about family size that not only benefit them, but are also compatible with global ecological sustainability.

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A Seneca Collapse for the World's Human Population?

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Abstract

Most scenarios for the world's human population predict continued growth into the 22nd century, while some indicate that it could stabilize or begin to fall before 2100. Almost always, decline is seen as not being faster than the preceding growth. Different scenarios are obtained if we consider the human population as a complex system, subject to the general rules that govern complex systems, in particular their tendency to show rapid changes which – in the case of populations – may take the shape of true collapses (defined here as "Seneca Collapses"). The present survey examines a small number of examples of rapid population collapses in the human and in the animal domains. While not pretending to be exhaustive, the data presented here show that biological populations do show rapid "Seneca-style" collapses. So, it is possible that the same phenomenon could occur for the world's human population.

Introduction

> "The Earth provides enough to satisfy every man's need but not for every man's greed." Gandhi (quoted in Pyarelal 1958 p. 552)

While Gandhi's observation about greed remains true even today, his statement regarding the ability of the world to meet needs may not apply to the modern world. In 1947, the world population was under 2.5 billion, about one third of the current figure of 7.5 billion. And it keeps growing. Does the world still have enough for every man's need?

It is a tautology that if there are 7.5 billion people alive on planet earth today there must exist sufficient resources to keep them alive. But the problem is for how long. The concept of "overshoot" was applied by Forrester in 1971 (Bardi 2016) to social systems. The innovative aspect of this concept is that it takes the future into consideration: if there is enough food for 7.5 billion people today, that doesn't mean that will be true in the future. The destruction of fertile soil, the depletion of aquifers, the increased reliance on depletable mineral fertilizers, to say nothing of climate change, are all factors that may make the future much harder than it is nowadays for humankind. The problems will be exacerbated if the population continues to grow.

But will the human population keep growing in the future as it has in the past? Many demographic studies have attempted to answer this question, often arriving at widely differing results. Some studies assume that population will keep growing all the way to the end of the current century, others that it will stabilize at some value higher than the present one, others still that it will start declining. Few, if any, studies have taken into account the phenomenon of rapid decline that I have termed "Seneca Effect" (or "Seneca Collapse") (Bardi 2017), based on the observation of the 1st century Roman philosopher Lucius Annaeus Seneca that "fortune is of sluggish growth, but ruin is rapid".

Seneca Collapse is a phenomenon affecting complex, networked systems where strong feedback relationships link the elements of the system to each other. Biological communities where predators and their prey are linked to each other are a good example of these systems. Such systems normally tend towards "homeostasis," that is they exhibit a tendency to maintain their parameters close to a set called the "attractor." However, they can also jump from one attractor to another in a cascade of phenomena that may strongly affect the structure of the system. The Seneca Effect describes a situation in which the feedbacks of the system act together to generate a rapid decline of some of the stocks

(populations) of the system. It may lead to the extinction of some species or their decline to low levels from which they can gradually recover. The typical "Seneca Curve" is shown in the figure below (ibid).

Seneca Curve

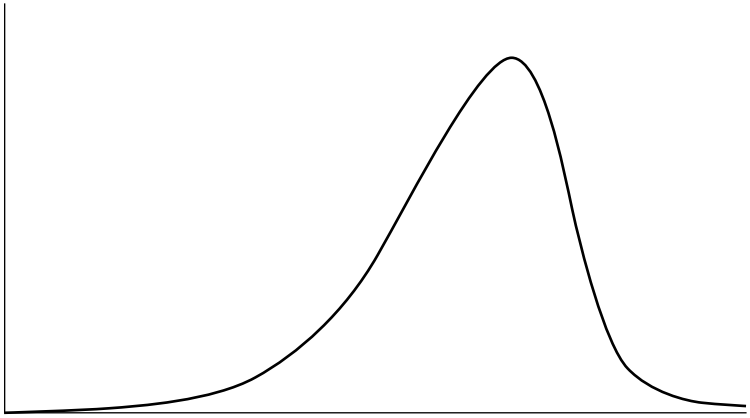

Figure 1. A typical "Seneca Curve" calculated by means of system dynamics. It shows how decline can be faster than growth.

Can the Seneca Collapse affect the human population? As usual, the future is never exactly predictable, but the study of the past tells us what we could expect.

Population collapses in nature

There are many examples of the rapid decline of a biological population. A simple and well-known case is that of the reindeer of St. Matthew Island (Klein 1968).

St. Matthew Island Reindeer Population

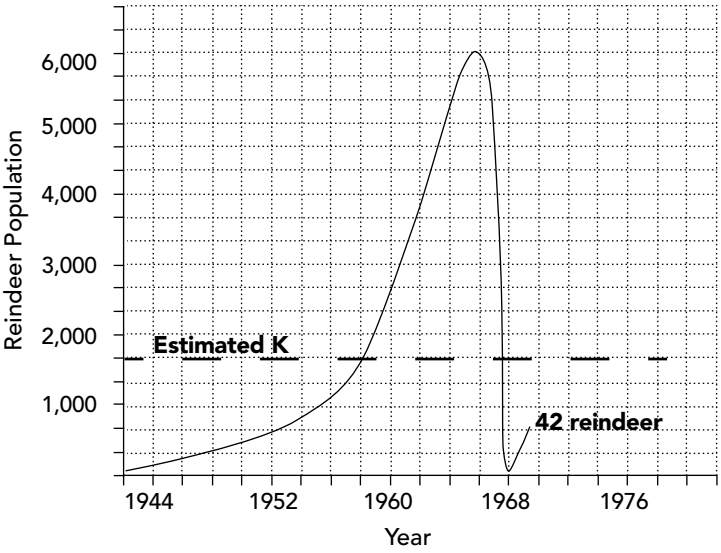

Fig 2. The Reindeer Population of St. Matthew Island. Image created by Saudiberg. https://en.wikipedia.org/wiki/St._Matthew_Island#/media/File:St._Matthew_Island_Reindeer_Population.svg

The curve shown in the figure is heavily interpolated, the actual data are scant. Nevertheless, it does show an extremely rapid crash from a population of thousands of reindeer to a less than fifty in just a few decades. It is a typical example of the "Seneca Curve." The reasons for the collapse are clear: a small number of reindeer introduced on the island grew to numbers that destroyed the grass faster than it could regrow. The result was a classic case of overshoot and collapse.

A different case is that of collapse generated by predation. A visually impressive example is the collapse of the thylacine species (the "Tasmanian Tiger") (McCallum 2012).

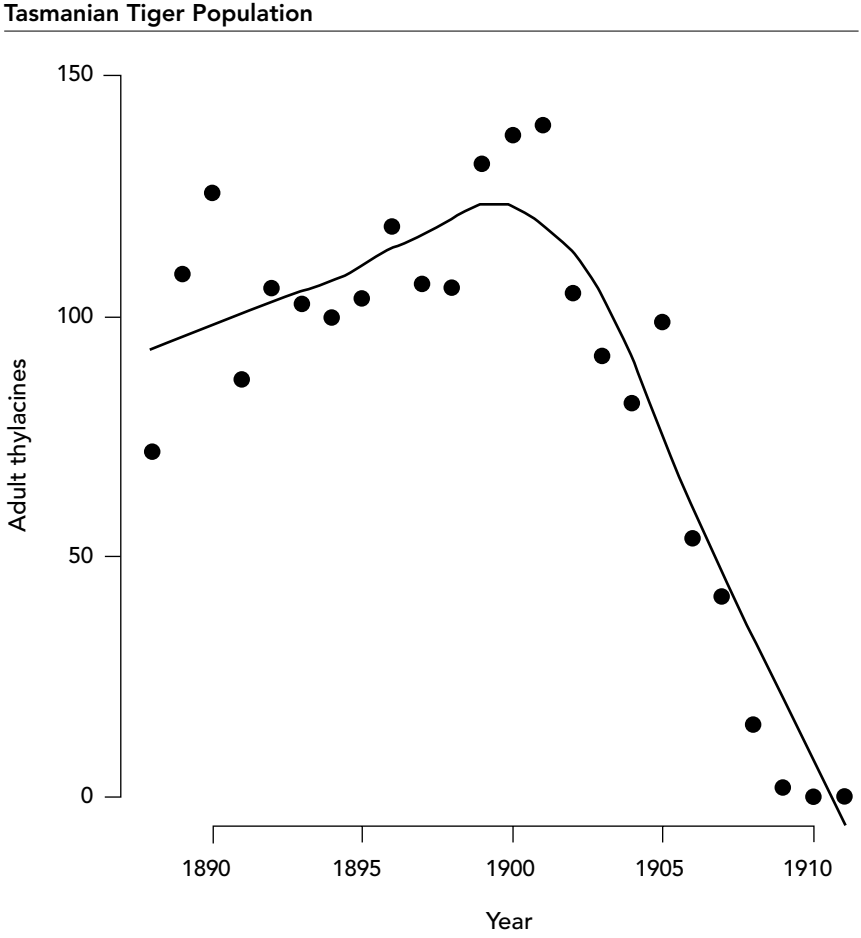

Figure 3. Population of Tasmanian tigers (Thylacines) before their complete extinction in the 1930s (McCallum 2012).

The data shown in figure 3 are not a direct measurement of the population size: they are the number of thylacine pelts produced by Tasmanian hunters as the result of a government scheme that provided a bounty for each animal killed. Nevertheless, they indicate a rapid collapse of the population: it went to nearly zero in just ten years, again a case of Seneca Collapse. The last Tasmanian tigers

were killed in the 1930s. The obvious origin of this collapse is human hunting, although disease has been sometimes blamed. Whether human or microbial pathogens were the predator, the graph shows how rapidly a biological population can collapse – even all the way to extinction – when under stress caused by increasing predation rates.

There is a third possible origin of population collapse, in this case generated by active birthrate control. Although this phenomenon doesn't seem to exist in the wild, we can clearly see it for the horse population in the United States.

Number of Horses in the United States

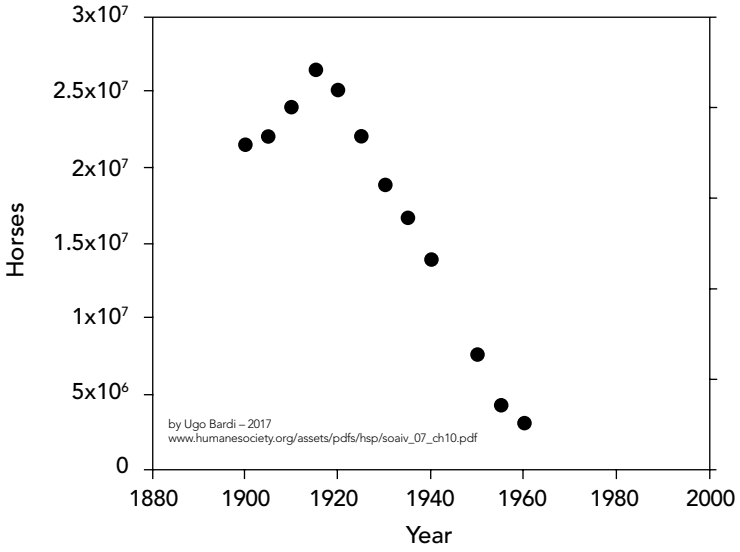

Figure 4. Horse population in the United States (data source: The Humane Society, http://www.humanesociety.org/assets/pdfs/hsp/soaiv_07_ch10.pdf).

We see how the horse population went down rapidly and abruptly, from a maximum of more than 26 million in 1915, to about 3 million in 1960. Today their population has increased again to levels of the order of 10 million, but has not regained the level of the earlier peak.

In this case, clearly, the number of horses didn't decline because lack of food, nor are there reports of fatal diseases affecting horses. Also, horses were not exterminated by humans: there is no evidence of horses being mistreated or killed in this period any more than in earlier periods. Horses were simply no longer competitive in comparison to engine-powered vehicles. They also were at a disadvantage because the pollution they created – dung – was visible and considered a serious nuisance at the time. As a result, horses were not allowed to breed. When old horses died, they were not replaced. Their place was taken by trucks, tractors, and tanks.

Human population collapses

This survey of the collapse of biological populations shows three causes for the "Seneca Collapse" to take place: overshoot, predation, and reproductive control. Do the same phenomena take place with human populations? It seems to be possible and let's see a few historical cases.

Perhaps the best example of the overshoot of a large human population is that of the Irish famine that started around 1845. A graph of the collapse is shown in fig. 5

Ireland Population: the Great Famine

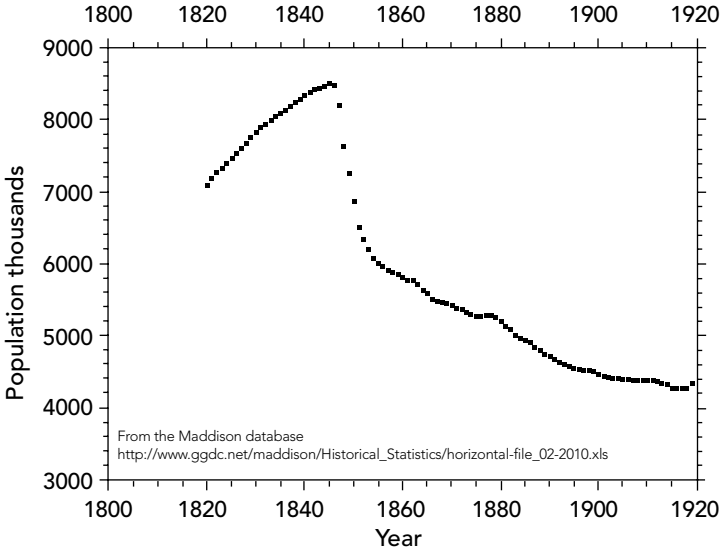

Fig. 5 – Irish population data before and after the great famine of 1845.

Effects of the Plague on Population

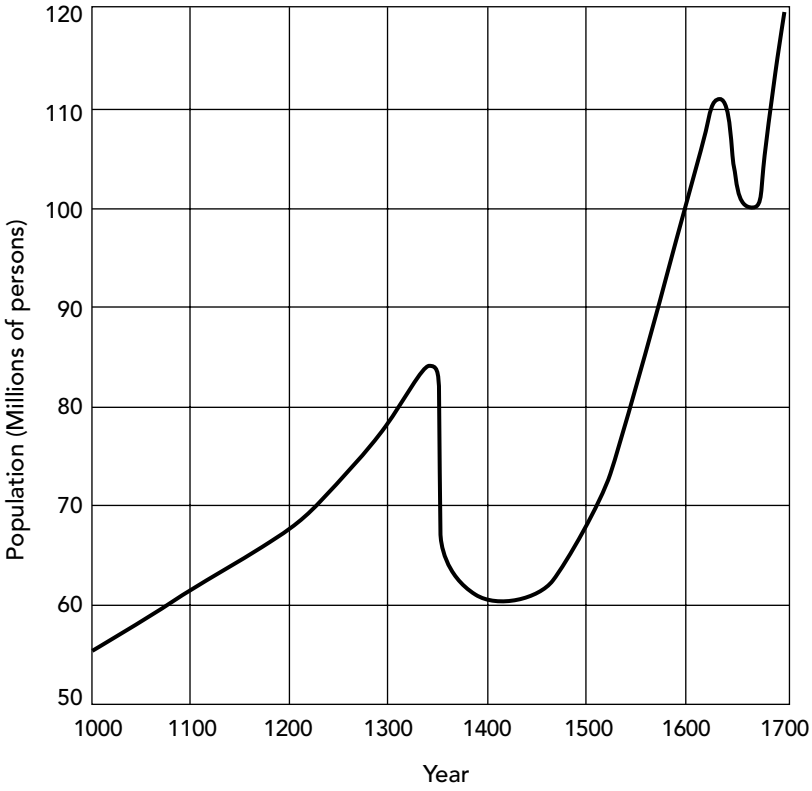

Figure 6 – European Population at the time of the Great Plague (from Langer 1964)

While a complex of economic, social and political factors contributed to the Irish catastrophe, the famine can be seen as a case of overshoot-generated collapse. This doesn't mean that the Irish overexploited their land in a simple way that is analogous to the collapse of reindeer numbers on St. Matthew's Island, but it is clear that the marginal land available to the poorest agricultural labourers couldn't support their population for any extended period. At the time of the famine Ireland was a large exporter of meat and dairy products, but when the potato blight destroyed their source of sustenance, the poorest – like the nearly 1 billion starving in the world today – had no purchasing power in the market for food. Thus, in

the absence of large-scale social and economic changes, the potato parasite that generated the crash was only a trigger for an inevitable population reduction. More than a million people died as a direct result of the famine, but it also precipitated a continuous wave of migration that persisted until the end of the 20th century. The Irish potato famine represents an example of how Seneca collapses can be the result of the complex interaction of ecological and social factors.

How about collapse caused by predation? Humans have no significant metazoan predator, but they are legitimate prey for many kinds of microbial creatures. In history, diseases are known to have caused human population collapses. A good example, here, is the effect of the "black death" in Europe during the Middle Ages.

The data are uncertain, but the "Seneca Shape" of the collapses is clear. In this case, however, the population started to regrow after the collapse. Note the difference with the case of Ireland in mid-19th century: during the Middle Ages, the European food production system was not in overshoot and only the total extermination of the population would have led to irreversible results.

Ukrainian Population

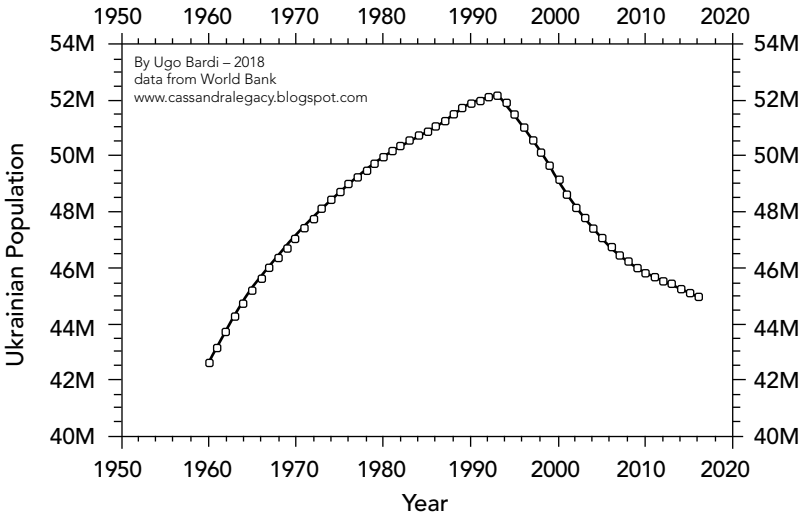

Fig. 7 – Ukrainian population – data from the World Bank

Finally, we can examine cases in which the human population has started to decline mainly as the result of lower birthrates. There are several modern examples, especially in Eastern Europe after the collapse of the Soviet Union in 1991. An especially evident case is that of Ukraine, shown in the figure 7.

There is no evidence of epidemic diseases nor of disastrous famines in Ukraine during the period that covers the recent population collapse. Emigration and increased mortality played a role, but what's impressive is how the Ukrainian population reacted to the economic crisis resulting from the disappearance of the Soviet Union with a decline in birthrates (see figure 8).

Ukraine Birth Rates

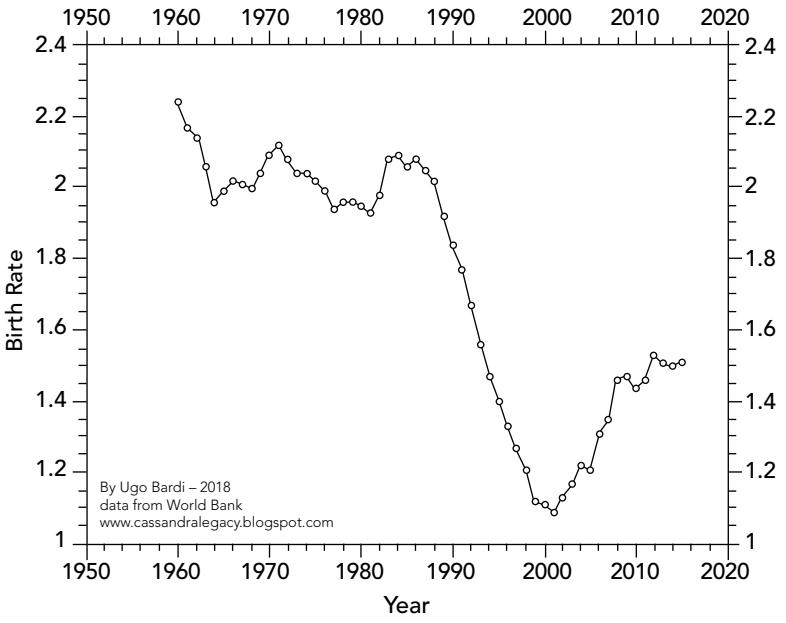

Figure 8 – the crash in birth rates in Ukraine. Data from World Bank.

An explanation of why Ukrainian families and Ukrainian women didn't compensate for the increased mortality and emigration might lie in their perception that there was no benefit in having a larger family given the economic situation. This trend

has been observed in all fomer Soviet Union countries. It may be seen as a typical reaction to an economic decline that in the future might take place worldwide.

Conclusion

The human population is subjected to the same constraints as non-human ones. All populations need food and are affected by predation. Wild populations normally have no internal mechanisms to plan ahead and the result is normally what we call "overshoot," where the population grows over the limits which the resources can sustain over a long time. The result is collapse. Cycles of overshoot and collapse are normally observed for wild populations but have also been observed for human populations in history.

The future of the world's human population may well be that of collapse as the result of one of the three mechanisms identified here: overshoot, predation, and birth control. Of the three, predation could take the form of a microbial infection spreading all over the world and killing a substantial fraction of the human population. It is a common theme of fiction and of conspiracy theories that some evil government or religious sect is engaged in preparing a deadly virus for this purpose and AIDS and the Ebola virus are sometimes described as the results of these efforts. If that is the case, it must be said that the perpetrators of such a monstrous crime don't seem to be as efficient as they are evil, since neither AIDS nor Ebola have led to a significant reduction in the global human population. Yet, it is not impossible that in the future a more deadly microbe will emerge, either by itself or by human manipulation. Even in this case, though, the effect would be short-lived and, if nothing else were to change, the population would soon start regrowing.

A more worrisome phenomenon is that related to overshoot, especially related to the decline of the agricultural capability of producing food or, more simply, to the capability of the globalized economic system to deliver it worldwide. In this case, the effects would be not only tragic, but also long-term. We can't say how long the system would need to recover from overshoot, but it may involve centuries of misery for the surviving population.

Finally, there is the possibility of birth control to reduce the human population before overshoot or diseases intervene. It doesn't necessarily require top-down

government intervention to force people to have fewer children. An economic slowdown or downturn may be sufficient to convince couples and single women that they have no need and no interest in having many children. In particular, the economic value of human beings is constantly eroded by the development of automated systems that replace them in the workplace. So, if women have access to contraception, we may just see a worldwide expansion of what we call the "demographic transition" and which is commonly observed in the so-called "developed countries" where agriculture ceases to be the main source of wealth.

Will the demographic transition be sufficient to reduce the human population before the evil demons of overshoot and plague intervene? This is hard to say, but it cannot be excluded. Humans are, after all, intelligent creatures and they may still be able to take their destiny in their hands.

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Postmaterial Experience Economics, Population, and Environmental Sustainability

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Prior to retirement, Douglas Booth taught economics at Marquette University for 26 years. A specialist in urban and environmental economics, he has published five books, including Hooked on Growth: Economic Addictions and the Environment *(2004) and* The Environmental Consequences of Growth: Steady-State Economics as an Alternative to Ecological Decline *(1998), and a number of articles on urban and environmental topics. His latest publications are "Postmaterialism and Support for the Environment in the U.S.," Society & Natural Resources, 30:11 (2017) and "Postmaterial Experience Economics," Journal of Human Values (2018 forthcoming).*

Key Words

Postmaterialism, Experience Economics, Sustainability, Population

Abstract

Postmaterial values with their reduced emphasis on accumulating material possessions lead to greater political support for limits on environmental pollution and to a less entropic way of life that increases environmental sustainability. Similarly, reducing human fertility to replacement levels can stabilize population and increase environmental sustainability in the future by reducing the pressure of population growth on environmental resources. In recent history, increases in per capita economic well being has been a primary driver of expansion in postmaterialism and reduce human fertility worldwide. The irony of this phenomena is that economic development potentially destructive to the environment leads to

more postmaterialism and reduced fertility, both of which benefit environmental sustainability. In this article, the underpinnings of these conclusions will be set out as well as possible ways around the dilemma they bring.

The driving motivation in the modern life of the global economy most observers would agree is to accumulate material possessions. From possessions come life's essential accomplishments and enjoyments. Many profess a belief in God as the final source of meaning, but what we do in practice to give our life significance is go to the cathedral of the mall or amazon.com. An emerging alternative view, one that can be called 'postmaterialist', claims instead that many human satisfactions come from the experiences of creative expression and interactions with human others in the enjoyment of life's cultural and natural wonders independent of private possession. Economic theorizing focuses heavily on the notion that accumulating material possessions is a necessary and sufficient path to a positive life experience. While material possessions may be necessary for the good life, they need not be sufficient nor even necessary beyond a threshold amount, opening up the possibility for human engagement in activities where material possession is secondary and not especially important.

The purpose of this article is to set out a theory of postmaterial economic experience that takes as a point of departure Ronald Inglehart's highly regarded theory of postmaterial values and to explain the potential relationships between postmaterialism, human population, and environmental sustainability. Postmaterial values, and their reduced emphasis on accumulating material possessions, lead to greater political support for limits on environmental pollution and to a less entropic way of life that increases environmental sustainability. Similarly, reducing human fertility to replacement levels can stabilized population and increase environmental sustainability in the future by reducing the pressure of population growth on environmental resources. In recent history, an increase in per capita economic well-being has fostered an expansion in postmaterialism on one hand, and reduce human fertility worldwide on the other. The irony of this phenomena is that economic development potentially destructive to the environment leads to more postmaterialism and reduced fertility, both of which benefit environmental sustainability. In the pages to follow, the underpinnings of these conclusions will be set out as well as possible ways around the dilemma they bring.

Inglehart's Theory of Postmaterial Values

The theory of postmaterial experience economics presented here is inspired by the work of Ronald Inglehart, a University of Michigan political science professor, who formulated the original conception of postmaterialism in terms of attitudes towards collective social goals with an eye to its use in empirical research (Abramson & Inglehart, 1995; Inglehart & Abramson, 1994, 1999; Welzel & Inglehart, 2008). If you attach high priorities to such purposes as (1) protecting freedom of speech, (2) giving people more say in important government decisions, (3) seeing that people have more say about how things are done at their jobs and in their communities, (4) trying to make our cities and countryside more beautiful, (5) progress toward a less impersonal and more humane society, and (6) progress toward a society in which ideas count more than money, then you are a postmaterialist. Suppose instead you attach high priorities to such goals as (7) maintaining order in the nation, (8) fighting rising prices, (9) a high level of economic growth, (10) a commitment to strong defense forces, (11) a stable economy, and (12) the fight against crime. In this case you are a materialist. If your highest priorities are all materialist, that's what you are; if your highest priorities all go the other direction you are a postmaterialist; if you have a mix of highest priorities you fall on a spectrum between materialism and postmaterialism (Abramson & Inglehart, 1995; Inglehart, 2008).

Survey research on postmaterialism finds that if you are currently a young adult, you probably grew up in a period of economic prosperity, and if you are older you more likely faced economic deprivations in your pre-adult years. Because our basic values are formed by the time we reach adulthood, whether or not we face economic scarcity or social upheavals in our youth matters. As we age, our orientations fluctuate to some extent with economic and social conditions, but our basic outlook does not change much. In explaining this position, Inglehart offers a socialization hypothesis claiming that our basic value structure is formed in our youth, and a scarcity hypothesis proposing that our values will focus most heavily on those items we lack. If, for instance, our life is highly insecure when we are young, one of our highest priorities will always be a safe and secure social and material environment (Inglehart & Abramson, 1994). This is not to say that our values won't change over time, but that our basic outlook will be strongly anchored by our coming of age experience. The result of this behavior pattern will be an increase in the extent of postmaterial values as younger generations replace older in the adult population (Abramson & Inglehart, 1995; Inglehart,

2008; Inglehart & Abramson, 1994, 1999). According to Inglehart, this intergenerational shift in value orientations can be ultimately explained in terms of Abraham Maslow's famous theory of the hierarchy of human needs (Inglehart, 1971; Maslow, 1987). The hierarchy hypothesized by Maslow includes (1) the basic needs such as food, drink, sleep, and sex; (2) the need for safety; (3) the need for a sense of belongingness including love, affection, and acceptance in a community; (4) the need for self-esteem flowing from prestige and social status; and (5) the need for self-actualization including being creative or accomplishing worthwhile purposes in life. The central point of Inglehart's research findings is that younger generations came of age farther up the hierarchy of needs than older and thus place relatively more importance on postmaterialist as opposed to materialists social goals. Moving up the needs hierarchy in effect shifts one in the direction of postmaterial experience as a more central focus and away from an emphasis on materialist economic experience.

Postmaterial Experience

While many of us are strongly oriented to expanding and reshaping our private world of material possession, some of us look increasingly to enjoying the publicly available experience of our cultural and natural legacy. The former among us I shall refer to as economic materialists, and the later as economic postmaterialists. If we are materialists our life's focus is on gaining control over objects and transforming them to mirror our deepest wishes. Our experience of such control and its resulting manipulations of the material stuff of life is sensual and virtual, a product of our perception-driven, conscious thought process. Our desire to physically manipulate and alter objects as we find them in nature ultimately calls sometimes for huge transformations of the material world. Witness the transformation of the global environment following, first, the agricultural revolution and, second, the industrial revolution (Harari, 2015). For postmaterialists, the essential quest in life is experiences of the physical world apart from any requirements for ownership and private control of it. Some material ownership and control is inevitably a part of our lives – we all need our own private supply of food, clothing, living space, and such – but post materialists look increasingly for experiences not necessarily contingent on ownership of physical objects in our field of perception. To summarize, a materialist is someone who focuses on seeking out the ownership of objects as an essential ingredient in the mental satisfaction interactions with them bring. A postmaterialist to the contrary is someone whose basic need for feelings of control

over objects has been met and is instead more directly oriented to the experiences of phenomena in the physical, social, and cultural world (Booth, 2018).

Ecological Release, Experience, and Entropy

In a strictly biological conception of economic behavior, mental experience drives material acquisitions. A feeling of hunger pushes us to acquire and consume food; cold temperatures, wind, and rain stimulate us to gain protective clothing or cover; sexual and family love cause us to copulate, reproduce, and acquire the material requirements for nurturing, protecting, and defending our lovers and kin. Mental motivations combined with the contingencies of daily experience drive our accumulation of control over material goods essential for long-term survival. We humans in contrast to other species enjoy the privilege of ecological release, meaning that we need not spend every waking hour in the satisfaction of our material necessities (Sahlins, 1974). This privilege comes to us by virtue of our special mental faculties that permit us to exploit nature's resources at uniquely high rates of economic efficiency. As a consequence, we can of course engage in the production of material goods well beyond our basic needs, or we can hang out and contemplate the beauties of the world around us, sing songs, or think the big thoughts. We can produce more than we need and use it to pay others to entertain us with stories or dance, teach us how to do mathematics, or to take us on guided nature walks. Economics doesn't distinguish between baking bread and presenting Shakespeare's Richard the III; both are economic goods for which people are willing to pay, and both offer mental stimuli and satisfaction. There is an important difference between them, however; bread is enjoyed in an act of physical consumption, and the pleasure of Richard the III is a shared perceptual and mental experience. The loaf of sourdough French bread I gobble down becomes unavailable to you, but we can both experience Shakespeare together without detracting from each other's pleasure. The experience of consuming a loaf of bread involves a using up of a material good, and the experience of consuming Richard the III does not. Experience requires stimulus from the physical world, but not necessarily a substantial physical transformation of that world. Experiences can be placed on a spectrum, heavily dependent on altering the material world at one end (eating bread and drinking wine or driving your Cadillac Escalade SUV around town), and not requiring any alteration at all on the other (enjoying a sunset or Shakespeare in the park). At one end you and I cannot consume the same exact material thing (a particular glass of wine), and at the other we can

(a sunset). The first activity is relatively more entropic than the second. The first absorbs nature's energy and reduces the chemical bonds of it's material being and the second does not.

Complications do arise. We can share a Shakespeare play, but if the audience is too big, some of us will not be able to get close enough to perceive all the action on the stage. In sharing a physical phenomenon, crowding can be a problem. Too many people detract from the experience. In some cases, such as a rock concert, where audience reaction is part of the experience, too few people instead can be a problem. In wilderness hiking, where the act of it does little to modify the physical world, the sharing of it can detract from the experience if one is running into someone on the trail too often or if all the good campsites are taken. In short, the number of people sharing an otherwise benign experience (i.e. with an innocuous physical impact) matters. In some cases the more the merrier, and in some more is bad (Olson, 1965).

While the direct enjoyment of a Shakespeare play is physically and entropically benign, its production is not. The stage, the costumes, and all the other necessary paraphernalia of making a play happen re-arrange the physical world just as does making loaves of bread. The difference between the two goods is that consuming the play is benign and the bread entropic. You and I can't consume the same loaf of bread but we can the same play. Some things in life are actually entropically free: you and I can enjoy the same sunset and the physical world is unchanged from what it otherwise would be. Of course, if the sunset is over Sonoran desert mountains, you and I will have used up material resources in our travels and caused some physical entropy, but once on the scene the extra physical changes we cause in watching the sunset becomes vanishingly small. And, of course, just walking around the desert will have some impact, but not much, especially if we step with care. In practice, experiences lay on a spectrum from heavily entropic to completely benign (causing near-zero entropy).

Entropy and the Form of Life

Richard Florida, a regional science professor, has gained star standing among urban planners for his book, *The Rise of the Creative Class* (Florida, 2002). Florida presents evidence for the emergence of an economically important group of individuals who play a driving role in a renaissance of downtown urban

revitalization and have a new take on life that bears the marks of post-materialist thinking. According to Florida, this creative class is compose of professionals, such as scientists, engineers, university professors, poets, novelists, entertainers, designers, architects, and opinion-makers who conceive new intellectual or artistic forms of economic or public value. Its members are at once bohemian and conformist. They have an intense desire for personal self-expression, which includes body-piercing jewelry and tattoos, but also possess a powerful work ethic and passion for personal accomplishment, especially in the digital arena doing software development or graphic arts. These are the people one increasingly sees sitting around gourmet coffee shops huddled over their computers or conversing in small groups about website design, solving a computer software problem, pulling off the conversion of an old commercial building into condominiums, or getting someone elected to political office. They don't like bureaucratic hierarchy, but believe strongly in being recognized for their work on its creative merits. They especially believe in social diversity of all kinds, and feel comfortable working with others of different races or sexual orientations. Members of the creative class both work and play hard, and express only limited interest in accumulating material possessions and are especially oriented to consuming individual and shared "experiences" such as adventure travel, road biking or rock climbing or other vigorous activities, offbeat theater performances, cutting edge studio art, or experimental musical events. While Silicon Valley is a suburban bastion for such individuals, they increasingly find urban centers such as downtown San Francisco, Seattle, or Minneapolis to be exciting places to live and work.

Youthful creative types, along with the return of aging suburban expats, fuel much of the boom in condominium construction and conversion of distinctive older commercial buildings to residences in downtowns around the country. Both groups are attracted to the excitement of urban street life in neighborhoods with concentrations of trendy restaurants, theaters, art galleries, espresso shops, brew pubs, bookstores, and entertainment venues. Retailing matters, but its orientation is to specialty foods or wines, boutiques, and outdoor stores that serve the active life of the new inner city residents.

The interest of affluent young professionals in downtown living finds confirmation in a Brookings Institution study of census data by Eugenie Birch, Professor of City and Regional Planning at the University of Pennsylvania (Birch, 2005). In a sample

of 44 cities, downtown population grew by ten percent in the 1990s and the number of households expanded 13 percent, a substantial recovery after years of decline. In 2000 25 to 34 year olds compose a quarter of downtown populations, up from 13 percent 30 years earlier. The proportion of downtowners having a bachelor's degree rose to 44 percent, a figure that exceeds both that for cities as a whole and their suburbs. The young and the educated moving downtown are exactly those groups where post-material values predominate.

Not all the creative occupations referred to by Florida in his writings enjoy the affluence of the creative class as a whole. True creativity doesn't necessarily bring wealth as the artists of the world historically discover repeatedly. Yet it is this group that concentrates most heavily among all occupations in the central city today and serves as a driving force for neighborhood renewal (Ann Markusen & Schrock, 2006; Strom, 2010). The popular image of starving artists or aspiring actors living in garrets and waiting tables for their living stands up to academic scrutiny. Artists (defined broadly to include actors and directors, announcers, architects, drama and music teachers, authors, dancers, designers, musicians and composers, painters, sculptors, craft artists and printmakers, and photographers), in comparison to other professionals, are highly educated but poorly paid (Alper & Wassall, 2006). They often hold multiple jobs in a given year, work outside their chosen occupation to make ends meet, face frequent periods of unemployment, and contend with an income distribution highly skewed towards the relatively few who experience substantial success. Financial accomplishment as an artist is a 'winner take all' gamble that very few achieve. Nonetheless, the number of artists has grown more than twice as fast as the labor force in recent decades, reflecting an expansion in public demand for the products and experiences artists have to offer as a well as a continued willingness of many artists to endure a lower income for the intrinsic rewards of creative work.

Given their economic vulnerability, artists normally choose to locate in inner city neighborhoods with inexpensive rents (A. Markusen & Gadwa, 2010). For those who require studios or places to rehearse, declining, seedy commercial or industrial areas often provide affordable space in which to both work and live. Artists concentrate in central cities to a greater degree than most other occupations and tend to cluster together in neighborhoods that best suit their needs for expansive but cheap workspace, artistic community connections, and

access to customers. Clustering enables interactions, from which spring ideas and information on economic opportunities, and the concentration of supporting art galleries and display spaces or performance venues.

A modest trend towards high-density city living in the U.S. and other auto-centric countries may not seem like much, but if it continues it will be a big deal. A shift to living at higher densities along European lines may well come in the nick of time to help reverse our ominous march to climatic warming (Newman & Kenworthy, 1999). If you live in a densely packed urban setting instead of a spatially expansive suburb, you move around much less to get to work, for shopping, and doing all the other things you love to do. When you do move around, chances are greater that you will walk, bike, or take public transit than if you live in a low-density suburb where odds are that you would drive everywhere because everything is so far apart. In short, if you move from suburb to city, you will cut back on your driving and the volume of auto-related greenhouse gas emissions you cause. Also in the city, chances are you will live in a smaller dwelling that requires much less greenhouse gas-emitting energy for heat and light, and if you live in a multi-family unit and share heat-emitting exterior walls and roof areas with others, your dwelling will be much more energy efficient than a single family, low rise house in the suburbs. By deciding to live in the city, you will do the environment a big favor whether you think much about it or not. If you are a post-material environmentalist, you might even decide to live in the city to live out your own philosophical values apart from realizing the benefits of city living.

Evidence for Postmaterial Values and Experience

The form that one's life takes matters for its use of material resources and impact on the environment. Living in a high-density city with multiple modes of transportation in general will be less entropic than life in a low-density suburban environment. The experience of life will differ as well in the former than the latter. In the central city, more of daily life will be spent in the public arena moving around, strolling in parks, hanging out at sidewalk cafes, and enjoying various cultural amenities that concentrate at urban centers. Suburban living with its heavy auto-dependency will be intrinsically more entropic than daily being in the central city. The density at which individuals live around the world truly matters for environmental sustainability as outline in the works of Peter Newman and Jeffrey Kenworthy (Newman & Kenworthy, 1999, 2015).

What one does in that daily life matters as well. The life of a postmaterial urban artist whose labor constitutes the vast bulk of an art object's economic value will be less entropic than, say, a highway engineer who designs freeway ramps and bridges. By the simple act of living a central city with all its opportunities for post material experiences, one lives less entropically than would be the case in a suburban location. While how one lives and what one does intuitively matters for environmental sustainability, direct empirical evidence on the values individuals possesses and their effect on the environment is only just beginning to be accumulated.

Inglehart Postmaterial Values

A lengthy literature exists on the global presence and effects of Inglehart postmaterial values and is summarized in a variety of sources (Abramson & Inglehart, 1995; Booth, 2017; Inglehart, 2008; Welzel & Inglehart, 2008; Welzel, Inglehart, & Deutsch, 2005). Such values have expanded their presence over time in both Europe and the U.S., although they may have suffered a setback more recently as a consequence of the recent growing popularity of conservative populist politics in many countries (Inglehart & Norris, 2016, 2017). An extensive literature using the World Values Survey and other survey data confirms that postmaterial values positively predict political support for environmental protection as well as public action in support of the environment (Booth, 2016, 2017). In my own research, a measure of environmental concern is taken from a two-part question that requires a trade-off between environmental protection and economic growth. Each respondent chooses one of the following two statements that best reflects their attitude: (1) Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs; (2) Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent. Three different questions provide measures of actual respondent behaviors directed at environmental protection, including whether the respondent (1) is an inactive or active member of an environmental organization, (2) has recently given money to an ecological organization, or (3) has recently participated in a demonstration for some environmental cause. In all cases, an index of Inglehart postmaterial values predicts environmental support and environmental action in the U.S. as well as for a global sample that includes 60 countries. To the extent that such individual attitudes and actions get translated into government action in the political arena, postmaterial values contribute to environmental sustainability.

Postmaterial Experience

The effect of postmaterial values on political support and actions in favor of the environment matters only if such support and actions get translated into actual government policies that diminish environmental pollution and increase environmental sustainability in practice. So far the evidence for this being the case is fairly limited although convincing (Gerhards & Lengfeld, 2008; Tjernstrom & Tietenberg, 2012; Zahran, Kim, Chen, & Lubell, 2007). A shift in favor of an increased orientation to postmaterial experience could lead more directly to environmental sustainability by reducing the entropy of daily human activities as explained above. These activities depend first and foremost on the reality of postmaterial experiences in everyday life.

The presence of postmaterialist experience on a global basis has only just begun to be investigated empirically. In my own work, using data from the World Values Survey, I have found evidence that global participation in such experiences as (1) membership in voluntary organizations, (2) participation in work that offers creative tasks and independence such as that undertaken by artists, and (3) participation in political action to be relatively extensive in a large global sample covering 60 countries (Booth, 2018; World Values Survey Association, 2015). I also find using regression analysis that a desire for riches fundamental to the accumulation of material possessions fails to predict memberships in voluntary organizations, and is a negative predictor of creative and independent work and participation in political action. In sum, those who focus on accumulating material possessions lack an interest in post material experiences. Positive statistical predictors for all three forms of experience activities include the importance to the respondent of thinking up new ideas and being creative, doing something for society, and looking after the environment. The nature of the three types of activities themselves matter for participation, as opposed to any private material benefits they confer.

These three forms of individual activity typically lack an orientation to the accumulation of material possessions or an extensive incremental need for material possessions beyond a basic threshold. There are, of course, exceptions. The creative highway engineer who thinks up new ways to build freeway overpasses and bridges would be engaged in an activity that supports a highly entropic activity, motor vehicle travel. This would be much less the case for the musician or

landscape photographer. Nonetheless, statistical predictors suggest that those engaged in creative and independent work are less orientated than others to the accumulation of material possessions and are more likely to possess a desire to do something for the environment. In addition to possible positive consequences for the politics of environmental protection, the expansion of a postmaterial outlook on life can cause a shift to a less entropic and more environmentally sustainable way of life. Instead of spending our days worried about accumulating more material possessions, we can focus on the daily experiences of life embodied in social interactions, cultural activities, and the wonders of the natural world. To do this we indeed require basic economic and physical security, but once accomplished we have the ecological luxury of focusing our attention on the existing wonders we encounter in daily life without adding much to the material transformation of the world.

An expansion of postmaterialism globally could in theory have a direct positive effect on environmental sustainability, but this proposition remains an untested hypothesis. Environmental economists have, however, invested heavily in a testing a related somewhat more general hypothesis that rising per capita income in individual countries ultimately leads to a reduction in per capita pollution emissions. In short, economic development in itself constitutes the final solution to environmental problems. If this is the case, then an expansion of postmaterialism contingent on rising individual economic security would accelerate that trend. Unfortunately the validity of this more general hypothesis remains to be settled, as we will now see.

Postmaterialism and Environmental Kuznets Curves

The gold standard for investigating the link between affluence and the environment is something called an "Environmental Kuznets Curve", named for an economist, Simon Kuznets, who discovered the presence of such a curve in the case of income inequality (Kuznets, 1955) a conclusion that only recently has come under challenge in the works of Thomas Piketty (Piketty, 2014). According to environmental Kuznets curve theory, as an economy advances from an agricultural to a modern industrial and digital economy, and as per capita incomes grow, environmental problems such as water and air pollution increase, but at some point such problems begin to diminish because of advances in pollution control technology and increased environment regulation fostered by a rising middle

class with political demands for a higher quality environment. In brief, plotted against a country's per capita income over time, the curve of pollution emissions per person has an inverted U-shape. The hypothesis remains controversial and has generated numerous research papers in environmental economics, some finding empirical support for the it, and others denying its existence (Ben Jebli, Ben Yousseff, & Ozturk, 2016; Galeotti, Lanza, & Pauli, 2006; Stern, 2004). The controversy continues, especially for greenhouse emissions such as carbon dioxide. The best one can say is that the curve may exist for relatively wealthy countries such as those belonging to the OECD, but there is little evidence for it outside the OECD. In short, poor countries of the world face environmental deterioration as they develop under prevailing economic arrangements, and the rich have achieved stability and perhaps modest reductions in their environmental impacts. In the case of greenhouse gases, the rich, western industrialized countries of the world of course bear most of the responsibility historically for cumulative greenhouse gas emissions, most of which continue to persist in the atmosphere to this day (Freidrich & Damassa 2014).

To put it in Kuznets curve lingo, a turn to postmaterialism bends the curve downward more quickly than otherwise by increasing political support for the environment and shifting human activities in a less entropic direction. The problem with the rise of postmaterialism is that its advance occurs at a fairly glacial pace (Inglehart & Norris, 2017) while such environmental problems as climate change and natural habitat degradation are advancing much more rapidly (Intergovernmental Panel on Climate Change, 2015).

Population and Postmaterialism

In contrast to the modest pace of postmaterialism, global human fertility has plummeted from around 6 children per female to about 2.5 in the last 75 years (World Bank, 2017), an amazing drop by historical standards, but substantial population growth yet remains in the pipeline (World Bank Population Blog, 2015). Before global population begins to stabilize due to reduced fertility, still more downward pressure on environmental sustainability will occur in the near future as added individuals expand global material consumption. Whether a shift to postmaterialism and a less entropic way of life also operates to increase sustainability by fostering an added reduction in human fertility and ultimately population growth remains an open question yet to be explored empirically.

Across countries, post-material values are more extensive on average in high- than low-income countries as confirmed by data from a sixty-country sample from the latest World Values Survey (World Values Survey Association, 2015). Population fertility for these same countries, is negatively correlated to per capita income as can be expected in light of the "demographic transition" (Kirk, 2010; World Bank, 2017a; World Values Survey Association, 2015). Postmaterial values and reductions in fertility are thus correlated, but correlation, of course, is not the same thing as causation. The reduced emphasis on economic accomplishment in a postmaterial way of life may, or may not result in a reduced desire to procreate. This question has yet to be investigated. In the U.S., fertility is declining among younger women who are delaying getting married, having children later in life, and having fewer children (Stone 2018). Since postmaterialism is relatively higher among younger people worldwide, such a decline in fertility may well be attributable to a postmaterial way of life. If so, then postmaterialism will indeed lead to a demographic shift reducing human fertility and increasing environmental sustainability. By decreasing the number of children they have, couples can have a profound long-term effect on the environment, especially for reducing greenhouse gas emissions (Wynes & Nicholas 2017).

Whatever the actual relationship between postmaterialism and human fertility, a rise in global per capita income does nonetheless have a double effect as described above: (1) a shift to less entropic postmaterial values and experience, and (2) a decline in human fertility. Both ultimately benefit global environmental sustainability.

Conclusion

A problem for sustainability yet arises because the shift to postmaterialism and reduced human fertility, each beneficial to the environment, are both advanced by an increase in per capita living standards on a global basis that can itself cause a decline in environmental sustainability. This is the critical dilemma of economic development as a way out of the environmental crisis.

To moderate such a decline, public efforts are essential that shift the global economy to clean energy and bring a halt to habitat degradation for all of the world's species. While optimism in today's political arena on the face of it seems unwarranted, an advance in postmaterialism could in the end make a difference

given the current relatively even split between forces for and against public action addressing climate change. A few more young postmaterialists in the political mix, especially in the USA, could tip the balance for the outcome of future elections in the favor of political actions that mitigate environmental degradation, but this remains to be seen (Booth, 2017). The one other hope is the downward plunge in clean energy unit costs will continue and eventually force fossil fuels out of the global energy market (Lazard, 2017). This could be a big bonus for solar-rich less developed countries arrayed around the equator. These same countries possess some of the highest population fertility rates in the world that could be dampened by solar-driven economic development to the benefit of our environmental future. Moreover, such development will skip over environmentally damaging fossil fuels, a primary source of pollution historically, and go directly to environmentally sustainable renewable energy. Sliding down the rightward side of the environmental Kuznets curve for the world as a whole is a possibility, but doing so in time to forestall climate change and degradation of the global environment requires concerted public action to accelerate the trend to clean energy and sustainability around the world.

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The Hidden Gem of the Cairo Consensus: Helping to End Population Growth with Entertainment Media

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Abstract

In 1994, the Programme of Action of the International Conference on Population and Development was adopted. The Programme conveys anthropocentric sensibilities when discussing the idea of sustainable development. Moreover, the Programme has largely been interpreted in such a way that it fails to hold the goal of ending population growth at the same level of esteem as the goal of ensuring reproductive health and rights. Despite some unfavorable outcomes, the Programme's orientation around gender equality is to be celebrated. In section 11.23, the Programme highlights a key tactic to help achieve gender equality: effective use of the entertainment media, including radio and television soap operas and drama. Since 1998, Population Media Center has successfully used mission-driven entertainment to confront the most powerful drivers of ongoing rapid population growth: the social norms, attitudes and behaviors related to the status of women in various societies around the world; misinformation about contraception and cultural barriers to its use (such as male opposition); and perceived norms with regard to ideal family size.

Nearly a quarter century ago, in September, 1994, the Programme of Action of the International Conference on Population and Development (UNFPA, 1994) was adopted. The occasion was heralded as a watershed moment in how UN Member States, non-governmental organizations, and donors would approach questions of fertility and human population growth. The lengthy document, referred to informally as the "Cairo Consensus", still serves as the philosophical guide-star for most international development efforts related to reproductive health and family planning, whether funded publically or privately.

One way to accurately summarize this consensus is that every individual adult on the planet is thought to have the basic right to decide, freely and responsibly, the number and spacing of their children and to have the information, education, and means to do so (see Principle 8). Moreover, the fundamental pathways to achieving this level of reproductive autonomy are working to establish bona fide "gender equality and equity and the empowerment of women, the elimination of all kinds of violence against women, and ensuring women's ability to control their own fertility" (see Principle 4).

While the ethical desirability of these pathways is strong and enduring, from a global sustainability perspective, the Programme of Action is not without serious weakness. For example, while recognizing the interdependence of global population, international development and environmental outcomes, the document nonetheless promulgates a decidedly anthropocentric worldview, using phraseology such as, "Human beings are at the centre of concerns for sustainable development", and "People are the most important and valuable resource of any nation". Such statements unwisely conceive that humans are at the center of all material and ethical concerns (Crist & Kopnina, 2014).

Pleasingly, recent initiatives and actions housed within the United Nations (UN) have begun constructing a "non-anthropocentric paradigm in which the fundamental basis for right and wrong action concerning the environment is grounded not solely in human concerns" (UN Harmony with Nature, 2018a). Perhaps in the not too distant future, the UN's Commission on Population and Development can reconsider the Program of Action's troubling anthropocentric bent in light of a new jurisprudence quickly developing around the rights of nature (UN Harmony with Nature, 2018b) – not to mention many years' worth of

experiences and learning that have taken place in the fields of population and development since Cairo.

Another important criticism of the Cairo Consensus is that it has resulted in a collective failure, in the minds of most development and philanthropic professionals, to hold the goal of ending population growth at the *same level of esteem* as the goals of ensuring reproductive health and rights (MAHB, 2015). Indeed, history shows that some reproductive health and rights activists hoped to influence the drafting of the Programme of Action so that it would discredit population concerns altogether (Petchesky, 1995). Fortunately, this agenda has and always will remain impossible to realize: human population dynamics are existentially fundamental to both civilization and the natural world. Any efforts to diminish the central importance of human population dynamics to natural history, and humanity's place within that history, are doomed to fail.

On the other hand, while the Programme of Action's various weaknesses are real, and important to guard against, its strengths are also numerous. One little known strength, which at first glance may strike the casual observer as esoteric, comes in the realm of entertainment media. On this score, the drafters of the Programme wisely highlighted a key strategy for any who are concerned with unsustainable population size and growth. In section 11.23 of the Programme of Action, it is noted that "Governments, non-governmental organizations and the private sector should make greater and more effective use of the entertainment media, including radio and television soap operas and drama, folk theatre and other traditional media to encourage public discussion of important but sometimes sensitive topics related to the implementation of the present Programme of Action".

Indeed, for the past two decades, Population Media Center (PMC) has produced entertainment programming to promote social and cultural change directly related to population dynamics – while improving the lives of millions of people around the world.

While dramatic radio and television shows may seem far-removed from a serious response to humanity's well-documented global overshoot, when such programming is based on social and behavior change communications theory, results can be both substantial and cost-effective. More importantly, such

programming can be customized to confront the most powerful drivers of ongoing rapid population growth: the social norms, attitudes and behaviors related to the status of women in various societies around the world; misinformation about contraception and cultural barriers to their use (such as male opposition); and perceived norms with regard to ideal family size.

Certainly, the Programme of Action did well to focus attention on gender inequality. Arguably, rampant and severe gender inequality – deeply rooted in social norms – does serve as the most fundamental and powerful driver of humanity's already oversized total population and ongoing growth. For example, when a female's personal autonomy is socially constrained or totally absent – from lack of education, lack of opportunity, or outright oppression – family size decisions are often controlled by husbands or in-laws (Agha, 2010), and families end up being larger than if women could truly decide for themselves how many children to have and when.

Of course, gender equality cannot be achieved without the backing of legal conventions. Far too many governments have failed to guarantee women equality in basic legal and human rights, in access to or control of resources, in employment or earnings, or in political participation. Men continue to occupy most positions of political and legal authority. Globally, only about 22% of parliamentarians are women. Laws against domestic violence are often not enforced on behalf of women.

However, at a fundamental level, all forms of gender inequality and discrimination are rooted in the socially constructed belief that girls and women are somehow inferior to boys and men. Until broad based normative change around the social status of women is achieved, it will remain impossible for the majority of the world's women to responsibly decide the number and spacing of their children. Their low social status precludes the conditions necessary to do so. Certainly, the ability to obtain both contraceptive supplies and services, and the full range of supporting information women need to manage childbearing will continue to be compromised in oppressive social situations (Campbell, Prata and Potts, 2012).

Another example of how addressing social norms is key to slowing down and stopping population growth is the concept of "unmet need" for contraception.

This condition is defined as when women are fecund and sexually active and report not wanting any more children within the next two years - but are not using any method of contraception.

It is well known that there are 214 million women in the developing world who meet the definition of having such an "unmet need" (Guttmacher Institute, 2017). A persistent current of commentary from some family planning advocates and other development experts – and the popular media discourses following their lead – attribute unmet need to a "lack of access" to contraception.

However, Population Media Center's analyses of Demographic and Health Survey reports from nearly 100 countries over the last two decades have consistently described a different reality: women with unmet need for contraception rarely cite cost, convenience or a "lack of access" as the reason they are not using contraception. In many countries, lack of access and cost are cited by less than 5% of the respondents. Rather, the primary barriers to use of family planning are large desired family size, fear of health effects (including misinformation about safety and effectiveness of contraceptives), and various forms of opposition, based on religion, fatalism, or patriarchal social norms.

Increasingly, new analyses are pointing to similar conclusions. In June 2016, for example, Guttmacher Institute researchers scrupulously analyzed a decade of data related to reasons for non-use in 52 developing countries (Sedgh, Ashford, and Hussain, 2016). They found non-users who actually "lack access" comprise 5% of the reasons for non-use. Meanwhile, based on the authors' reporting, fear of health effects and personal or spousal opposition to contraception account for 49% of non-use. In other words, non-use related to informational and socio-cultural barriers out-numbers non-use related to a lack of access by a factor 10.

The largest constituency of non-users of contraception in the world are those who are simply not seeking to avoid pregnancy. Statistics from the developing world, for example, show that of 1.6 billion women of reproductive age living in these regions, only about half (885 million women) want to avoid a pregnancy at all (Guttmacher Institute, 2017). Evidence suggests social norms related to high-desired family size are major drivers of this type of non-use, especially in West Africa, where "ideal number of children" often exceeds actual fertility rate.

Here, a glance at some examples of country specific data from USAID's Demographic and Health Surveys (DHS) is helpful (see – https://dhsprogram.com/Where-We-Work/Country-List.cfm). In 2012, the ideal number of children for women in Niger was 9.5 – for men, it was 10.9, while fertility was 7.6. Notably, but unsurprisingly, 47% of women in Niger expressed an intention to never use contraception in the future (DHS, 2012). Similarly, in 2014, the ideal number of children for women in Senegal was 5.6 – for men, the ideal number was 7.5, while fertility rate was 5.0. Over 60% of women in Senegal expressed an intention to never use contraception in the future (DHS, 2014).

Changing these troubling dynamics will require helping people understand the personal benefits in health and welfare for them and their children of fewer, spaced births and delayed childbearing. It will require a major shift in societal attitudes and knowledge. It involves role modeling small family norms and making them popular and ending child marriage.

The good news is that progress on these issues is not impossible; even the most damaging, deeply-rooted social norms can be changed. However, social norms are, by definition, deeply entrenched. Patient and determined approaches to change are necessary. Direct messaging, talking points, and "quick fix" interventions that are contrary to dominant social norms are usually insufficient to create change and may even be counter-productive.

Meanwhile, high-quality entertainment is in demand nearly everywhere on the planet. Likewise, as the vast majority of people on Earth have access to some form of broadcast media (whether radio, TV, internet or other), the delivery of entertainment via mass media outlets can reach large audiences cost-efficiently and reliably. Decades of work has shown that education can be combined with entertainment, attracting enthusiastic audiences and informing, empowering, and motivating normative change. One powerful intervention in the quest to end population growth, therefore, involves broadcasting entertainment-education serial dramas. These powerful, emotionally compelling entertainment products can catalyze normative change around the status of women, perceptions of the safety and efficacy of contraception (and cultural barriers to their use, such as male opposition), and perceived norms with regard to ideal family size.

The unique entertainment strategy deployed by PMC is constructed from multiple scientifically validated communication, psychosocial, and psychological theories. Bandura's (1977, 1986) Social Learning and Social Cognitive Theories play a fundamental role in PMC's creative process. According to these theories, much of human behavior is learned through observation of role models, whether in person or through the media. Meanwhile, sufficient time is necessary for observational learners to engage in a "mediating process" – to incrementally reflect upon an observed behavior and its consequences and in turn develop sufficient self-efficacy to enact the new behavior.

PMC's entertainment products always honor and advance the hallmarks of great episodic story-telling, such as captivating characters, cliffhangers, multiple/interwoven storylines, and unexpected plot twists. The shows are delivered in long-running episodic format, usually broadcasting for a duration of 1 to 3 years. The programs are socially relevant, with fictional settings accurately reflecting the existing world of the audience. Production and writing teams, sourced from the country where the show will air, embed three character types into the story: positive, negative, and transitional. The positive and negative characters represent the extremes of behavior on one or more particular issues as practiced in the audience's own community, while also serving as positive and negative role models for the transitional characters.

The methodology portrays the transitional character moving through a sequence of experiences. First the transitional character encounters a situation that requires or forces a decision on their part (e.g., "Life cannot continue as before"). At this point, both the positive and negative characters – purposefully designed to exhibit polarized and opposing values – make attempts to influence the transitional character's decision so that the decision coincides with their own outlook and worldview. The transitional character then makes a decision, wholly and completely of his or her own accord. The transitional character experiences a reward or punishment based on whether her or his decision was good (aligned with the positive character) or bad (aligned with the negative character).

As audience members listen or watch the transitional characters experience this sequence of events, spread over successive episodes, their emotional ties and identification with the transitional characters sparks an emotive, psychological

desire to adopt similar values and actions in their real life. Simultaneously, as they follow the transitional characters successfully navigating the challenge of repeated decision making and the resulting consequences, the audience gains a vicarious experience of self-efficacy on the process of implementing change.

A good example of PMC's transformational entertainment is the condensed story of Ngendo, a character in PMC's 208-episode radio serial drama, *Agashi*. This hit program aired from January 2014 to January 2016 in the country of Burundi, which has an annual population growth rate of over 3%. This program reached more than two million people and cost a mere $0.74 US per loyal listener.

NGENDO'S STORY

Ngendo is a 30-year-old farmer (and is also a transitional character in this fiction). He and his wife, Tengenge, have already had 3 children in 4 short years. They are quite poor in a financial sense. Unfortunately, Ngendo's mother (who is a negative character) insists the couple should have as many children as possible.

Early in the story, Tengenge (who is a positive role model for the audience) begs Ngendo to allow her to use family planning. Ngendo refuses and, as a consequence, Tengenge gets pregnant again. This time, it is announced that she will have triplets. Tengenge becomes very weak and requires frequent visits to the health center - which consumes the family's already tight budget. With three children and triplets, the family can't afford food and Ngendo is forced to steal. He is caught and seriously wounded during his capture.

During his night in the hospital, his brother (who serves as a positive character) convinces Ngendo about the benefits of family planning. When he returns home, Ngendo surprises Tengenge by saying that they should use contraceptives. With his brother's help, Ngendo finally stands up to his mother and refuses to have another child. Shocked by this "betrayal", his mother tries to poison Tengenge. When she is caught in the act, the villagers chase her, vowing to burn her alive for trying to murder her daughter-in-law. She is driven out of the village and never seen again.

Agashi aired two new episodes per week on seven radio stations in Burundi with national coverage. At one point, over 80% of Burundians, aged 15-49, were

listening to the show. As measured by an end-line survey, after controlling for other variables (such as income, education, and place of residence), *Agashi* listeners were: 2 times more likely than non-listeners to say they know a place to obtain a method of family planning; 2.3 times more likely than non-listeners to report that their partner/spouse is open to the discussion of family planning; and 1.8 times more likely than non-listeners to say that they generally approve of family planning for limiting the number of children.

At clinics in Burundi during the broadcast, 20% of new reproductive health clients cited *Agashi* by name when they were asked what inspired the visit to the clinic. Similarly, in Sierra Leone, 50% of new reproductive health clients cited PMC's program *Saliwansai* as the source of information that brought them to the clinic.

It is worth pointing out that the transitional character in this story was a fictional Burundian man – not a woman. In Burundi, the ideal number of children is over 4 for men, and the percentage of currently married men aged 15-49 who want to have another child either sooner or later is over 60%. Moreover, over 20% of married women in Burundi do not make decisions about their own health care – rather the husband does. Clearly, if gender equality is to be fully realized in Burundi, changing the attitudes and behaviors of men will be instrumental. Likewise, to ease socio-cultural barriers inhibiting the use of contraception – such as mother-in-law opposition – there will need to be a critical mass of empowered individuals who are motivated to adopt behaviors that contradict age old norms.

Finally, there may be no more important aspect to the goal of ending human population growth than helping people around the world understand the health benefits for them and their children of fewer, spaced births (Johns Hopkins Bloomberg School of Public Health, 2016). This is especially true in East, Central, and West Africa where the average number of children per woman still ranges between five and six– and the number of children per man is likely even higher (Schoumaker, 2017). Whether, and how quickly, fertility rates decline in these regions over the next few decades will be the major factor in determining the peak of world population (Madsen, 2015).

As we look towards the quickly approaching 25th anniversary of the Programme of Action of the International Conference on Population and Development, we can

find comfort in recognizing the power ensconced in section 11.23. After all, theory driven entertainment media are particularly well suited to tackle the most acute needs in global family planning programs and related efforts to end population growth: interventions that can challenge and spark change in long-established and widely practiced social norms around gender equality, contraceptive uptake, and ideal family size.

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Anthrozoology: Embracing Co-Existence in the Anthropocene
Michael Charles Tobias and Jane Gray Morrison. Cham: Springer, 2017.
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Following this review (page 66) is a previously privately circulated explanation of IPAT – "A Brief History of "IPAT""– written by John Holdren in 1993 and published here with permission.

Most thoughtful people understand that very fundamental changes in the global culture of *Homo sapiens* are required if civilization is to persist. That means ending the wrecking of its life-support systems, of which the microorganisms, plants, and other animals of our planet are critical parts, and becoming a civilization *not* focused on money, competition, consumption, efficiency, and colonialism.

Following work summarized in this brilliant book, in Carl Safina's superb volume *Beyond Words* (2015), and in David Montgomery's excellent *Other Half of Nature* (2015), many of us are already altering our views of the living world. We are realizing that people are basically cooperative assemblages of human and microbial cells, that other organisms (the "Others" in *Anthrozoology*) are often more "sentient," "conscious," "intelligent," or "feeling" than usually assumed, and that humanity's insane *growthmania*, combined with its uncaring annihilation of other life forms, is leading civilization directly toward collapse.

Tobias and Morrison, the authors of *Anthrozoology*, are both leading ecological philosophers and friends of mine (full disclosure), and I share many of their attitudes and conclusions. Nonetheless, I found this a tough but entrancing book

1 This review and the following paper by John Holdren, was previously published on the Millennium Alliance for Humanity and Biosphere (MAHB) blog: https://mahb.stanford.edu/blog/review-anthrozoology/

– forcing me to reexamine many of my own feelings, even while agreeing with its general thrust. More and more people are recognizing that there is a crying need for reexaminations of humanity's ethical duties to other human beings and (if any) to the other organisms with which people share Earth. *Anthrozoology* is a reexamination of the latter – basically a long poem to the Others, and a long indictment of *Homo sapiens* for its ignoring of the Others' needs and wants in service to humanity's culturally-evolved *wants*. And at the moment the most obvious of those wants is also lethal to civilization and to most of the visible Others (what will happen to Earth's microbes is a more complex issue). That lethal want, the perpetual expansion of human numbers and per capita consumption, also turns out to be impossible, as a horrific collapse will sooner or later amply demonstrate.

In many of today's cultures some of Tobias and Morrison's ideas will be pleasant if different. That a parrot can communicate much to human beings, and even change their lives for the better and alter their thinking in significant ways, is a good example in the book. More difficult to deal with are issues like vegetarianism (should the deaths of billions of chickens annually for human consumption be considered a "holocaust"?) and whether the feelings and desires of worms, cockroaches, or even Norway rats, should be a subject for human consideration. Such questions are examined in *Anthrozoology* from a stunningly broad array of perspectives, including, literature, philosophy, religion, psychology, ecology, and evolution. It deals with topics as diverse as Dunbar numbers and pyromaniac hawks to the art of Albrecht Dürer.

Science certainly gives little guidance in answering many of the questions *Anthrozoology* raises, but its poetry may be helpful. In the end, though, much depends on the receptivity of the person and society to the themes of the poem. Ethics are agreed-upon standards of behavior about what is good and bad. They are entirely human decisions and become norms when there is broad concurrence. Such concurrence requires advanced language with syntax, about the only major species feature that still can be viewed as characteristic only of *Homo sapiens*. So we can have Jain ethics and SS ethics but (sadly) no Bonobo ethics. Most human beings have decided that the unquestionable suffering of chickens being slaughtered is balanced by the nutritive and satisfaction benefits consumers receive – just as they (if they ever think of it) find that a captured impala's terror and pain is balanced by the lion's survival and satisfaction. But having known a few

chickens personally, and having watched a lot of impalas in the field, I can't find an answer so easily. When we're considering the fates and feelings of individuals we can relate to (frightened pigs about to be slaughtered) or we can learn to relate to (brilliant octopuses that can sometimes outwit us), it becomes more difficult to continue long-established dietary habits.

There are a few places where I thought I detected mistakes in *Anthrozoology*, and then I thought: "*There really can't be mistakes in a poem.*" All would be trivial, even in an essay. At one place, though, Michael and Jane jabbed me right in the ego. They write (loc. 781) of the "famed Paul Ehrlich, John Holdren, Barry Commoner I=PAT equation." The equation was actually developed by Holdren and Ehrlich to show how ridiculous was Commoner's continuous claim that population growth and increasing consumption were *not* important in causing environmental problems, only faulty technologies were to blame. With that claim, widely believed by non-scientists, he was probably the scientist who did the most to block solving humanity's environmental crisis. The details of his ideology and gross dishonesty need not concern us here, but John Holdren, just retired as head of the Government Office of Science and Technology Policy and President Obama's science advisor, has permitted Millennium Alliance for Humanity and Biosphere (MAHB) and the JP&S to publish his 1993 memo, "A brief history of IPAT" following this review (page 66).

I find myself uncertain or ambiguous on many of the themes of *Anthrozoology*, but of its most basic themes I'm convinced. The human enterprise – a product of numbers of people and how much on average each consumes – is much too large, and our treatment of the Others is much too cruel and unthinking. What to do? Read *Anthrozoology* and then discuss it with your friends.

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A Brief History of "IPAT"

(IMPACT = POPULATION X AFFLUENCE X TECHNOLOGY)

JOHN P. HOLDREN (7 SEPTEMBER 1993)

Published here with permission as an appendix to Paul Ehrlich's book review (page 63).

In late 1969, the thenprominent biologist Barry Commoner began claiming in speeches and lectures that he had sorted out the responsibility for the environmental crisis and had found that neither population growth nor rising affluence had much to do with it. The culprit, he said, was ecologically inept choices of productive technologies in post World War 2 industrial societies. He often used the figure 95 percent in these talks to describe the share of the "blame" for environmental problems attributable to faulty technology. (The 95 percent claim is also made on page 176 of *The Closing Circle*, the 1971 popular book through which his argument reached its largest audience.) During 1970 Commoner published these claims in a variety of unrefereed forums – *Saturday Review*, Congressional testimony, and the like – and in April 1971 his more detailed analysis, "The Causes of Pollution" (with Michael Corr and Paul J. Stamler) appeared in *Environment* (1971/2010). That journal was then the house organ of the Scientists' Institute for Public Information, which Commoner headed; I mention this because the transparent errors of arithmetic and logic in "The Causes of Pollution" would have precluded its publication in any competently refereed professional journal.

In the *Environment* article, Commoner and coauthors offered up, with great fanfare, their discovery that

pollution = (population) x (production/capita) x (pollution/production)

(an intellectual achievement roughly equivalent to noticing that GNP equals population times GNP per capita); and they proceeded to try – through a combination of biased selection of data, redefinition of widely understood concepts, and neglect of causeandeffect relations, and with the help of major mistakes in arithmetic – to support the proposition that 95 percent of the problem resides in the last factor. These flaws survived unscathed the expansion of the

argument to 300 pages' length in *The Closing Circle*, which appeared later the same year and hammered home relentlessly the simplistic message that neither population growth nor rising material consumption is a major cause of environmental disruption. The culprit is faulty technology, brought about by a faulty economic system. Here are some quotes from *The Closing Circle* (1971):

> It seems clear, then, that despite the frequent assertions that blame the environmental crisis on 'overpopulation', 'affluence', or both, we must seek elsewhere for an explanation. (Ibid. p. 139)

> The pattern of economic growth is the major reason for the environmental crisis. A good deal of the mystery and confusion about the sudden emergence of the environmental crisis can be removed by pinpointing, pollutant by pollutant, how the postwar technological transformation of the United States economy has produced not only the muchheralded 126 percent rise in GNP, but also, at a rate about ten times faster than the growth of GNP, the rising levels of environmental pollution. (p 146)

> [M]ost of the sharp increase in pollution levels is due not so much to population or affluence as to changes in productive technology. (Ibid. p. 177)

> [The technology factor] has a far more powerful effect on pollution levels than the other two. (Ibid. p. 211)

As it happened, prior to Commoner's initial revelation that population and affluence are unimportant causes of environmental problems, I had started to collaborate with Stanford biologist Paul Ehrlich on studies of more or less the same questions –the interactions of population, poverty and affluence, technology, and resource and environmental issues. (I was then a doctoral student at Stanford in aeronautics and astronautics and theoretical plasma physics.) Our first joint paper, "Population and Panaceas: A Technological Perspective" (written in late 1968 and published in the refereed journal *Bioscience* in December 1969), showed why technological "fixes" alone were unlikely to be able to cope with the pressures posed by the combination of population growth and rising material consumption.

We were dismayed to learn, at a conference at the end of 1969, of Commoner's determination to persuade people that population growth and rising material consumption were nothing to worry about, and we began preparing a rebuttal. It was presented as an invited paper to the President's Commission on Population Growth and the American Future in November 1970 and was published in the 26 March 1971 issue of the refereed journal *Science* under the title "Impact of Population Growth". In it, we took the position that ALL of the factors (population, affluence, technology, socioeconomic variables) are important, that they interact, and that neglect of any of them, or of their interactions, is dangerous. Here are some quotes from our paper:

> Problems of population size and growth, resource utilization and depletion, and environmental deterioration must be considered jointly and on a global basis. In this context, population control is obviously not a panacea – it is necessary but not alone sufficient to see us through the crisis. (3rd paragraph of the paper)

> 'Environment' must be broadly construed to include such things as the physical environment of urban ghettos, the human behavioral environment, and the epidemiological environment. (5th paragraph)

> Complacency concerning any component of these problems – sociological, technological, economic, ecological– is unjustified and counterproductive. It is time to admit that there are no monolithic solutions to the problems we face. Indeed, population control, the redirection of technology, the transition from open to closed resource cycles, and the equitable distribution of opportunity and the ingredients of prosperity must ALL be accomplished if there is to be a future worth having. Failure in any of these areas will surely sabotage the whole enterprise. (conclusion of the paper; emphasis in original)

As for the "IPAT" relation, Commoner's version of the population production pollution identity had not been published yet when we wrote the *Science* article, and we chose to present the population impact relation in a way that stressed its inherent complexity from the outset. Here is our initial treatment of the subject from *Science* of 26 March 1971:

> The total negative impact of an [agricultural or technological] society on the environment can be expressed, in the simplest terms, by the relation
>
> I = P * F
>
> where P is the population, and F is a function which measures the per capita impact. A great deal of complexity is subsumed in this simple relation, however. For example, F increases with per capita consumption if technology is held constant, but may decrease in some cases if more benign technologies are introduced in the provision of a constant level of consumption…. Pitfalls abound in the interpretation of manifest increases in the total impact I. For instance, it is easy to mistake changes in the composition of resource demand or environmental impact for absolute per capita increases, and thus to underestimate the role of the population multiplier. Moreover, it is often assumed that population size and per capita impact are independent variables, when in fact they are not. (Ibid. p.1212)

The actual "IPAT" equation, using those symbols, appeared for the first time in the critique of *The Closing Circle* that Paul Ehrlich and I wrote and circulated widely in late 1971, and that was published together with Commoner's rebuttal in the April 1972 *Environment* and the May 1972 *Bulletin of Atomic Scientists*. We introduced the "IPAT" version as a vehicle for illustrating the flaws in Commoner's use of the populationproductionpollution identity, starting with the problem that "pollution" is too narrow a concept for what is being done to the environment (hence our preference for "impact") and that "production" is too narrow a term to capture the array of effects associated with rising material wellbeing (hence our preference for "affluence"). Here, in full, is the passage from our 1971/72 critique of *The Closing Circle* in which the "IPAT" equation made its first appearance in the literature:

> Commoner admits that the factors contributing to environmental impact are multiplicative, rather than additive; he offers (in a footnote to pp 211212) the equation
>
> pollution = (population) x (production/capita)
> x (pollution emission/production)

> Here the second factor on the right, production per capita, is in some sense a measure of affluence, and the last factor, pollution per unit of production, is a measure of the relative environmental impact of the technology that provides the affluence. For compactness, let us rewrite this equation
>
> $$I = P \times A \times T \qquad (1)$$
>
> or, in terms of initial values and the subsequent changes, over a specified period of time,
>
> $$I + \Delta I = (P + \Delta P) \times (A + \Delta A) \times (T + \Delta T) \qquad (2)$$
>
> Here I is for impact (a better word than "pollution" for reasons already explained), P is for population, A for affluence, and T for technology. Let us also assume for a moment that the variables P, A, and T are independent; i.e., that a change in P does not cause changes in A or T, and vice versa. We shall find later that this is not true, but it is the simplest assumption and the one most favorable to Commoner's hypothesis.
>
> It is immediately obvious from equation (2), of course, that the actual magnitude of the environmental deterioration engendered by an adverse change in technology depends strongly both on the initial levels of population and affluence and on such changes in these levels as may occur simultaneously with the change in technology. A corollary is that population and affluence would be important factors in environmental degradation even if they were not growing. A change for the worse in the technology of production is more serious environmentally if it occurs in a populous, affluent society than if it occurs in a small, poor one. (Ibid. pp. 19-20)

We went on, in the critique, to elucidate many of the ways in which the factors are in fact causally interrelated, as well as showing how Commoner had mangled the logic and arithmetic even for the hypothetical case when they are independent. In our conclusion to this critique, we wrote:

> In fixing the blame for environmental deterioration on faulty technology alone, Commoner's position is uncomplicated, socially comfortable and, hence, seductive. But there is little point in deluding the public on these matters; the truth is that we must grapple SIMULTANEOUSLY with overpopulation, excessive affluence, and faulty technology. (Ibid. p. 27, emphasis in original)

Unfortunately, numerous writers revisiting "the population debate" in subsequent decades have chosen to expound at length on the content and significance of this 19691972 Ehrlich/Holdren/Commoner disagreement without, apparently, taking the trouble to read any of the original documents. The result is passages like the following (from an opeditorial essay in *Science* of 25 June 1993 by National Academy of Sciences staffer Paul Stern:

> Scientific progress has been slowed by a futile debate about which of these factors is the most important driving force, a debate that rests on the erroneous assumption that the contributions of these forces can be assessed independently. For example, in decades of sharp debate about the impact of population growth on the environment, some have argued that population growth is the primary cause of environmental cause of environmental degradation (2), others that population growth is environmentally neutral or even beneficial (3), and others that population is secondary to technological or socioeconomic factors (4). (Stern 1993 p. 1897)

Under note (2), Stern cites the 26 March 1971 Ehrlich/Holdren paper in *Science* (from which I quoted at length above), as well as a 1974 Holdren/Ehrlich paper in *American Scientist*, entitled "Human Population and the Global Environment", in which we are emphatic throughout that population, affluence, and technology are ALL important, that the "IPAT" relation conceals much complexity, that its component factors are causally interrelated and influenced by context, and so on. Stern's essay then goes on to inform the reader that:

> What has become clear is that the driving forces interact – that each is meaningful only in relation to the impacts of the others and that the environmental consequences of increased population are highly

> sensitive to the economic and technological conditions of that population (7). (Ibid. p. 1897).

But everything that Stern appears to think has only recently "become clear"(his reference 7 being a 1992 National Research Council study for which he was the staff director) was in fact already clear – and clearly stated in the literature Stern misportrays – when Paul Ehrlich and I were writing about it in 1971. Evidently Stern has not acquired the scholarly habit of reading the works he cites.

He is not alone. As another example, consider the 1992 article by World Bank analyst R. Paul Shaw on "The Impact of Population Growth on the Environment: The Debate Heats Up" (1992). Shaw writes that the "IPAT" equation was "proposed by Paul and Anne Ehrlich in 1990" (Ibid. p. 29), characterizes their position as being that population growth "is largely responsible for global environmental degradation", and cites with an apparent sense of discovery and approval the 1988 (re)statement by "leading environmentalist Barry Commoner" that "The theory that environmental degradation is largely due to population growth is not supported by the data" (Ibid. p. 11). The rest of Shaw's analysis is at a comparable level.

Consider, finally, a paper entitled "Population, Environment, and Development: Key Issues for the EndofCentury Scenario", presented by Brazilian analyst George Martine at a 1992 international conference on environment and development. Martine writes:

> A sizeable segment of the existing literature on population and environment has attempted to grapple with the intricacies of the theoretical interrelationships between environmental change and what appears to be a restricted list of variables: technology, population size, characteristics, and growth, consumption levels and patterns. These relationships are customarily summarized in the formula:
>
> I (impact) = P (pop.) x A (affluence) x T (technology).
>
> In reality, however, the relationships between population size, consumption, and technology are much more complex than suggested in this formula. [1]The heated debates which have ensued within

> what appears to be a relatively limited number of variables can be partly attributed to this complexity, as well as to divergences of a theoreticalideological character. Inspiration for different stances has come from a gamut of contrasting positions ranging from Malthusian to Marxist to neoclassical. Lack of hard data compounds the absence of consensus on appropriate methodological approaches and added fuel to the debate. What's worse, all of the different positions are correct, when examined from their own relative standpoints. [2] (Martine, 1992).

Under note [1], Martine refers the reader "for a more general discussion" to Paul Harrison, *The Third Revolution: Environment, Population, and a Sustainable World* (1992). In that book, Harrison struggles with the complexities of "IPAT", clearly handicapped by having read and talked to only Commoner on the subject, and gets some of it right and some of it wrong. He accuses Ehrlich of lack of precision – not realizing, having not actually read the relevant literature, that it is Ehrlich AND Holdren he means to be (incorrectly) accusing – and he credits Commoner with "the seminal work" in the field. He ends up saying, with Martine, that EVERYBODY is more or less right. In note [2], Martine (op. cit.) quotes Harrison as suggesting helpfully that "to overcome partial views, we treat our familiar three factors – population, consumption, and technology – as the proximate, direct determinants of environmental use which influence each other and are influenced by other factors."

This last "insight", which it appears that Martine believes Harrison discovered in 1992 (and perhaps Harrison DID learn of it only then), is of course the perfectly obvious position that Ehrlich and I took when we first wrote about "IPAT" in 1971.

As for the proposition that "all of the different positions are correct", I must insist that when one position holds that only technology is important and another holds that technology, affluence, and population are all important, both positions are NOT correct; the first position is wrong, and the second one is right. Of course, Martine may be onto something when he writes that the debate has been partly due to "divergences of a theoretical-ideological character": Ehrlich and I hold to the theory that logical argument, getting one's sums right, and reading the references one cites are important principles in intellectual life; some of the other people in the debate evidently hold to the theory that these principles can be safely ignored.

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